

Evaluation and Improvement of Business Processes in the Operational Division Using Business Process Improvement (BPI) (Case Study: PT. Mitrasukses Engineering Indonesia)

Ichi Rizqi Sinatriya, Buce Trias Hanggara, Aditya Rachmadi

Abstract— PT. Mitrasukses Engineering Indonesia (MEI) is a manufacturing company specializing in custom machine production. The company has an operational division responsible for managing product orders until they are delivered. The main problem in the operational division of PT. MEI is the inconsistency between product designs and customer needs, leading to machine design redesigns and delays in order processing. Therefore, a more detailed analysis of potential errors is required, followed by recommendations for improvement through business process improvement. The methodology used to analyze potential errors is the Failure Mode and Effect Analysis (FMEA) method. Meanwhile, the methodology used to provide improvement recommendations is the Business Process Improvement (BPI) method with the streamlining tools. The improvement measures adopted include streamlining tools such as Standardization, Upgrading, Simplification, Automation, and Error Proofing. Simulations will be conducted after modeling the improved business process based on the improvement recommendations. The simulations compare the time between the current business process model (as-is) and the improved business process model (to-be) to determine the percentage increase in efficiency. Efficiency occurs due to changes in process activities in the current business process that have been improved. The simulation results indicate an efficiency improvement in the product ordering process by 16.58%, material procurement process by 35.37%, production process by 38.85%, and product delivery process by 22.42%.

Index Terms— business process modeling, FMEA (Failure Mode and Effect Analysis), BPI (Business Process Improvement), business process simulation.

I. INTRODUCTION

The business process in the manufacturing industry is based on observations of each product, focusing

Manuscript received January 9, 2024. This work was supported in part by Brawijaya University.

Buce Trias Hanggara is with the Brawijaya University, Malang, Indonesia (ichrzq94@gmail.com)

Ichi Rizqi Sinatriya is with the Brawijaya University, Malang, Indonesia (buce_triya@ub.ac.id)

Aditya Rachmadi is with the Brawijaya University, Malang, Indonesia (rachmadi.aditya@ub.ac.id)

on providing products in the market as a result of operational activities. However, the manufacturing industry is often challenged due to changes in the business environment and increased competition. According to data from the Ministry of Industry in 2023, the manufacturing sector plays a significant role in contributing to the national GDP by 16,39%, making it the largest contributor to supporting the national economy [1].

PT. Mitrasukses Engineering Indonesia is a company in the manufacturing sector related to Mechanical, Electrical, and Steel Construction in Pasuruan City. In PT, Mitrasukses Engineering Indonesia has several divisions involved in the company's business processes, one of which is the operational division that has a role in carrying out the main activities at PT. Mitrasukses Engineering Indonesia.

Based on the results of interviews with the CEO of PT. Mitrasukses Engineering Indonesia, there are several issues in the operational division, such as delays in the production process that are caused by delays in material delivery and many redesign processes, both in the design processes and production processes. According to the interview with PT. Mitrasukses Engineering Indonesia, it's also known that almost 20% of the entire business processes in the operational division experienced delays in the past year.

Based on the issues described, there is a need for an evaluation of the business processes in the operational division at PT. Mitrasukses Engineering Indonesia. This evaluation is conducted to assess the risk of failures that may occur in the operational division's business processes using the Failure Mode and Effect Analysis (FMEA) method. FMEA facilitates the identification of potential failures by assessing the risk of failure, which is useful for determining corrective actions based on their urgency [2], [3].

Furthermore, business process improvement is carried out based on the evaluation results obtained using the Business Process Improvement (BPI) method. BPI helps optimize business processes to achieve more efficient outcomes compared to the previous business processes [4].

The outcomes of the business process enhancement will be subsequently evaluated through simulation, which will be utilized to compare the time efficiency of the previous business process with that of the enhanced business process. Based on the simulation results, can be known how effective and efficient the recommended business process is.

II. BACKGROUND

A. Business Process

Business processes represent assets owned by an organization because they have a direct impact on services or products that affect the customer experience [5]. For optimal business process operation, organizations need to pay attention to every issue that arises in the business process. Issues in business processes usually occur due to communication differences and difficulties in interaction between functional areas in an organization [6].

B. Functional Decomposition

Functional decomposition is a process of resolving complex functional relationships into parts that make them easy to understand [7]. Meanwhile, functional decomposition is defined as a concept that breaks down the complexity of business processes [8]. Therefore, functional decomposition can be used to generate business functions into business processes.

