Optimizing Line Balancing to Achieve Rate 7 Efficiency at Boeing

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Abstract

This project addresses the production bottlenecks in the Moving Bin Buckets Line at Boeing South Carolina with the goal of achieving a production Rate 7 for the Boeing 787 program. Through time studies and lean analysis, inefficiencies were identified, and an optimized layout with resource reallocation was proposed. The study applied takt time principles, identified a critical bottleneck, and introduced a dedicated 'runner' role to improve process flow. The implementation of these changes resulted in meeting the takt time target of 9.2 minutes per unit. These improvements showcase the effectiveness of lean tools in real-world aerospace manufacturing challenges.

Introduction

The Boeing Company is a leading global aerospace company that designs, manufactures, and services commercial airplanes, defense systems, and space technologies. The surges in global demand for the Boeing 787 program at the Interiors Responsibility Center at Boeing South Carolina is a critical contributor to the company's wide-body aircraft production. To meet market demand, the Moving Bin Buckets Line, responsible for assembling and delivering structural components to the final assembly, must support Rate 7, which is equivalent to producing 7 aircraft per month. Achieving this rate requires each workstation along the production line to meet a takt time of 9.2 minutes. The current layout of the line was unable to support this rate, with several stations exceeding allowable cycle times, causing bottlenecks and inefficiencies.

The Moving Bin Buckets Line, a critical component of the assembly process, was tasked with ramping up production from Rate 5 (30 parts per shift) to Rate 7, equating to 42 parts per shift. This required reducing takt time from 13.0 minutes to 9.2 minutes per unit. Initial evaluations identified the Moving Bin Buckets Line as a bottleneck in achieving the revised production goals.
The objectives of this project are to achieve a consistent Rate 7 production target on the Moving Bin Buckets Line without compromising product quality or operator efficiency, and to establish a balanced workflow that optimizes productivity while managing MT's workload effectively. To accomplish this, sustainable process improvements were implemented, including workstation rebalancing, cycle time reduction strategies, and layout optimizations to eliminate bottlenecks and improve line flow.

Background

Lean manufacturing principles, rooted in the Toyota Production System [1], have long been applied in aerospace to improve efficiency and eliminate waste. Takt time is a core concept in lean manufacturing, defined as the rate at which a finished product must be completed to meet customer demand [2]. Takt time is central to synchronizing workflow [3].

Line balancing, cellular layout, and standard work are tools used to ensure that no station exceeds takt time. Past studies [4] have shown that imbalances in cycle time among workstations reduce throughput and increase non-value-added time.

Manufacturing aircraft interiors involves intricate manual processes influenced by operator skill variability. These factors pose challenges in achieving a balanced assembly line. Prior studies have highlighted that inadequate task distribution and lack of synchronization across stations lead to inefficiencies, especially during rate transitions [5]. Successful line balancing strategies often involve workload redistribution, role adjustments, and continuous monitoring. Benchmark studies within aerospace and other complex manufacturing sectors reveal that increasing production rates require proactive planning and sometimes additional staffing or tool support [6].

Methodology

A total of eight time studies were conducted on the Moving Bin Buckets Line focusing on tracking cycle times at each station under the Rate 7 production target. Each workstation was evaluated for its value-added (VA), non-value-added (NVA), and necessary but non-value-added (NNVA) activities. In parallel, staffing levels and shift structures were reviewed to understand labor distribution and identify inefficiencies. This data was compared against the revised takt time of 9.2 minutes to pinpoint operational bottlenecks and overburdened stations. The assessment also involved a detailed review of the current line layout, mapping operator workloads and task distribution to highlight areas of imbalance. Several stations were found to be exceeding their allowable cycle times.

To resolve imbalances, multiple scenarios were developed:
- Reallocate existing MTs across stations.
- Introduce a runner to manage the delivery and handling of bulk potting mix.
- Combine both approaches.

These interventions were selected for their potential to optimize cycle times and improve line flow without increasing headcount.

Results and Discussion

After implementing the proposed changes, the revised layout and staffing model enabled all stations to achieve or remain below the 9.2-minute takt time. Table 1 outlines the current layout and staffing levels, along with the recommendations for improvement. To support the existing structure at Rate 6.9, it is recommended that one additional MT be assigned to Station 2, which currently exceeds the takt time by 12.2 minutes.

