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## Abstract

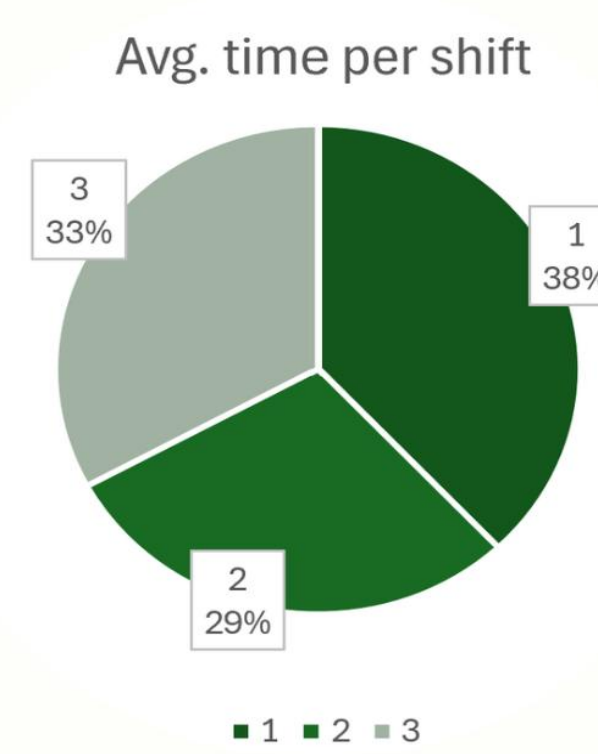
Inefficient shift handovers at MM Packaging in Manati, Puerto Rico, caused approximately 30 minutes of downtime per transition, reducing productivity in the Printing and Folding departments. The project applied the DMAIC methodology to identify root causes, including inconsistent documentation, poor communication, and delays in equipment handling. Improvement actions implemented a standardized shift handover checklist, structured communication protocols, and organized equipment storage, resulting in a 50% reduction in average handover time, from 30 to 15 minutes. Control measures such as Standard Operating Procedures, supervisory audits, and periodic training ensured the sustainability of improvements. The project demonstrates that structured and standardized shift handovers significantly enhance workflow continuity, reduce downtime, and improve overall operational efficiency in high-volume manufacturing processes.

## Introduction

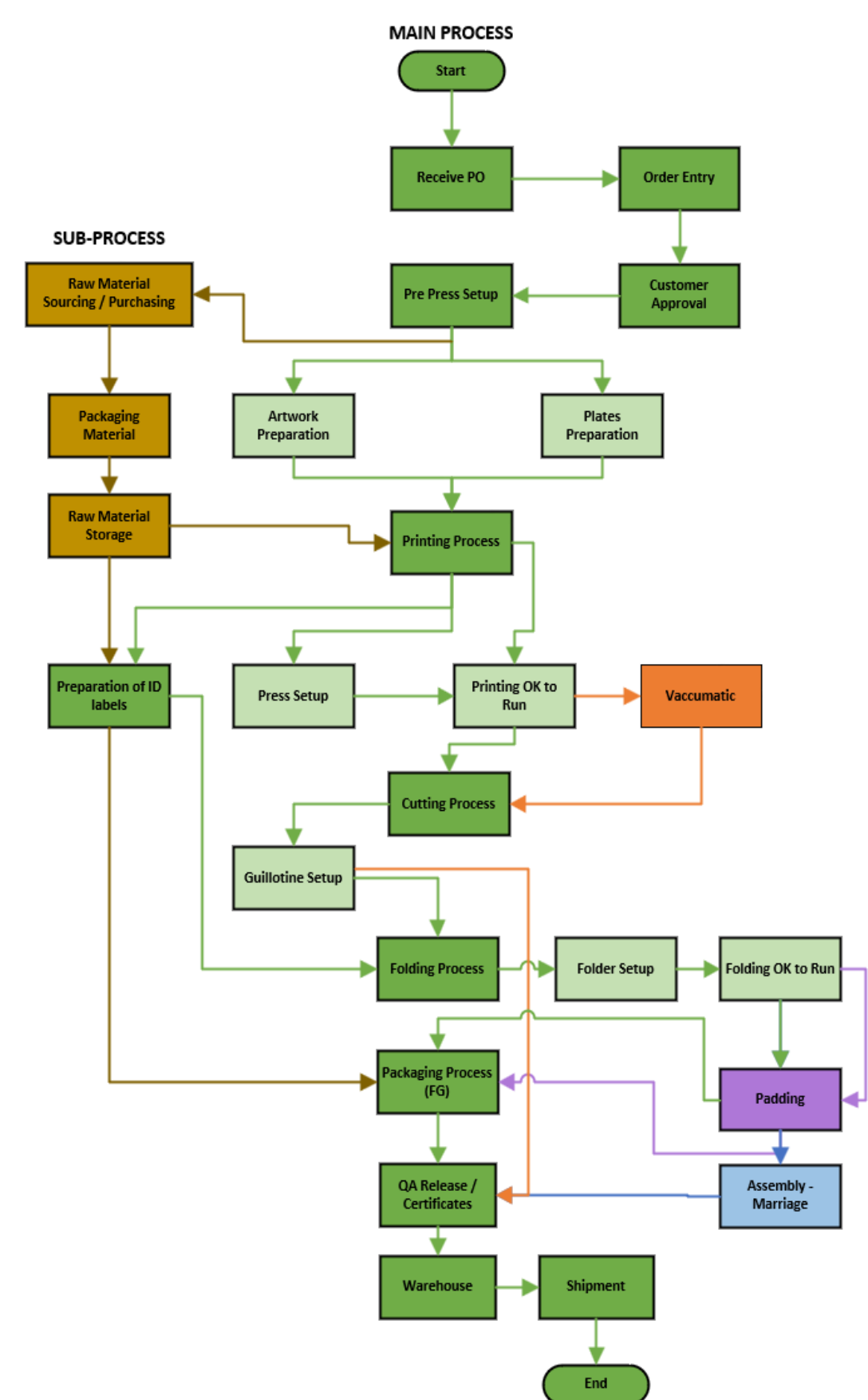
Efficient operations were crucial in the pharmaceutical packaging industry, where stringent regulations and fluctuating customer demand meant that companies had to maintain high levels of productivity and quality. MM Packaging is a pharmaceutical packaging plant located in Manati, Puerto Rico. The plant specializes in the production of secondary pharmaceutical packaging, delivering to both Puerto Rico and the USA. The plant focuses on producing inserts (topserts and outserts), piggybacks, and various label formats. MM Packaging served a critical role in the supply chain by delivering high-quality printed sheets and labels that supported the safe distribution of medicines. The company had developed expertise in handling multiple components, and large-volume orders, supported by advanced inspection technologies. To sustain its production capacity, MM Packaging operated on a three-shift schedule designed to ensure a continuous flow of operations. Despite this structure, inefficiencies remained during shift transitions, which disrupted workflow and reduced overall output, where sustaining a constant workflow across shifts was essential to overall performance.