C. Business Process Model Notation (BPMN)

The visualization of business processes uses Business Process Model and Notation (BPMN). BPMN is a process model that utilizes graphical notations to represent organizational process activities, making it easily understandable for business users. BPMN provides standards that are useful in associating the gap between business process design and implementation [9]. Business Process Model and Notation (BPMN) is also represented as a model for executing integrated processes among different systems [10].

D. Failure Mode and Effect Analysis (FMEA)

Failure Mode and Effect Analysis (FMEA) is one method that focuses on preventing failures and improving safety and user satisfaction [11]. FMEA is used to analyze the potential failures in a component and classify them based on the magnitude of the potential failure and the impact of the failure that may occur [12].

Failure Mode and Effect Analysis (FMEA) uses parameters to facilitate the process of identifying potential failures [13]. There are three types of assessment parameters in FMEA, such as severity level (S), occurrence level (O), and detection level (D). Each of these assessment parameters will be calculated to obtain the Risk Priority Number (RPN) that is used for determining the priority of risks that need to be handled immediately.

E. Business Process Improvement (BPI)

Business Process Improvement (BPI) is an approach to managing business processes and resolving occurring issues that focus on improving business processes rather than changing organizational culture [14]. There are five phases in BPI, which include:

1. Organizing for Improvement

In this phase, the process is ensured by building understanding and commitment as well as determining the responsible team to do improvement.

2. Understanding the Process

In this phase, the process involves understanding all dimensions related to the current business process within an organization.

3. Streamlining

In this phase, the process is improve effectiveness, efficiency, and adaptability to achieve the goals of the business process improvement accomplished by 12 tools available in this phase, which is part of the improvement techniques in BPI.

4. Measurement and Control

In this phase, the process implements a system to measure and control activities when conducting business process improvement.

5. Continuous Improvement

In this phase, improvements are implemented periodically.

I. RESEARCH METHODS

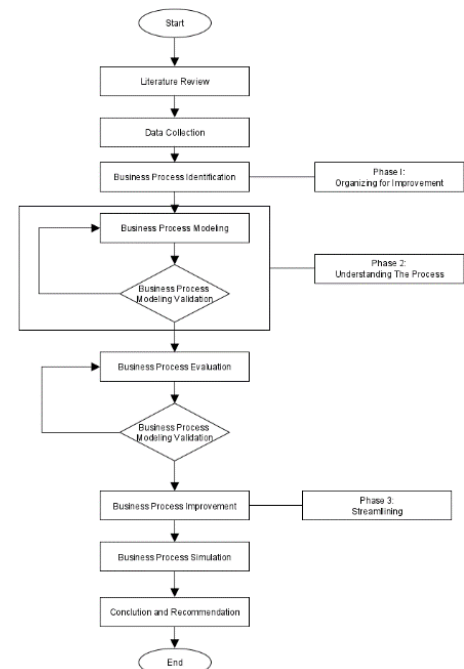


Fig. 1. Research Flow Diagram

The research begins with a literature review to assist the researcher in getting an understanding of the research topic through related theories. In the initial stage, the researcher can search for theories related to the evaluation and modeling of business processes from books, journals, and previous research. Next, the researcher can collect business process data obtained through interviews with the company's stakeholders

and observations related to the business processes occurring in the company. Then, the collected business process data will be identified to determine the existing business functions in a company. The next step is to model the current business process functions using the Business Process Model Notation (BPMN) that is supported by Bizagi Modeler. On the other hand, validation of the current business process modeling is conducted with the company to ensure that the modeled business processes are accurate. The following stage is evaluating the business processes using the Failure Mode and Effect Analysis (FMEA) method to identify potential failures in the business processes. Validation of the current business process evaluation also does with the company's stakeholder. The results from FMEA are analyzed using Business Process Improvement (BPI), then modeling the business process improvement. Furthermore, a business process simulation is conducted to compare the average time between the current business processes and the recommended business processes. The final step is providing conclusions and recommendations that are useful to answer the problem and give considerations for future research.

