

## CHAPTER VI

### CONCLUSIONS

This chapter serves as the conclusion, containing explanations of the findings drawn from the research conducted and recommendations for future studies.

#### 6.1 Conclusions

Based on research conducted to design an optimal production facility layout at PT. Kunango Jantan, the focus was on reducing material transfer distances, increasing material handling cost efficiency (MHC), and reducing environmental impact due to emissions from forklift energy use. The results of the study suggest that transitioning from a process layout to a product layout offers a significant solution to the existing challenges. In a process layout, facilities are organized by process type, leading to substantial distances between workstations. In contrast, a product layout arranges facilities according to a structured production process sequence, resulting in a more efficient material flow and reduced distance between workstations.

The proposed product layout reduced the material displacement distance by 15.11%, which translated into material handling cost savings of Rp238,334.70, as well as a 17.25% reduction in CO<sub>2</sub> emissions. This layout redesign improves cost efficiency and reduces forklift fuel consumption, contributing to a decreased carbon footprint and supporting environmental sustainability. Furthermore, the electric forklift exhibited lower MHC efficiency compared to the diesel forklift. The MHC efficiency for the diesel forklift was higher, offering a more favorable material handling cost (MHC) ratio, thus making it more cost-effective in terms of operational expenses, especially in the short term. The electric forklift has a higher initial MHC of Rp1,527,748.81, compared to the diesel forklift's MHC of

Rp1,300,473.97. Despite the higher upfront cost, the electric forklift achieved an MHC efficiency of 0.28%, or Rp4,292.86, indicating that while initial costs are higher, the long-term operational efficiency of material handling improves significantly.

The total emissions generated by material handling in the existing layout using diesel forklifts amounted to 7.08 kg CO<sub>2</sub>eq, while the electric forklift in the proposed layout generated 16.70 kg CO<sub>2</sub>eq. This demonstrates that, despite the advantages of electric forklifts in terms of sustainability, the switch results in a significant environmental cost in terms of emissions, especially due to Indonesia's reliance on fossil fuel-based electricity. Moreover, the electric forklift presents significant improvements when considering Abiotic Depletion. The Abiotic Depletion for the electric forklift is 248 MJ, which is considerably lower than the 548 MJ for the diesel forklift, representing an efficiency improvement of 54.74% in reducing the consumption of non-renewable fossil resources. This indicates that the electric forklift helps reduce the depletion of non-renewable fossil resources, promoting more sustainable operations by minimizing the consumption of fossil fuels. This aligns with SDG 12: Responsible Consumption and Production, which emphasizes the need for industries to reduce waste and minimize resource use. By switching to electric forklifts, PT. Kunango Jantan contributes to responsible production practices by lowering its consumption of non-renewable resources and reducing the environmental impact of its operations. This change supports not only operational sustainability but also encourages a more resource-efficient manufacturing process in line with global efforts to foster sustainable industrial practices. Regarding emissions, the Emission Ratio for electric forklifts is substantially lower compared to diesel forklifts. The Emission Ratio for a diesel forklift using solar is 0.000004399 kgCO<sub>2</sub>eq/Rp, while for the electric forklift, it is 0.000001252 kgCO<sub>2</sub>eq/Rp. This means that for every Rp spent, the electric forklift generates much lower emissions, contributing to a reduction in overall greenhouse gas emissions.

Through this evaluation, it can be concluded that the Designed Layout is more optimal than the Initial Layout, with an increase of 11.43% in fulfilling the evaluation criteria. This improvement is primarily due to the redesigned layout, which addresses critical points related to material transfer distances and material handling efficiency, significantly enhancing operational performance. The transition to the new layout, combined with the use of electric forklifts, has successfully optimized both the environmental and operational aspects of PT. Kunango Jantan, ensuring long-term sustainability, improved productivity, and better resource efficiency.

## **6.2 Recommendations**

The next research suggestion is to explore the social aspect, specifically investigating how changes in production efficiency and layout design impact workers' physical and mental health. The study could include an analysis of workplace ergonomics, workload balance, job satisfaction, and the role of employee engagement in sustainability initiatives.