## Problem

The project analyzed the inconsistency in the shift changeover process in the printing and folding department. Despite the three-shift structure, transition periods between outgoing and incoming operators remained unstructured, causing approximately 30 minutes of downtime per changeover. This directly reduced production output, particularly in the printing and folding departments, where interruptions resulted in the loss of thousands of sheets or finished goods units.



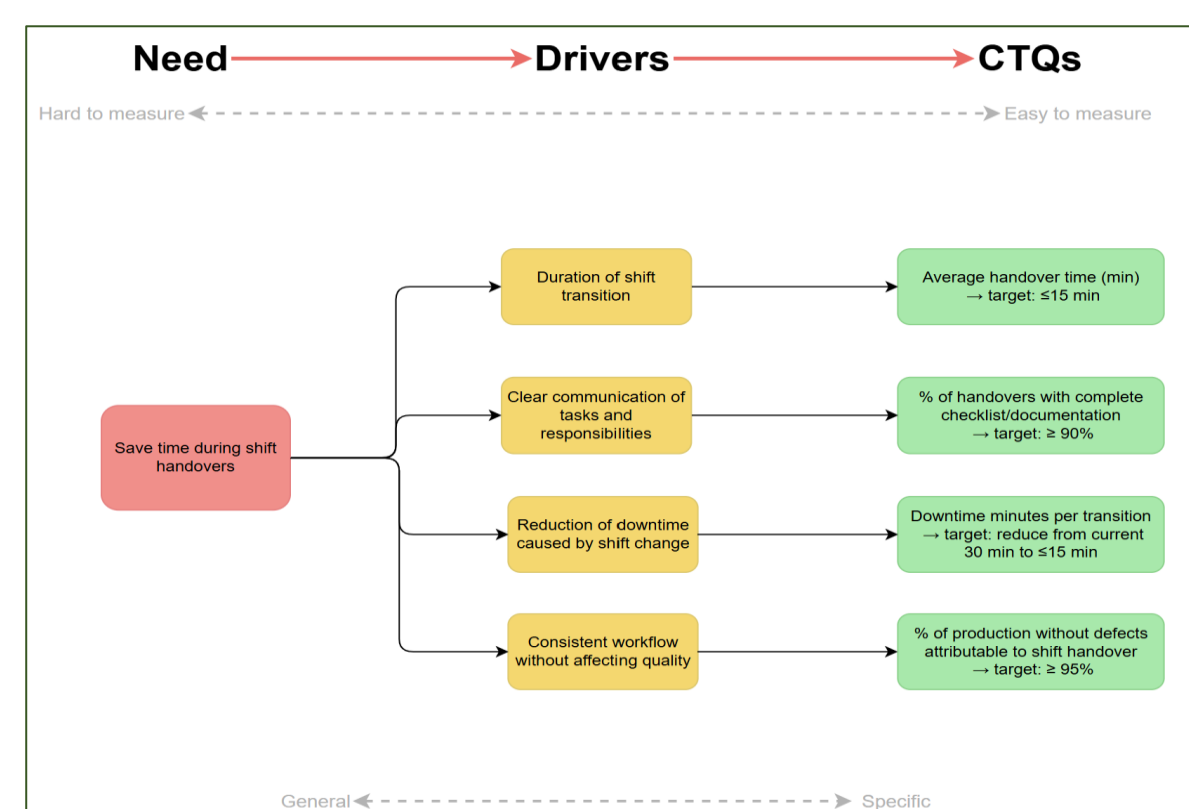
The flowchart provides an overview of the entire operation, offering a visual summary of the process analyzed from start to finish. It identifies key stages, handover points, and areas where time losses were observed, serving as a baseline for improvement actions.