III. RESULT AND DISCUSSION

A. Business Process Modeling and Evaluation

The identification of business processes is conducted after data collection through observation and interviews with stakeholders at PT. Mitrasukses Engineering Indonesia. The identification of business processes is doing the functional decomposition that transforms business functions into business processes. From the business processes, the decomposition is breaks again into the smallest functions, namely activities. Based on

interviews, the operational division consists of four business processes, namely the Product Ordering, Material Procurement, Production, and Product Delivery processes. The functional decomposition at PT. Mitrasukses Engineering Indonesia can be seen in Figure 2

Fig. 3. Material Procurement Business Processes (as-is)

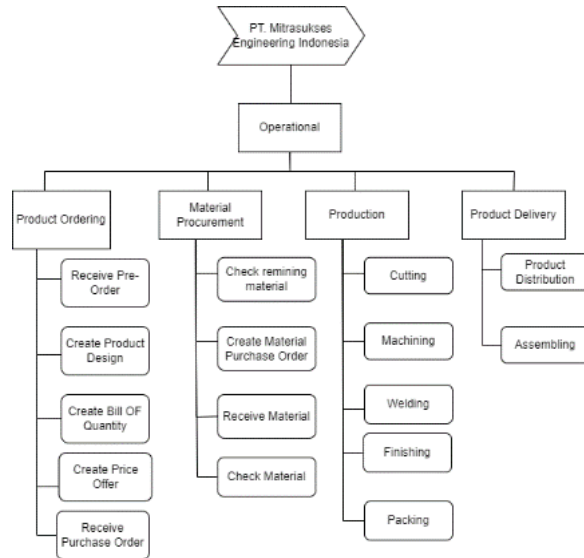


Fig. 2. Functional Decomposition

In Figure 2, it's shown that the research is only focused on the operational division because it has role of the top- level business function. Next step is modeling the current business processes using the BPMN that show in Figure 3, specially related to Material Procurement process

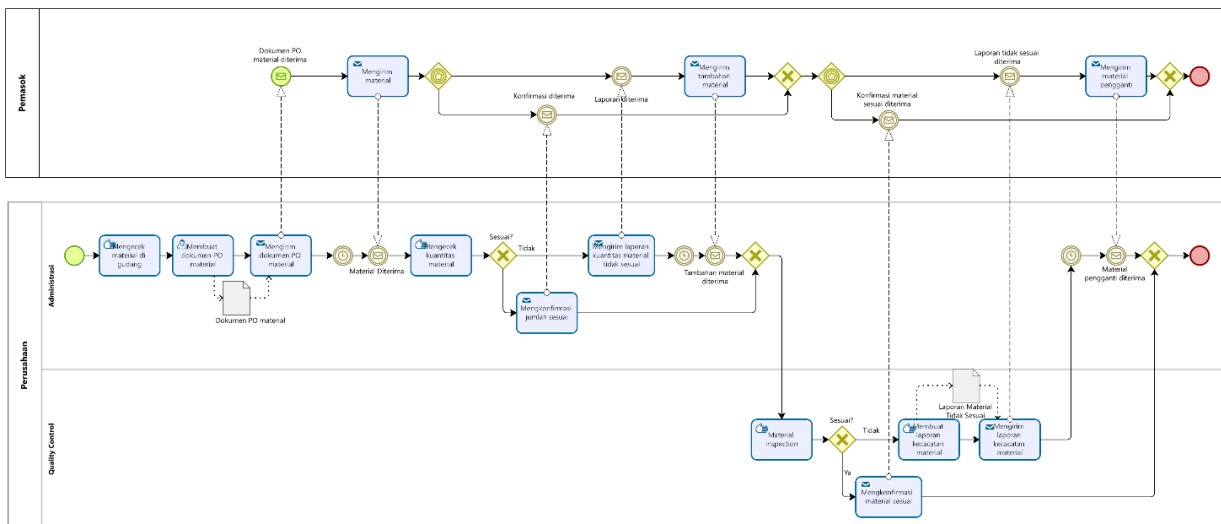


Fig. 3. Material Procurement Business Processes (as-is)

Then, an FMEA analysis is conducted on the Material Procurement business process to obtain the Risk Priority Number (RPN) that derived from three factors, such as severity, occurrence and detection levels. The RPN that

has high values indicate that the failure has a high potential risk. The analysis of potential failures using FMEA method can be seen in Table 1.