Table 1
Current Layout and staffing levels

Shift	Headcount (HC)	Shift Target	Notes
Current	8 MTs (7 + 1 Team Lead)	42 Bin Buckets	Production managed by current staffing
Proposed	9 MTs (8 + 1 Team Lead)	42 Bin Buckets	Add 1 MT at Station 2 to reduce over-takt workload

Furthermore, to achieve a more balanced workload across the production line, the clean surface task should be reallocated from Station 5 to Station 6. Figures 1 and 2 show the layout across stations before improvements.

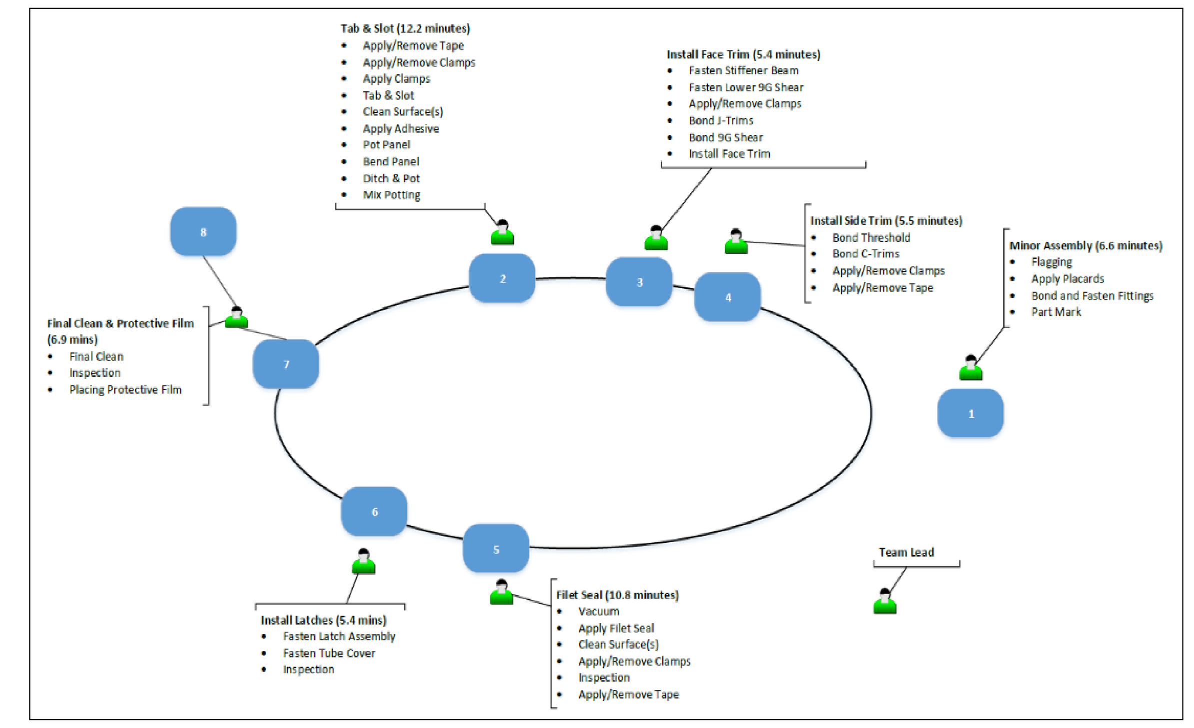

Figure 1
Current Layout

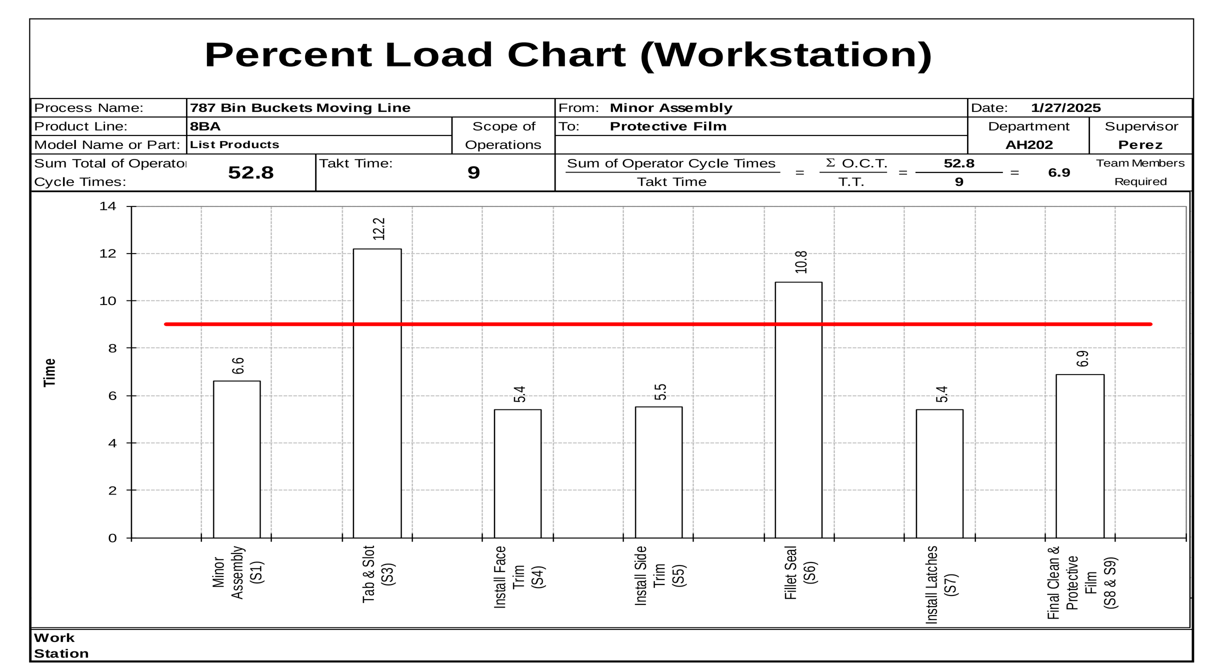

Figure 2
Load Chart before improvements

Following the application of the proposed methodologies and subsequent improvements, Figures 3 and 4 illustrate the