## Methodology

The methodology was conducted using the DMAIC framework, which included each phase that guided the work through a sequence of actions.

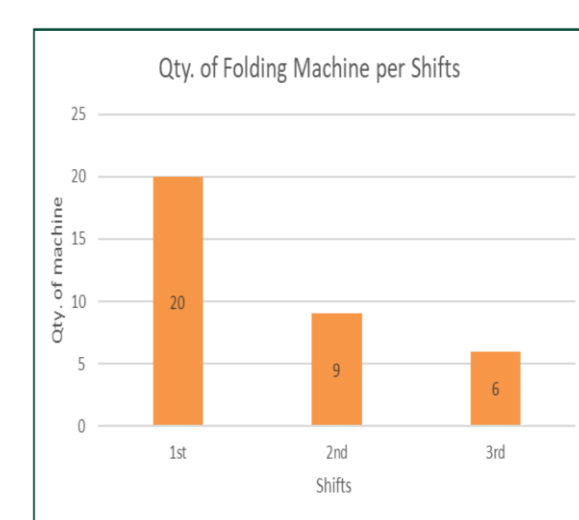
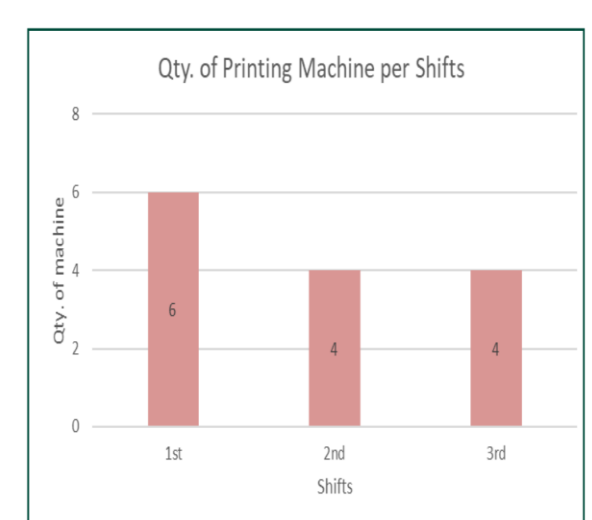
### DEFINE PHASE



