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Proposed ProModel Implementation to Increase Production Quantity at PT. ABC

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Abstract: *This study focuses on initiatives to enhance production quantity at PT ABC. The study applied a simulation-based approach using ProModel software to test various improvement scenarios without interfering with actual production activities. The data collected includes processing time at each workstation and machine capacity, which were used to build an accurate simulation model. The simulation results showed a significant increase in productivity from 35 to 78 units per hour after implementing the second improvement alternative involving additional manpower. This study offers practical and data-driven solutions to enhance production efficiency, reduce cycle time, and eliminate bottlenecks. The findings serve as a valuable reference for companies aiming to implement production line optimization strategies and simulation modeling to support continuous improvement in manufacturing performance.*

Keywords: *Manufacturing Efficiency; Process Improvement; ProModel; Production Quantity; Simulation*

1. Introduction

In today's manufacturing landscape especially within the automotive and electronics industries, the assembly of wiring harnesses plays a pivotal role in determining product quality and operational efficiency. A wiring harness consists of a bundle of organized cables used to connect various electronic parts. The assembly process is typically labor-intensive, leading to frequent challenges in achieving line balance. Such imbalances can result in production bottlenecks, idle workstations, and lower output, ultimately driving up both lead time and manufacturing costs.

Simulation techniques have shown considerable potential in enhancing different facets of manufacturing operations. For example, Vaghefi and Sarhangian [1] highlighted how simulation improves inspection planning in multi-stage production, contributing to lower defect rates. Werker et al. [2] also emphasized the value of discrete event simulation, not just in healthcare but also in manufacturing, by improving process accuracy and operational efficiency.

In supply chain applications, Purwito et al. [3] utilized simulation to balance production systems, while Eftonova et al. [4] adopted agent-based models to examine dynamic system interactions. Bhushan [5] further noted the relevance of simulation in building resilient systems for emergency conditions, an approach that can be extended to manufacturing contexts as well.

Simulation also plays a strategic role in digital manufacturing, particularly in production planning and operational control [6-7]. Its utility spans across optimizing energy consumption, strengthening supply chain resilience, and enabling predictive maintenance [8–9]. When it comes to sustainable manufacturing, Kaur and Kander [10] as well as Tsiamas and Rahimifard [11] demonstrated that simulation can support decision-making by evaluating operational impacts and promoting sustainability.

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The integration of advanced technologies into simulation is also emerging, as shown by Akter Jahan et al. [12], who incorporated graph neural networks into welding process simulations. In terms of logistics and production workflows, simulations are effective in identifying and eliminating process inefficiencies and bottlenecks, as highlighted in studies [13–14]. Butrat and Supsomboon [15] also pointed out how simulation can enhance resource allocation, reduce operational costs, and boost productivity.

A relevant example is provided by Muchtar et al. [16], who investigated a food manufacturing company facing bottlenecks due to labor shortages. Through scenario-based simulations, the company was able to significantly increase its production capacity. This case underscores the importance of simulation in decision-making and capacity planning.

Despite extensive research on simulation's effectiveness across multiple areas of manufacturing, studies specifically examining the application of ProModel in addressing line balancing issues in wiring harness assembly remain scarce. This gap highlights the need for further exploration to aid companies in creating optimized and efficient workflow designs.

2. Methodology

The study was carried out at PT ABC, with a specific focus in the production line. The study took place in 2025 and involved several key stages, including field observations, data collection, initial analysis, and the development of a simulation model. A quantitative research method was employed, utilizing a discrete-event simulation approach through the use of ProModel software.

This simulation technique was selected because it enables the virtual modeling of production activities, making it possible to analyze the workflow, identify process inefficiencies, and locate potential bottlenecks without disrupting actual operations.

The method also allowed for the testing of multiple improvement scenarios to determine the most effective solution for achieving line balancing. The overall objective of this research was to enhance production efficiency and output. The study was structured through a series of systematic steps to ensure accuracy and relevance in solving real world production challenges faced by the company.

