



Abstract

This project was conducted at Medtronic, a medical device manufacturing company operating in a high-volume production environment. It focused on enhancing the palletizing process for a specific medical product by integrating a manual feeder with an existing automated palletizing module. The manual method previously used led to inefficiencies in cycle time, increased operator fatigue, and elevated risk of human error. The implemented solution aimed to reduce cycle time, improve throughput, and enhance operator ergonomics while supporting production scalability. The approach included a thorough analysis of the current workflow, validation of equipment, strategic integration, and post-implementation monitoring. Results demonstrated a reduction of 80% in palletizing time and error rates, alongside positive operator feedback regarding ergonomic improvements. The system's configuration allowed for a balance between automation and human input, reinforcing adaptability and operational flexibility. Ultimately, this automation initiative contributed to a more sustainable and efficient manufacturing process.

Introduction

Medtronic is a global medical technology company focused on delivering innovative solutions to improve patient outcomes. Within its manufacturing operations, the company consistently seeks to optimize production processes through automation and lean practices. Among the manufacturing processes carried out at Medtronic is palletizing, which refers to the systematic placement of products onto pallets for storage or shipment.

The palletizing process for product “X” was fully manual, leading to inefficiencies in cycle time, increased labor dependency, and a higher risk of human error. These challenges prompted the need for improvements that aligned with the company’s goals for operational efficiency and quality. This method placed physical strain on operators, limited scalability, and introduced variability in cycle time and product handling.

To resolve these issues, the integration of a manual feeder into the existing automated palletizing module used for product “Y” was planned. This solution was expected to reduce cycle times, increase throughput to support higher production demands, and improve operator ergonomics by eliminating the physical burden of manual palletizing.

The objective of this project was to enhance performance metrics across the line by streamlining the palletizing process and minimizing human error.

Background

The evolution from Industry 4.0 to Industry 5.0 marks a significant shift in manufacturing—advancing from digitalization and AI-driven automation toward a more human-centric, sustainable, and socially responsible approach [1][2]. Industry 4.0 focused on improving efficiency, reducing human error, and optimizing cycle times through automation and intelligent systems [1]. Industry 5.0 builds upon this foundation by promoting greater collaboration between humans and machines, while also emphasizing flexibility, environmental sustainability, and ethical production values [2].

Modern manufacturing increasingly leverages Automated Intelligent Manufacturing Systems (AIMS), which use real-time data and algorithms to optimize production with minimal human input [4]. These systems offer a more flexible and cost-effective alternative to traditional methods like Six Sigma, which require extensive training [4]. It is important to distinguish between automation—focused on autonomous systems—and robotics, which involves sensors and actuators to facilitate human-machine interaction [5]. Additionally, pilot lines—key tools during Industry 4.0—are evolving to support the demands of Industry 5.0 by integrating advanced technologies while enhancing human involvement and maintaining high-quality standards [2][5].

Methodology

Current Workflow Analysis

- The process began with a detailed mapping of the manual palletizing workflow. Time studies showed an average of 19 seconds per tray and 25 minutes per pallet. Key inefficiencies and bottlenecks were identified to guide the design of an optimized automated system.

Equipment Validation and Integration Planning

- All system components—utilities, hardware, and software—were evaluated for compliance with operational and safety standards. An ergonomic assessment ensured the new module would support operator safety and fit within current workspace constraints, informing the integration strategy.

Equipment Implementation

- The Manual Feeder to Auto Palletizing Module was installed and integrated into the existing lines. Figure 1 illustrates the layout: orange for product Y, blue for product X. SOPs were updated, and training was delivered to operators and maintenance staff. Technical documentation was revised for ongoing support.

Monitoring and Final Verification

- Post-installation production runs were used to verify system performance. KPIs such as cycle time, uptime, and output quality were monitored. Results confirmed a successful integration and identified opportunities for ongoing optimization.