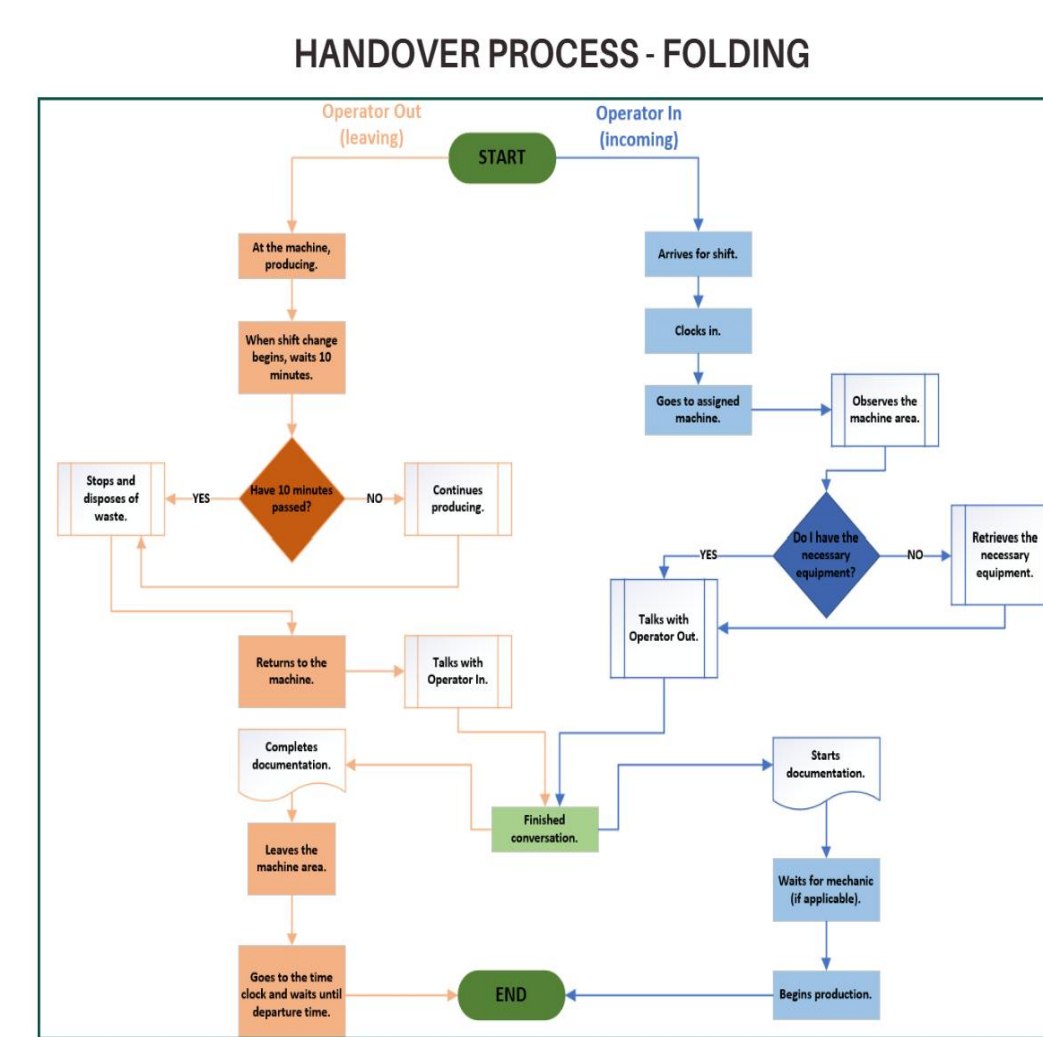
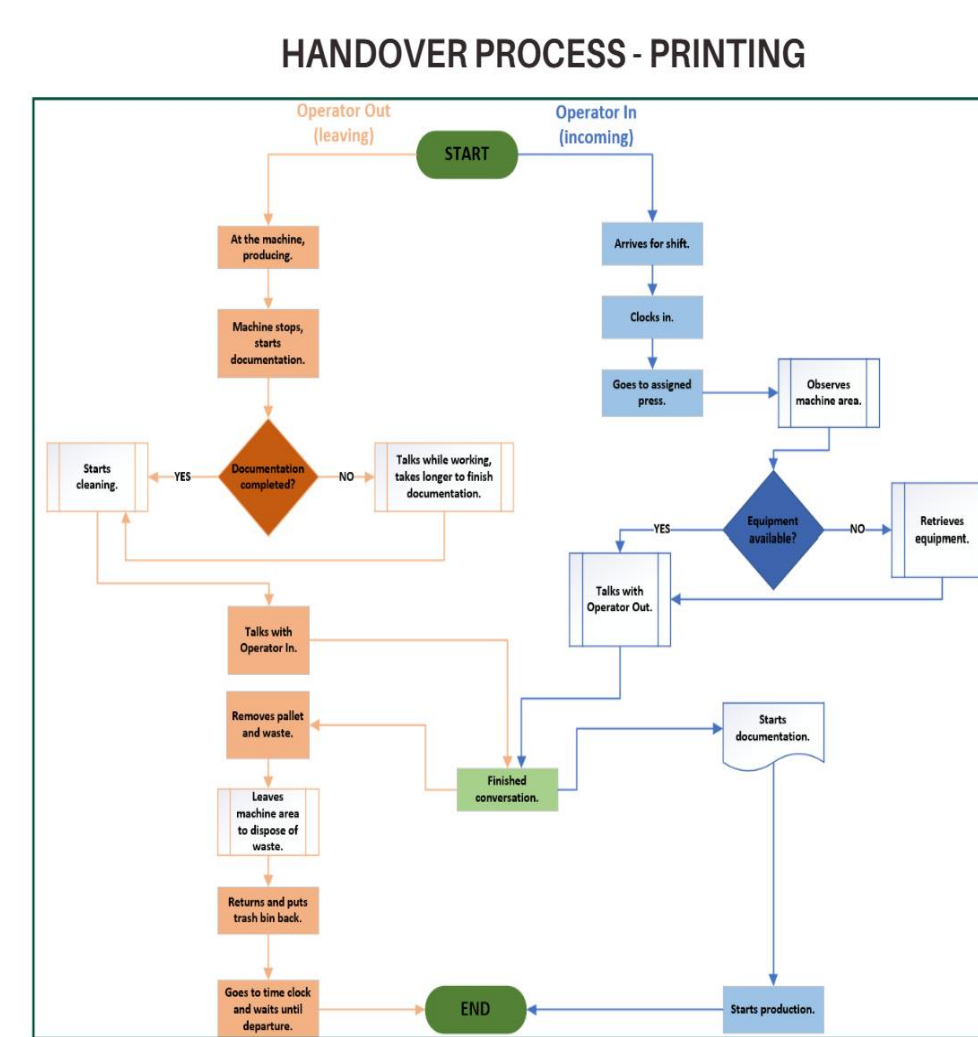
A CTQ diagram was developed to define key requirements affecting handover efficiency and to align measurement efforts with customer and process needs.