Table 1. FMEA Analysis of Material Procurement Business Processes

Actor	Activity	Failure	Impact	S	Cause	O	D	RPN	Rank
Administration	Check material in warehouse	Mistake in checking material in warehouse	Incorrect material quantity in BQ doc.	1	Checking material manually	6	8	48	3
Administration	Create material Purchase Order doc.	Unclear material description	Non-conformity of materials received	1	Undetailed BQ doc.	5	7	35	4
Administration	Checking material quantity	Mistake in checking material quantity	The quantity of material doesn't match with the ordered	2	Lack of supervision when checking	4	7	98	2
Quality Control	Material inspection	Mistake in checking material quality	Material quality doesn't meet company standards	5	Lack of supervision when checking	3	7	105	1

Based in the analysis of potential failures in the material procurement business process using FMEA method as explained in Table 1, the highest RPN value is 105, which is in material inspection activity performed by the quality control department, This activity has the potential for errors in quality checking due to lack of supervision during inspection that resulting the material not meet the company's standards. Meanwhile, the lowest RPN value is 35 that found in the activity of create material Purchase Order documents. This activity involves unclear material description due to carelessness of material details that can impact to nonconformity of material received.

B. Business Process Recommendation

The redesign of the business process is using Business Process Improvement method with streamlining tools. In the redesign of the business process, key areas are identified to address potential failures that obtained from the evaluation of the business process using Failure Mode and Effect Analysis (FMEA) method. The redesign of the Material Procurement business process can be seen in Table 2.

Table 2. Material Procurement Business Process Improvement Plan

Rank RPN	Streamlining	Rekomendasi Perbaikan
1	<i>Simplification</i>	Checking the quality of materials at the same time as checking the quantity of materials received
2	<i>Simplification</i>	Checking the quality of materials at the same time as checking the quantity of materials received
3	<i>Upgrading</i>	Checking residual material through system
4	<i>Upgrading</i>	Ensure Purchase Order documents are detailed.

Based on the design of improvement to the material procurement business process contained in Table 2, solutions are explained to overcome potential failures in material procurement business process activities, such as optimizing workflow and implement management systems.

The changes applied to other three business processes areas follows:

1. Product Ordering Business Process

Changes were made to several activities by implement streamlining, including Standardization with applying ISO 9001:2015 standards to each document required in the product ordering business process, Upgrading with implementing Google Workspace and Automation with applying payment aggregator automation for down payment for product orders.

2. Production Business Process

Changes were made to several activities by implement streamlining, including Error Proofing by conducting product checklist during the production process, Standardization with applying ISO 9001:2015 standards to each document required in the production business process, Simplification with combining activities with similar goals and Simple Language with applying clear descriptions to the necessary documents.

3. Product Delivery Business Process

Changes were made to several activities by implementing streamlining, including Standardization with applying ISO 9001:2015 standards to each planning activity based on standard guidelines and Automation with applying payment aggregator for final product payments.

The model of business process improvement is process model recommendation using BPMN. The model of business process improvement is represent based on the results of the redesign of the business process using streamlining tools in the BPI method. The model of the Material Procurement business process improvement can be seen in Figure 4.