2.1 Identification of the Problems

During this phase, constraints within the visual acc and assembly stages of the production line were recognized as primary obstacles to increasing output. To assess process efficiency, several key metrics were evaluated, including cycle duration, periods of inactivity, workstation utilization rates, and queue buildup at each station, providing insights into areas needing improvement.

2.2 Data Collection

At this phase, various types of data were gathered, including the processing time at each workstation, available machine and labor capacity, workflow of the production line, and the average daily output. The data collection process involved multiple techniques such as observing production activities firsthand, conducting interviews with operators to gain insight into on-site conditions, and examining production-related documents. These approaches were employed to ensure that the information obtained was accurate and effectively used for subsequent simulation and analysis steps.

2.3 Simulation Modeling

In the simulation modeling stage, an initial representation of the production system was developed using ProModel software. This model was constructed based on real operational data collected directly from the shop floor to ensure it closely mirrored actual working conditions.

After the model was built, a validation process was carried out to verify its accuracy and reliability. It involved comparing the simulation outcomes with historical production data to assess whether the model could reliably reflect real-world performance. Validation is a crucial step in any simulation study, as it builds confidence that the model behaves in a way that aligns with actual production behavior. Without proper validation, any improvements based on the simulation might be misleading. Once the model was verified to be dependable, it served as a foundation for testing various improvement scenarios.

These scenarios were then used to explore ways to increase production output, reduce inefficiencies, and support better decision-making in optimizing the production process.

2.4 Results Analysis and Recommendations

The simulation results from each scenario were carefully analyzed to determine the best possible solution for improving production. After thorough evaluation, recommendations were developed based on these findings to guide the implementation of improvements in the actual production environment.

These proposed measures focus on enhancing the overall efficiency and effectiveness of the production process by addressing key issues identified during the simulation. The goal is to eliminate bottlenecks, reduce downtime, and increase output quality and quantity.

Furthermore, these suggestions serve as practical guidelines for the company to apply the most suitable solution directly on the factory floor. By following these recommendations, the company is expected to achieve smoother operations and better resource utilization, ultimately supporting sustainable improvements in production process performance.

3. Results and Discussion

The researchers recorded the processing time at each workstation along the production line to identify the available capacity at each stage. This data was crucial for evaluating the performance of the current production system.

Using ProModel simulation software, they developed a dynamic model that accurately represents the real-world production environment. The simulation was built upon actual operational data gathered during observations, which served as the foundation for creating the initial model. Through this simulation, the researchers were able to examine potential bottlenecks, assess workflow efficiency, and determine whether the current capacity met production demands.

Additionally, the model helped in identifying areas that might require improvements or adjustments to enhance overall productivity and reduce delays. This approach provided valuable insights for future planning and optimization of the manufacturing process.

The data gathered from the production system was initially used in a simulation to identify specific points where inefficiencies were occurring. In the first simulation run, it became evident that a buildup of products happened due to the limited capacity in the Production line, which created a bottleneck in the workflow. This restriction negatively impacted overall process efficiency and highlighted the need for capacity adjustments. Under these initial simulated conditions, the total operational cost was recorded at approximately Rp. 21,100,000, signaling a significant cost burden that could be reduced through targeted process improvements.

To resolve the identified challenges, the research team suggested increasing capacity at certain key workstations to improve efficiency and overall production performance by removing bottlenecks. Detailed analysis of the collected data along with simulation outcomes highlighted areas where product accumulation was occurring throughout the production line. In response, a second simulation scenario was created, focusing on enhancing capacity at these critical stations. This improvement was supported by specialized training programs designed to boost worker productivity and operational skills. The results of these efforts, including performance improvements and efficiency gains, are thoroughly discussed in the following section, providing valuable insights into the effectiveness of the implemented strategies for optimizing the manufacturing process.