### MEASURE PHASE

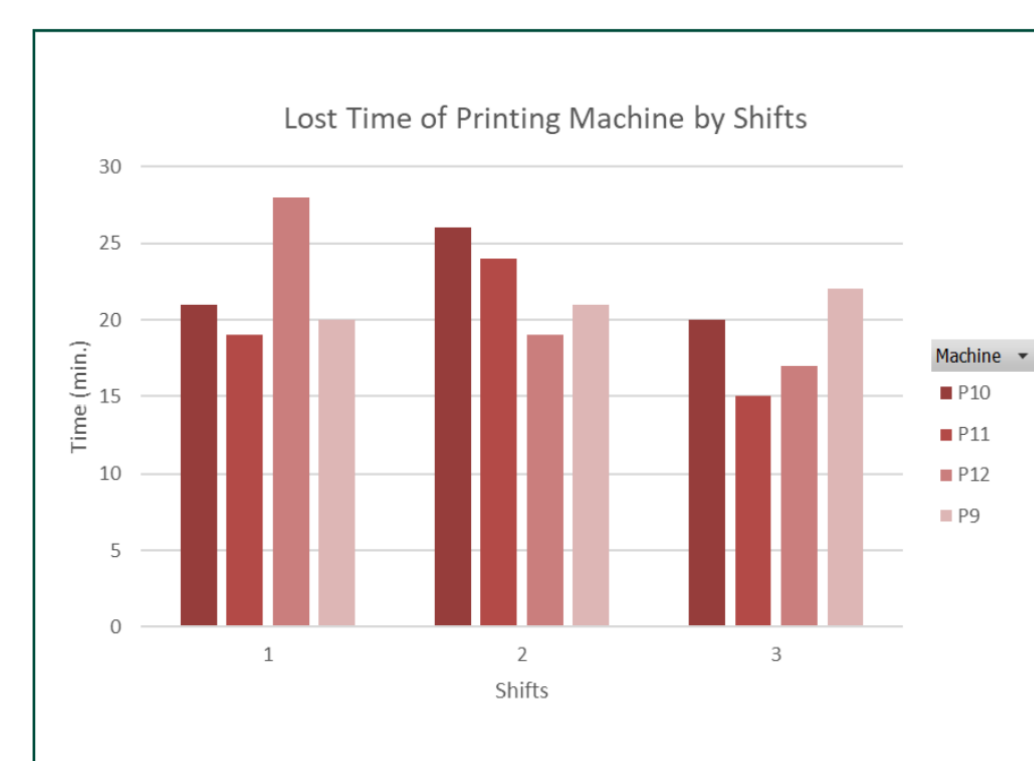
Perform a data collection plan. The variables measured were lost production time and handover duration (continuous data in minutes). The tools used included a digital stopwatch, and approximately a 30-sample design was collected (3 per day).



The flowchart represented the tasks of the outgoing operator (the one finishing the shift) and the incoming operator (the one starting the shift).