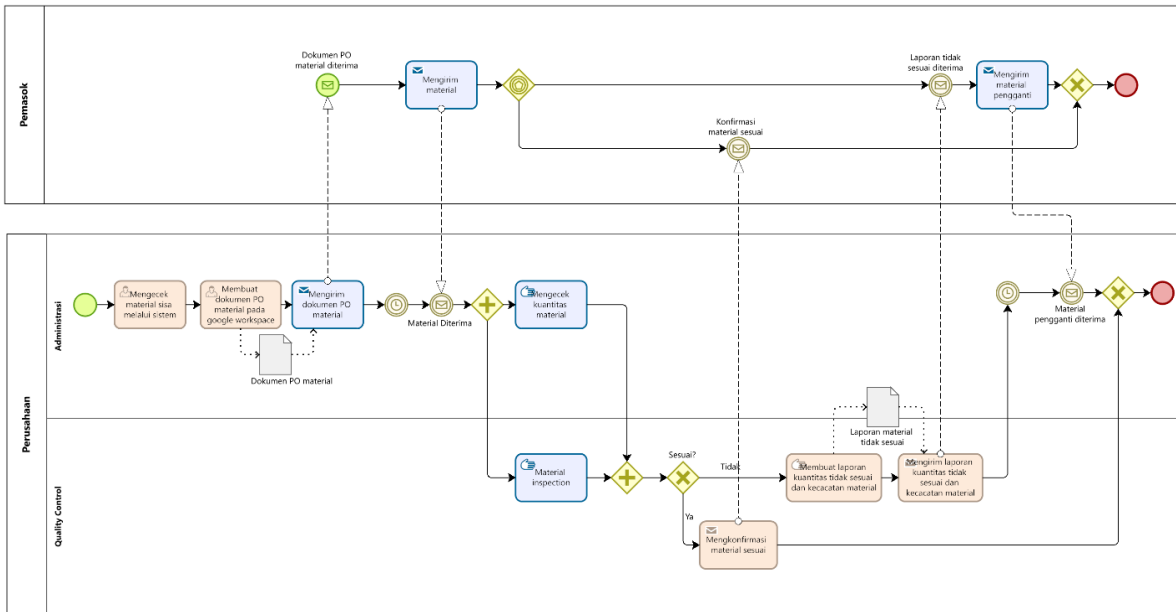


Fig. 4. Material Procurement Business Processes

C. Business Process Simulation

The business process simulation conducted on all four business processes within the operation division PT. Mitrasukses Engineering Indonesia. The simulation is performed at process validation level and time analysis level. In process validation level indicated that all task processes in the four business processes, both as-is and to-be are considered valid because instance start and instance complete has same amount.

The product ordering business process is simulated over a period of 1 month with total of 5 product orders and rarely increase in orders. The simulation of 5 product orders within a month indicates that the instances ser for simulation are 5 instances. Meanwhile the duration of each activity in the product ordering business process is based on interviews with PT. Mitrasukses Engineering Indonesia. The simulation results for the four business processes can be seen in Table 3.

Table 3. Comparison of Time Analysis Simulation Level

Business Process	As-is Time	To-Be Time	Time Difference	Efficiency
Product Ordering	17 hours 58 minutes 52 second	15 hours 14 second	2 hours 58 minutes 38 second	16,58%
Material Procurement	8 hours 57 minutes 25 second	5 hours 47 minutes 51 second	3 hours 9 minutes 34 second	35,27%
Production	1 days 23 hours 4 minutes 39 second	1 days 4 hours 47 minutes 13 second	18 hours 17 minutes 26 second	38,85%
Product Delivery	4 hours 33 minutes 9 second	3 hours 31 minutes 53 second	1 hours 1 minutes 16 second	22,42%

It can be seen in Table 3 that there is an improvement in efficiency in all four business processes in the operational division of PT. Mitrasukses Engineering Indonesia. This Indicated that the product ordering

business process improvement is capable of reducing current issues in the product ordering business process. The recommended improvements for the product ordering is use Google Forms for get order and use Google Workspace for collaboration within employees, standardizing the required documents and also implementing an automated payment system.

The business process improvement in material procurement also effectively handled the current issues in the material procurement process. Recommended improvements for the material procurement business process include implementing warehouse management systems and collaborating in material inspection processes. Similarly, the business process improvement in production can reduces current issues in the production process. Recommended improvements for the production business process include implementing clear documentation related detailed product design, conducting pre-inspection activities during the production process, simplifying production planning activities and user Google workspace to collaborating withing employees.

Furthermore, in the business process improvement for product delivery can handled current issues. Recommended improvements for the product delivery business process include conducting assembling planning activities and use system to generate invoice automatically.

IV. CONCLUSION

A. Conclusion

Based on the results of the research and discussion, the conclusions of this research are as follows:

1. Business process evaluation is using Failure Mode and Effect Analysis (FMEA) method based on observations and interviews with the operational division of PT. Mitrasukses Engineering Indonesia. The results of the business process evaluation show that potential failure accompanied by Risk Priority Numbers (RPN) that indicate the priority of these failures. The evaluation results indicate failure in the product ordering business process with the highest RPN is design discrepancies, failure in the material procurement business process with the highest RPN is mistake in checking the quality and quantity of materials, failure in the production business process with the highest RPN is machine cutting not working properly, and in the product delivery business process with the highest RPN is unusable due to assembling errors.

2. Business process improvement in the operational division of PT. Mitrasukses Engineering Indonesia is using Business Process Improvement (BPI) method with streamlining tools that resulting the improvement recommendations to handled potential failures in each business process. The model of business process improvement is using BPMN that performed after get recommendations, including the implementation of product design checklists, activity simplification, using Google Workspace for real-time monitoring, get invoice automation and improvement planning activities.