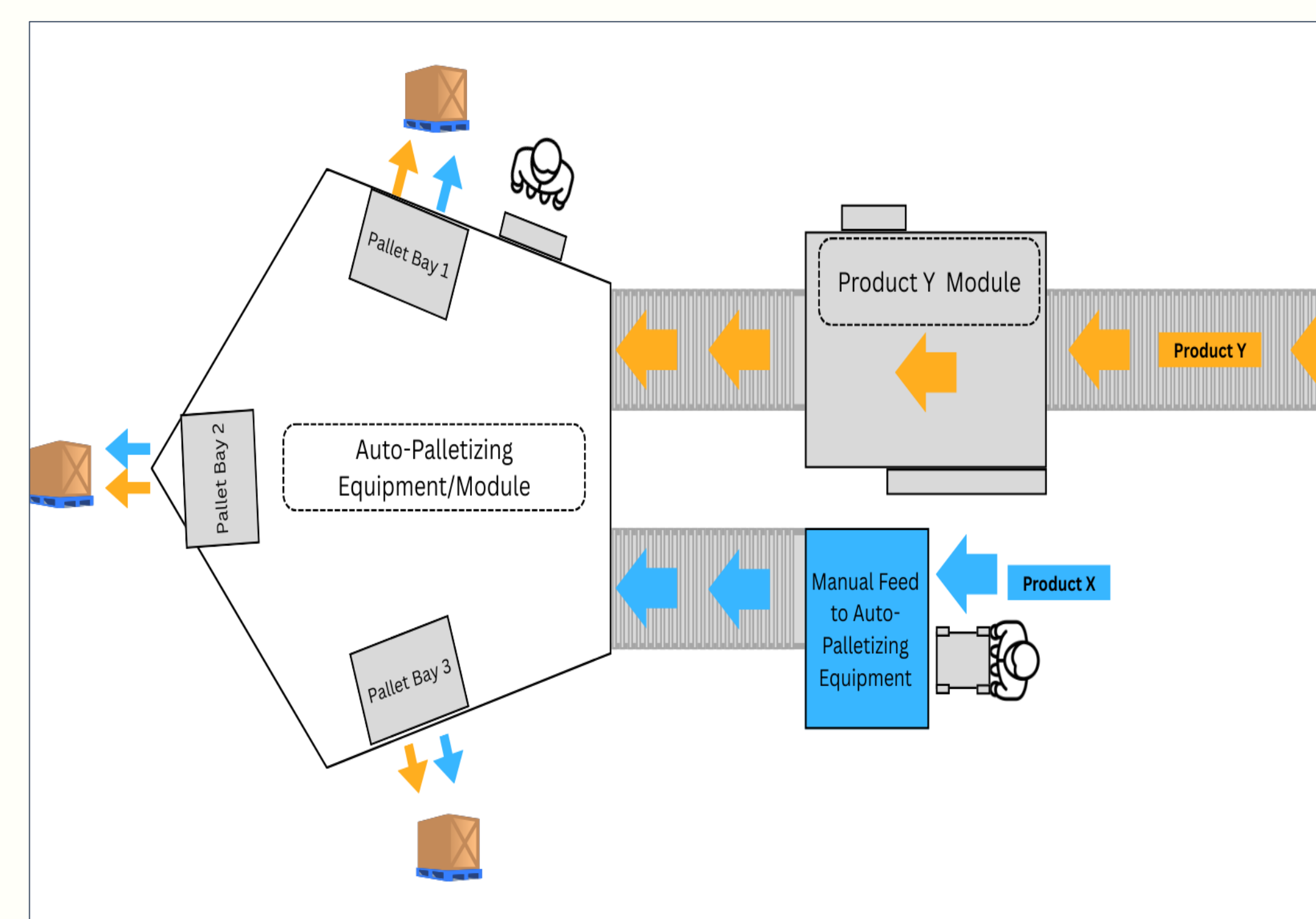


Figure 1

Product Flow and Equipment Integration

Results

The implementation of the Manual feeder to Auto Palletizing Module led to a notable improvement in cycle time. A comparative analysis between the manual and automated processes showed a consistent 80% reduction in palletizing cycle time, from 25 minutes per pallet manually to 5 minutes with automation. The manual process required approximately 18 seconds per tray, for inspection, handling, and system transactions, while the automated system reduced the cycle time to 4 seconds per tray. This allowed the production line to operate at a higher throughput and better align with increasing demand. In addition to speed, the quality of the palletizing process improved significantly. Data collected post-implementation revealed a measurable reduction in palletizing errors, such as misalignments and stacking inconsistencies, which previously contributed to rework and variability in downstream processes. Figures 2 and 3 illustrate the process flows and highlights the contrast between the manual and the new automated process.