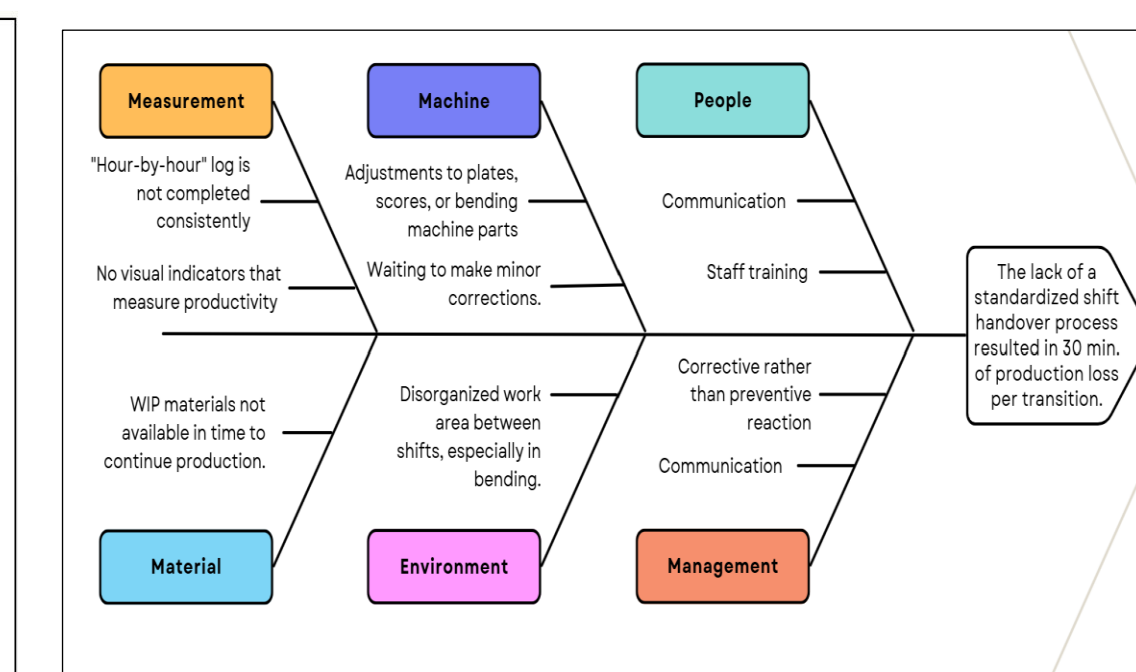
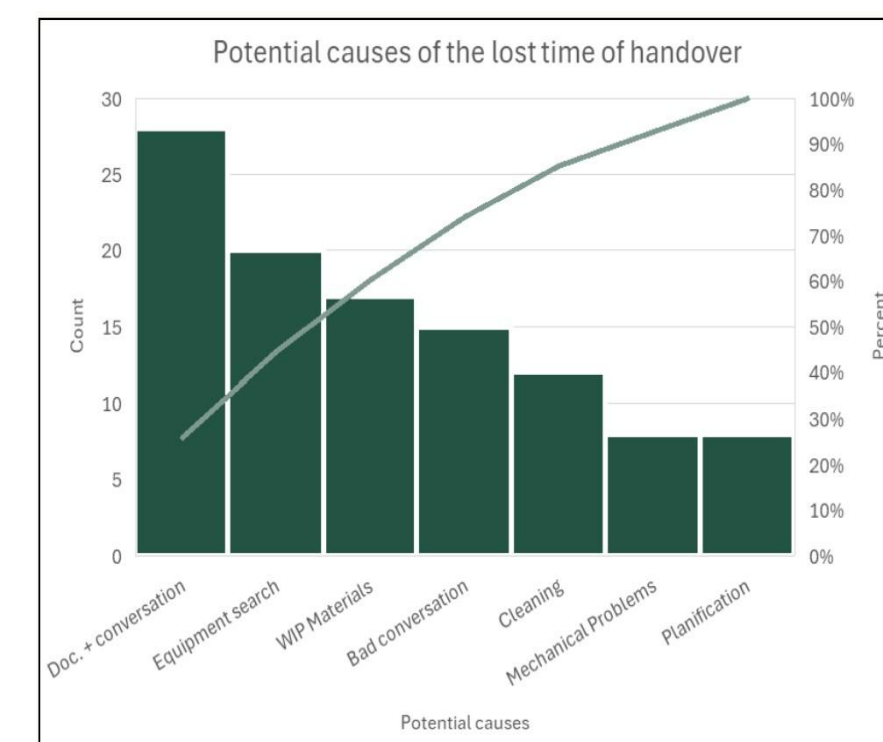


Data collection identified the total lost time during handovers printing and folding department, gathered over three days. The printing graphs illustrate the increase in lost time, highlighting that the presses P9 and P12 took over 27 minutes to complete the process. In the folding department, machines were grouped by format to ensure consistent data representation. This dataset revealed that Group C lost about 30 minutes on average. Overall, interruptions caused an estimated loss of 1,500–1,600 sheets per press and 400–500 finished units per folder.



### ANALYZE PHASE

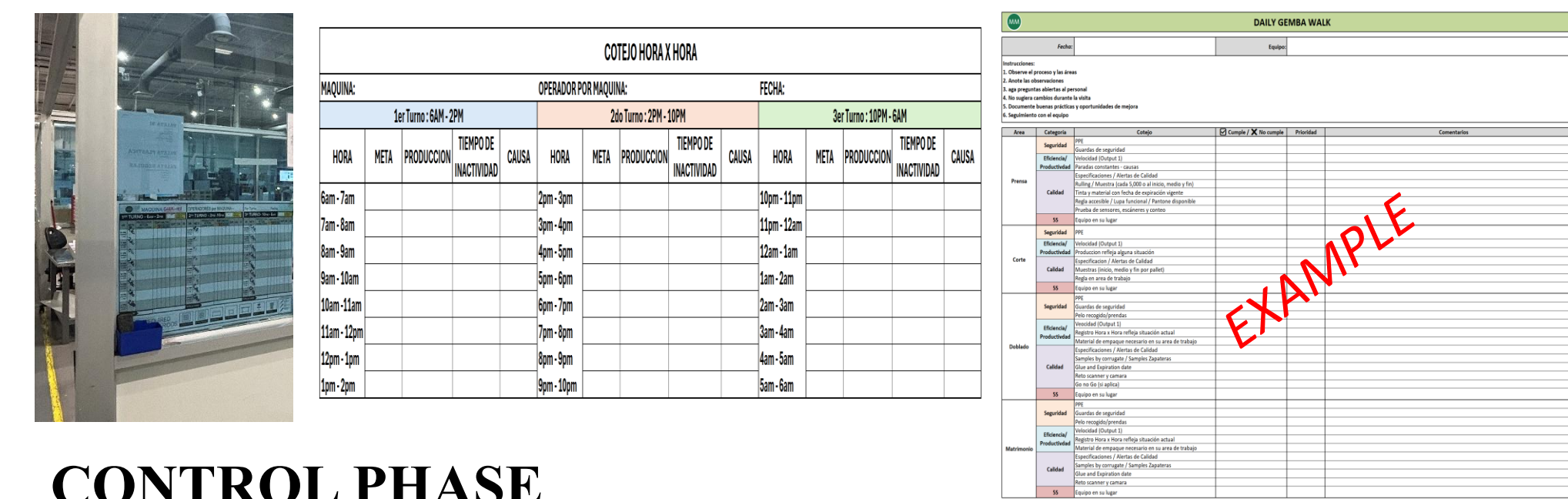
The Pareto graph illustrated the potential causes of lost time in the printing and folding departments. It presented eight causes impacting the variable of lost time during handovers in both departments. The main cause identified was the time consumed in completing the required documentation while speaking with a peer. The second major cause was the time lost searching for equipment and materials needed for the machines.