3. Business process simulation is using Bizagi Modeler at process validation level and time analysis level in each business process in the operational division of PT. Mitrasukses Engineering Indonesia, both in the current business processes and the improved business processes. The simulation results provide a comparison of time between the current business processes and the improved business processes that useful for determining the efficiency improvement of the business process. The results of the business process simulation in average time show an efficiency improvement in the product ordering business process by 16.58%, the material procurement business process by 35.27%, the production business process by 38.85%, and the product delivery business process by 22.42%.

B. Suggestion

The suggestion that researcher can provide based on the research are as follows:

1. The results of this research can be used as a reference in designing information systems to handled potential failures in the operational division of PT. Mitrasukses Engineering Indonesia.

2. Conduct further simulation using Bizagi Modeler at resources analysis level and calendar analysis level to reduce potential errors in terms of time and cost. This would be useful for estimating a business process that takes place over a period of time.

ACKNOWLEDGMENT

This research is granted by the Faculty of Computer Science, Brawijaya University. Authors would like to express their appreciation to all colleagues and participants who are willing to participate in the study for this research.

REFERENCES

- [1] Perindustrian, K., 2023. *Kontribusi Dominan dan Melonjak, Industri Manufaktur Masih Pede*. [online] Available at: <<https://kemenperin.go.id/artikel/24036/Kontribusi-Dominan-dan-Melonjak,-Industri-Manufaktur-Masih-Pede->>>.
- [2] Alijoyo, A., Wijaya, B. and Jacob, I., 2020. Failure Mode Effect Analysis (Analisis Modus Kegagalan dan Dampak). Center for Risk Management & Sustainability.
- [3] Ahsen, A. von, Petruschke, L. and Frick, N., 2022. Sustainability Failure Mode and Effects Analysis – A systematic literature review. *Journal of Cleaner Production*, 363(132413).
- [4] Ahmed, E.S., Ahmad, M.N. and Othman, S.H., 2019. Business process improvement methods in healthcare: a comparative study. *International Journal of Health Care Quality Assurance*, 32(5), pp.887–908.
- [5] Dumas, M., Rossa, M. La, Mendling, J. and Reijers, H.A., 2018. *Fundamentals of Business Process Management*. 2nd Editio ed. Data and Knowledge Engineering, Berlin, Germany: Springer. <https://doi.org/10.1016/j.data.2007.06.004>.
- [6] De Sordi, J.O., 2023. *Management by Business Process: A Managerial Perspective of People Process and Technology*. Switzerland: Springer.
- [7] Jiang, J.M., Zhu, H., Li, Q., Zhao, Y., Zhang, S., Gong, P. and Hong, Z., 2020. Event-based functional decomposition. *Information and Computation*, [online] 271, p.104484.
- [8] Weske, M., 2019. *Business Process Management: Concept, Languages, Architectures*. 3rd ed. Berlin, Germany: Springer.
- [9] OMG, 2011. *Business Process Model and Notation (BPMN)*. 2.0 ed. OMG.
- [10] Schäffer, E., Stiehl, V., Schwab, P.K., Mayr, A., Lierhammer, J. and Franke, J., 2021. Process-Driven Approach within the Engineering Domain by Combining Business Process Model and Notation (BPMN) with Process Engines. *Procedia CIRP*, 96, pp.207–212.
- [11] Mcdermott, R.E., Mikulak, R.J. and Beauregard, M.R., 2008. *The Basic of FMEA*. 2nd Editio ed. CRC Press.
- [12] Pribadi, H.I. and Ernastuti, E., 2020. Manajemen Risiko Teknologi Informasi Pada Penerapan E-Recruitment Berbasis ISO 31000:2018 Dengan FMEA (Studi Kasus PT Pertamina). *Jurnal Sistem Informasi Bisnis*, 10(1), pp.28–35.
- [13] Sukmawati, R. and Priyadi, Y., 2019. Perancangan Proses Bisnis Menggunakan UML Berdasarkan Fit/Gap Analysis Pada Modul Inventory Odoo. *INTENSIF: Jurnal Ilmiah Penelitian dan Penerapan Teknologi Sistem Informasi*, 3(2), pp.104–115.
- [14] Harrington, D.H.J., 1991. *Business Process Improvement: The Breakthrough Strategy for Total Quality, Productivity, and Competitiveness*. United States: McGraw-Hill.