Table 1. Production line data

Location	Capacity	Unit	Time Process
Raw Material	15 pieces	1	0,3 Min
Move to Housing	2 pieces	1	1 Min
Housing Process	2 pieces	1	0,1 Min
Move to Assembling	2 pieces	1	1 Min
Assembling Process	3 pieces	1	0,1 Min
Move to Visual Acc	3 pieces	1	1 Min
Visual Acc	2 pieces	1	0.2 Min
Move to Storage	2 pieces	1	1 Min
Storage	13 pieces	1	0.5 Min

Table 2. Alternative data 1

Location	Capacity	Unit	Time Process
Raw Material	20 pieces	1	0,3 Min
Move to Housing	3 pieces	1	1 Min
Housing Process	3 pieces	1	0,1 Min
Move to Assembling	3 pieces	1	1 Min
Assembling Process	4 pieces	1	0,1 Min
Move to Visual Acc	4 pieces	1	1 Min
Visual Acc	3 pieces	1	0,2 Min
Move to Storage	3 pieces	1	1 Min
Storage	15 pieces	1	0,5 Min

An alternative method to optimize the production line focuses on increasing capacity in key areas such as the Housing, Assembling, and Visual Acceptance stages. This improvement scenario aims to address potential bottlenecks by allocating more resources to these critical processes. During the initial simulation of this scenario, it was observed that production costs remained stable, matching the original model's total operational cost of Rp. 21,100,000. Although costs did not increase, the enhanced capacity is expected to improve workflow efficiency and output rates, which may lead to better overall performance and productivity in the long term.

Based on the simulation tests conducted using ProModel on the production line, the initial bottleneck problem was effectively resolved. Despite this success, it became clear that further modifications would be required due to an increase in customer demand. The existing production capacity was no longer sufficient to meet these heightened targets, indicating the need for additional enhancements. Consequently, several new improvement options were considered to ensure that production goals could be achieved without compromising quality or efficiency. The following section will detail one of these proposed alternative solutions, explaining how it could help address the capacity shortfall and support the company's efforts to keep up with growing market demands.

Table 3. Alternative data 2

Location	Capacity	Unit	Time Process
Raw Material	20 pieces	1	0.3 Min
Move to Housing	3 pieces	1	1 Min
Housing Process	3 pieces	1	0,1 Min
Move to Assembling	3 pieces	1	1 Min
Assembling Process	8 pieces	1	0,1 Min
Move to Visual Acc	8 pieces	1	1 Min
Visual Acc	3 pieces	1	0,2 Min
Move to Storage	3 pieces	1	1 Min
Storage	15 pieces	1	0.5 Min

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The decision to increase the number of workers in the assembly process was made due to the critical role this stage plays in determining the overall production output. Analysis showed that the assembly stage was a major bottleneck affecting the efficiency of the entire workflow. To address this, a simulation was conducted where an additional worker was assigned to the same workstation within the assembly section. The simulation results indicated a noticeable improvement in both capacity and operational efficiency. With the added workforce, the time required to complete a single unit was reduced, and the risk of delays was minimized. This strategic move is expected to positively impact the overall productivity and quality of the final products, ultimately enhancing the performance of the entire production system. Analysis showed that the assembly stage was a major bottleneck affecting the efficiency of the entire workflow. To address this, a simulation was conducted where an additional worker was assigned to the same workstation within the assembly section