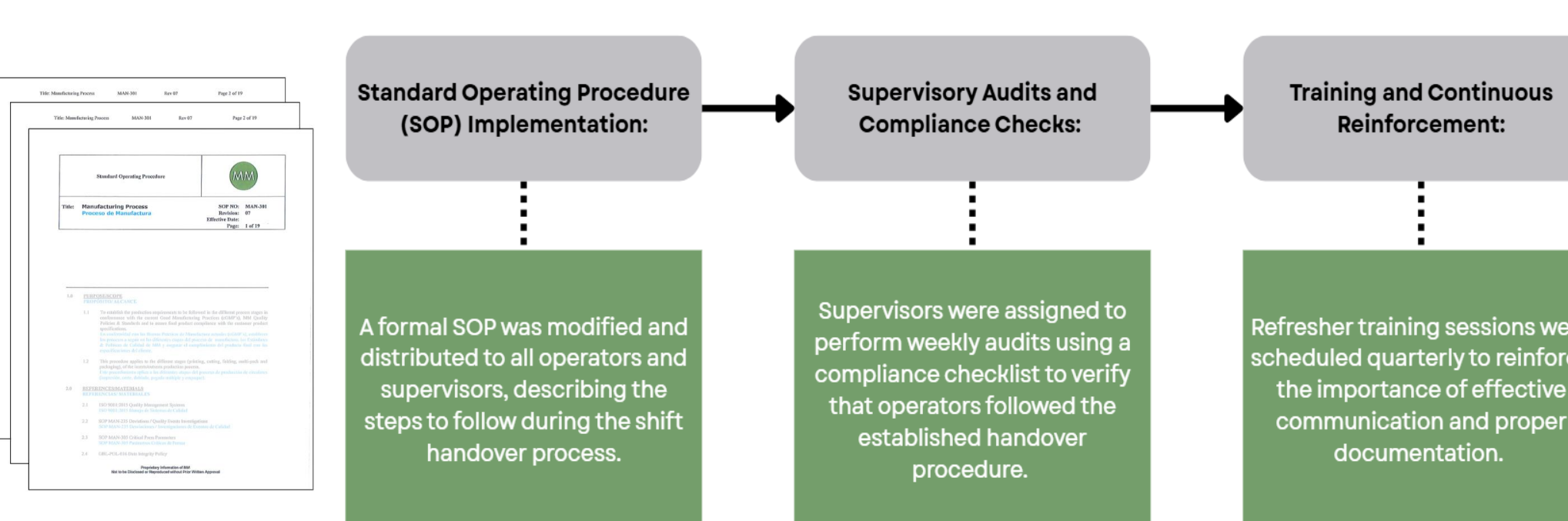
## Results and Discussion

### IMPROVE PHASE

| Improvement Action                 | Department         | Responsible        | Start Date | Impact                     |
|------------------------------------|--------------------|--------------------|------------|----------------------------|
| Implement Shift Handover Checklist | Printing & Folding | Supervisors        | Week 39    | Reduce documentation delay |
| Establish Communication Protocol   | Both               | Operations Manager | Week 40    | Improve handover clarity   |
| Implement Hour-by-Hour Log         | Printing           | Supervisors        | Week 41    | Track shift performance    |