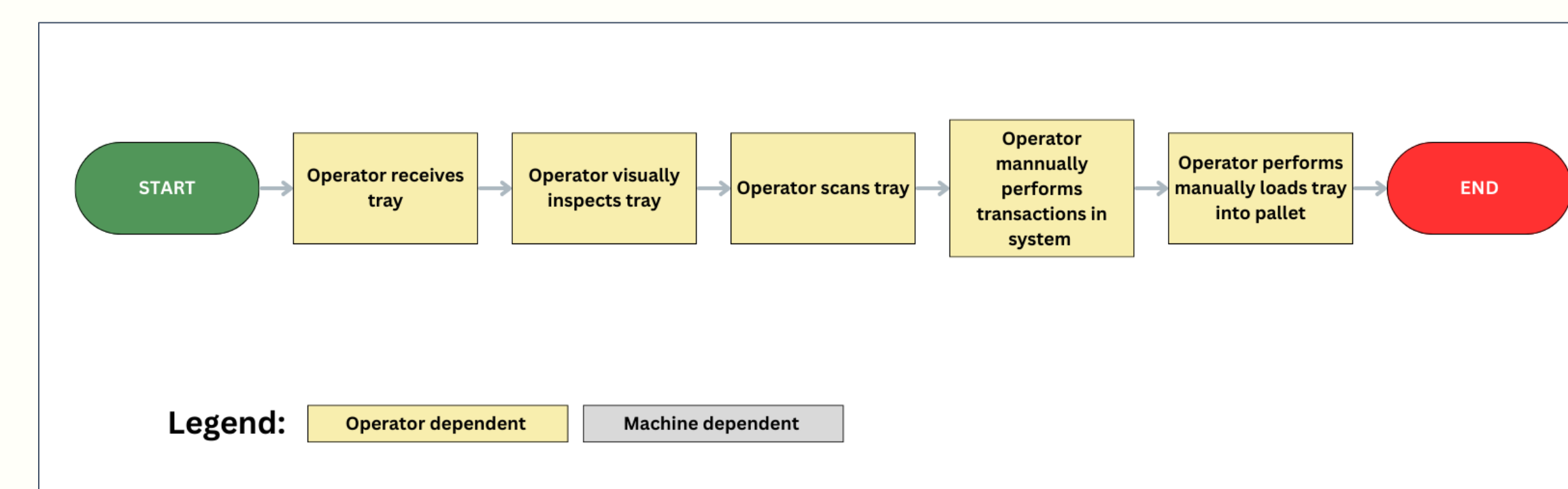


Figure 2
Manual Process Diagram

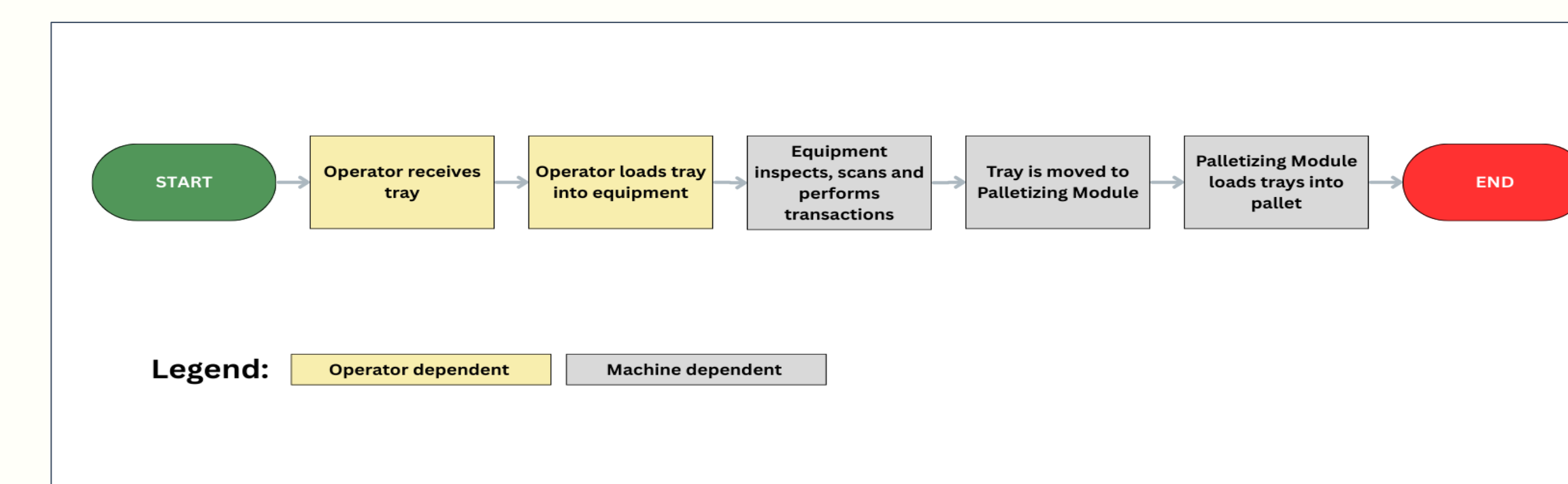


Figure 3
New Process Diagram

Conclusion

The introduction of automation into the palletizing process had a transformative effect on manufacturing performance. The system enhanced consistency and productivity while simultaneously reducing the physical demands placed on operators. These improvements contributed to a more stable and scalable production environment.

This project was initiated to streamline material handling transactions, reduce operator burden, and enable automated management of tasks that were previously performed manually one by one. By integrating a manual feeder into an existing Auto Palletizing Module, the initiative aimed to improve process flow and reduce operational complexity. The approach combined structured workflow analysis, system validation, implementation planning, and post-integration monitoring to ensure smooth and effective deployment.

The results confirmed the benefits of automation in terms of reduced cycle times, improved process consistency, and enhanced ergonomic conditions for operators. These outcomes highlight the effectiveness of targeted automation strategies in optimizing specific process areas without requiring full system overhauls. Moreover, the design provides a scalable model for future automation initiatives, supporting both operational efficiency and human-machine collaboration. Future efforts should focus on replicating this approach across additional lines and leveraging real-time data for continuous performance improvement.

References

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