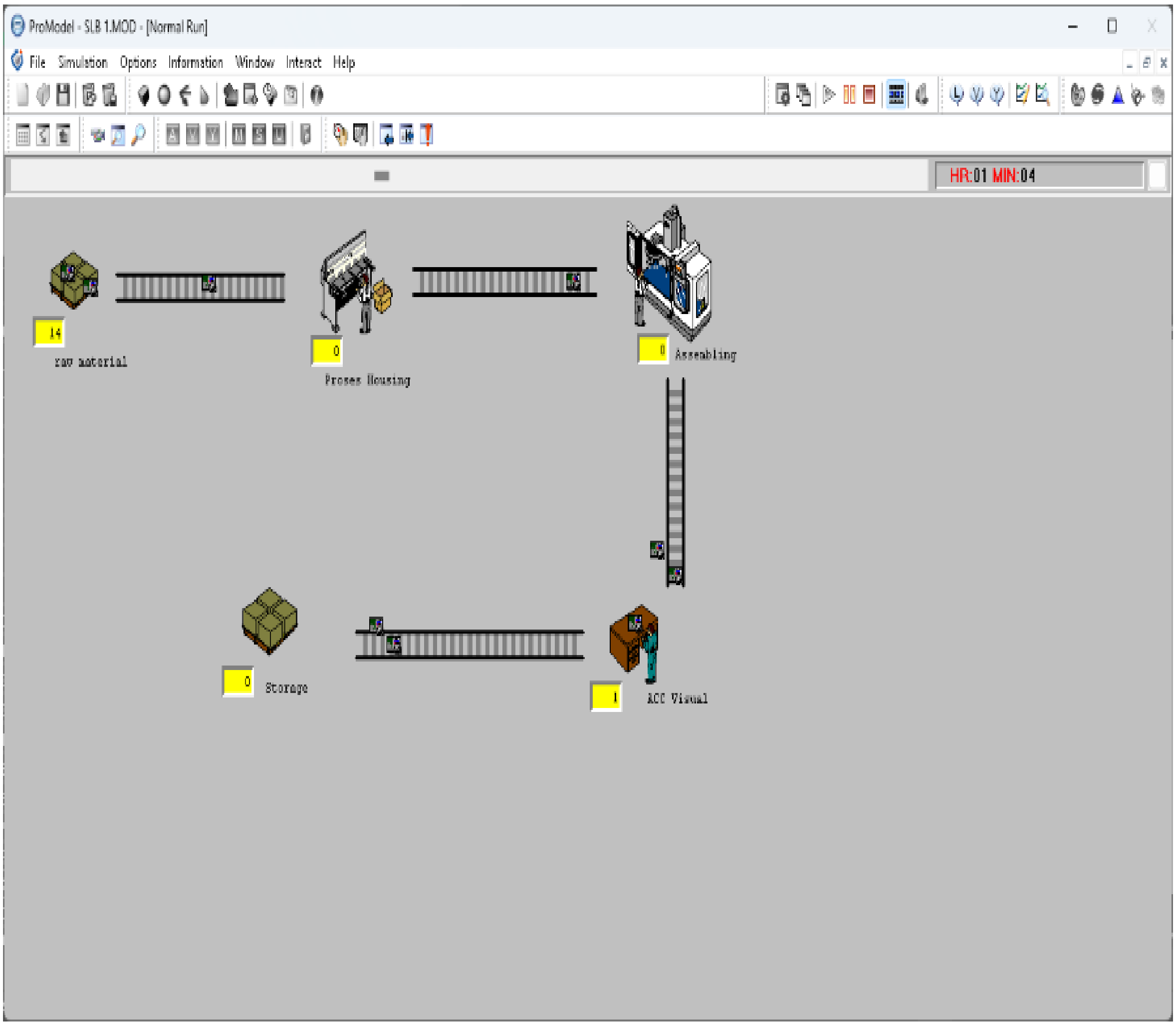

Figure 1. Addition of manpower in the assembling process

The following results were obtained from a simulation carried out using ProModel software. In this simulation, the number of workers assigned to the Assembling process was increased in order to evaluate its influence on overall production performance. The main goal was to assess whether the addition of labor at this specific stage would lead to improvements in output quantity, workflow efficiency, and time utilization. This strategic adjustment aimed to generate useful insights into how modifying resource distribution can optimize operations and enhance the overall productivity of the manufacturing system.

Based on the simulation of the second alternative production line optimization scenario using ProModel in the production line, it was observed that adding manpower to the Assembling process significantly improved output. The production rate increased from 35 units per hour to 78 units per hour. This alternative required an additional cost of Rp. 3,500,000, bringing the total cost to Rp. 24,600,000.

Based on the various simulation models developed, the following presents a summary of the outcomes generated through the use of ProModel simulation software in the production analysis. To address the identified issue, a second alternative was developed. This scenario recommends assigning an additional operator to the assembling area, as it directly influences the productivity of the HA Export production line. Simulation results showed a significant improvement, with output rising to 78 units per hour more than double the previous rate. This adjustment only increased operational costs by Rp. 3,500,000, raising the total from Rp. 21,100,000 to Rp. 24,600,000.