### CONTROL PHASE



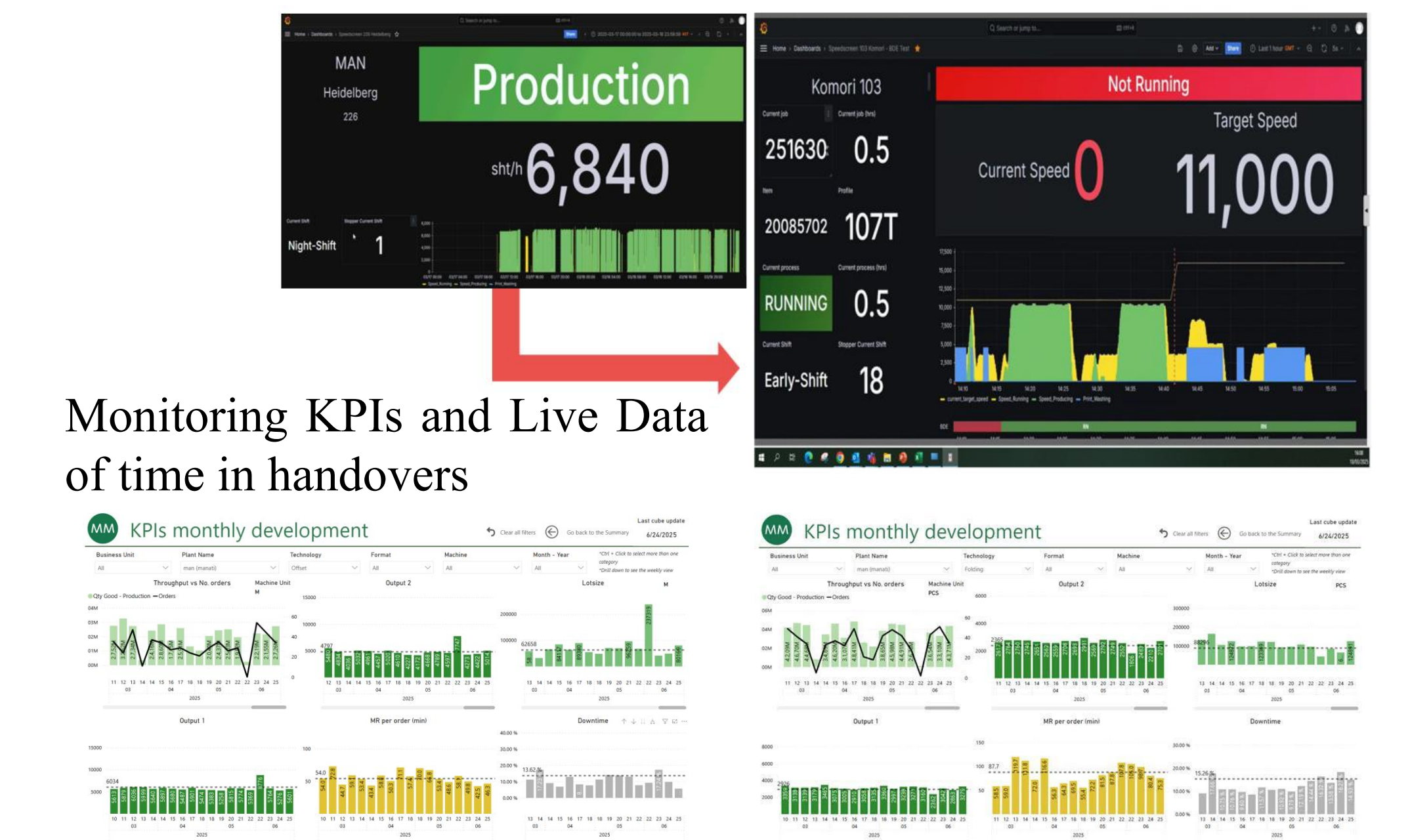
The implementation of these actions effectively reduced the average shift handover time by approximately 50%, reaching an average of 15 minutes per transition. Operators demonstrated greater awareness of communication efficiency and better organization when preparing for the next shift. Additionally, improvements were observed in equipment availability, documentation accuracy, and overall coordination between the printing and folding departments. These results confirmed that the proposed actions successfully addressed the root causes identified in the Analyze phase and contributed to a more structured and productive handover process.

## Conclusions

The project optimized the shift handover process at MM Packaging by addressing key causes of production loss. Implementing standardized checklists, communication protocols, and equipment management reduced handover time by half and improved coordination across shifts. Control measures such as SOPs, audits, and training sustained these results over time. Overall, the project demonstrated that structured process optimization enhances efficiency, minimizes downtime, and supports continuous improvement within the organization.

## Future Work

Next steps include monitoring long-term results, expanding the standardized handover process to other departments, and exploring new strategies to minimize production losses.



## Acknowledgements

| ESTIMATED   | USED   | PROJECT COST  |
|---|--|---|
| \$1,000   | \$804  | The chart summarizes the estimated and actual project expenses, showing that the implementation was completed under budget. |
| <ul style="list-style-type: none"> <li>Personnel</li> <li>Training &amp; Meetings</li> <li>Data Collection &amp; Analysis</li> <li>Software &amp; Tools</li> <li>SOPs &amp; Visual Aids</li> <li>Contingency</li> </ul> | <ul style="list-style-type: none"> <li>Training session = \$350</li> <li>Trial &amp; Error of SOP = \$80.00</li> <li>Data Collection = \$45.00</li> <li>Use of AI Tool = \$54.00</li> <li>Visual Aids = \$25.00</li> <li>Contingency = \$250.00</li> </ul> | Total savings: \$196 under budget   |

I would like to express my sincere appreciation to MM Packaging, Manati, for providing the opportunity to conduct this project within the operational area of its manufacturing plant. Special thanks are also extended to our sponsor, Benjamin Nelson, MD, and his entire team for their support throughout the process. Finally, sincere gratitude is given to the Polytechnic University of Puerto Rico and our advisory professor, Dr. Héctor J. Cruzado, for their valuable guidance and recommendations that continue to contribute to the advancement of the industry.