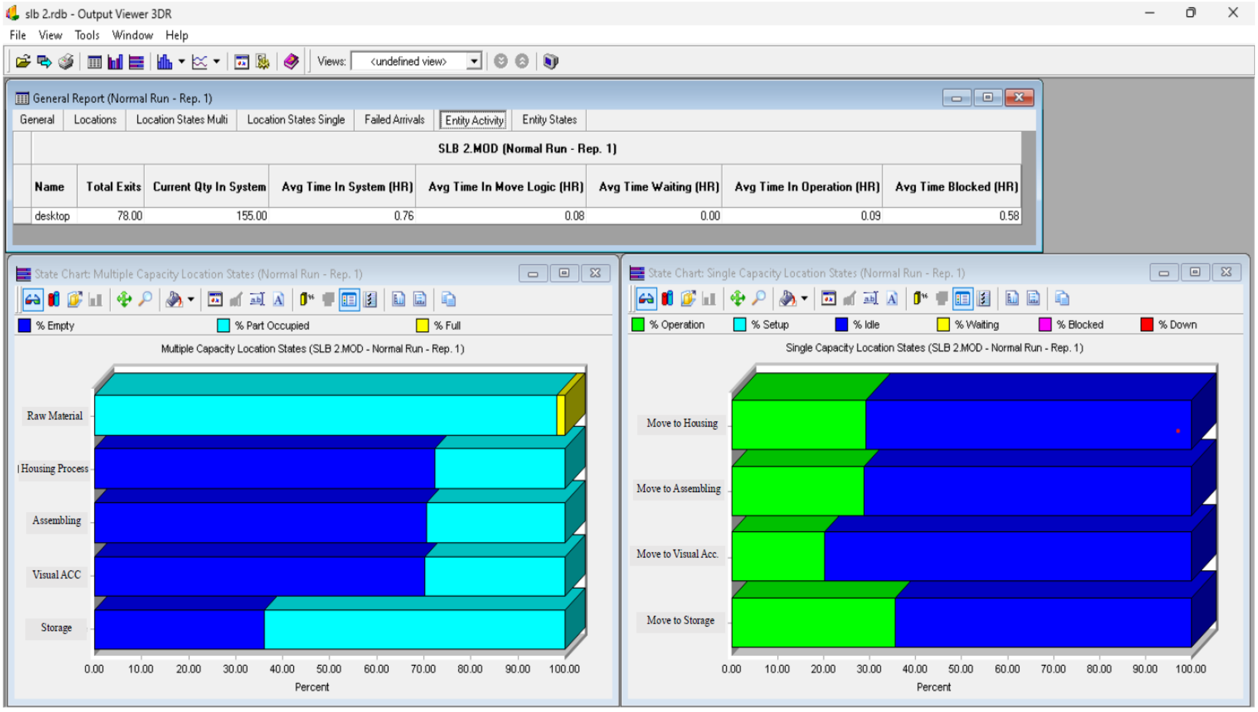

Figure 2. Alternative 2 after simulation

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Table 4. Simulation result summary

Resume	Early Model	Alternative 1	Alternative 2
Bottleneck	15.40%	0.00%	0.04%
Cost	Rp. 21.100.000	Rp. 21.100.000	Rp. 24.600.000
Production (Total Exit)	35 Pcs/Hour	35 Pcs/Hour	78 Pcs/Hour

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4. Conclusion

The latest simulation executed through ProModel demonstrated a considerable improvement in production quantity at PT ABC's production line. Applying a simulation approach using ProModel, this study successfully replicated the production process virtually, enabling detailed analysis of workflow and pinpointing areas of accumulation. Increasing capacity and manpower effectively eliminated bottlenecks, resulting in a smoother and more efficient production flow. The simulation indicated that output improved from 35 to 78 pieces per hour after applying the second alternative.

The study encourages the company to maintain regular review of production operations and consider further capacity expansions and workforce training to meet growing product demand.

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