significant enhancements in the production flow and task allocation. Notably, the addition of one MT to Station 2 has effectively addressed the previous excess in takt time, bringing all processes in line with the ideal target of 9 minutes or less for Rate 7.

Additionally, the strategic reallocation of the clean surface task from Station 5 to Station 6 has further contributed to a more balanced workload across the production line. This comprehensive approach not only alleviated the workload imbalances but also ensured that all stations now perform optimally, thereby reinforcing operational efficiency and maintaining production standards well within the established takt time parameters.

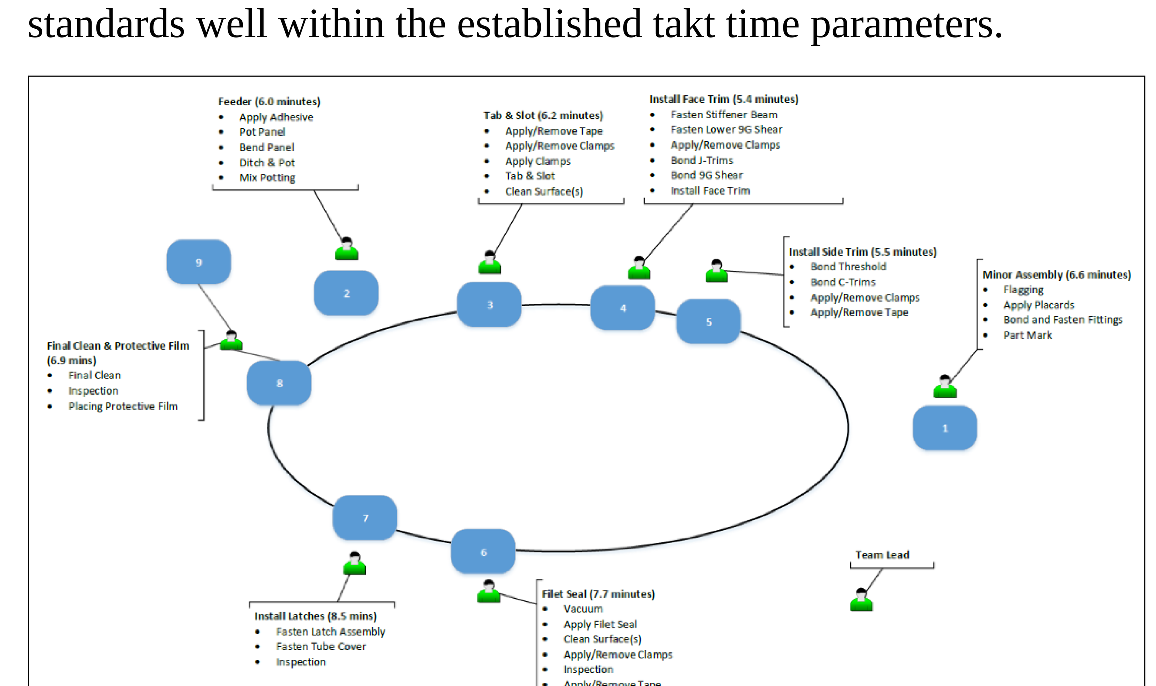

Figure 3
Recommended Layout

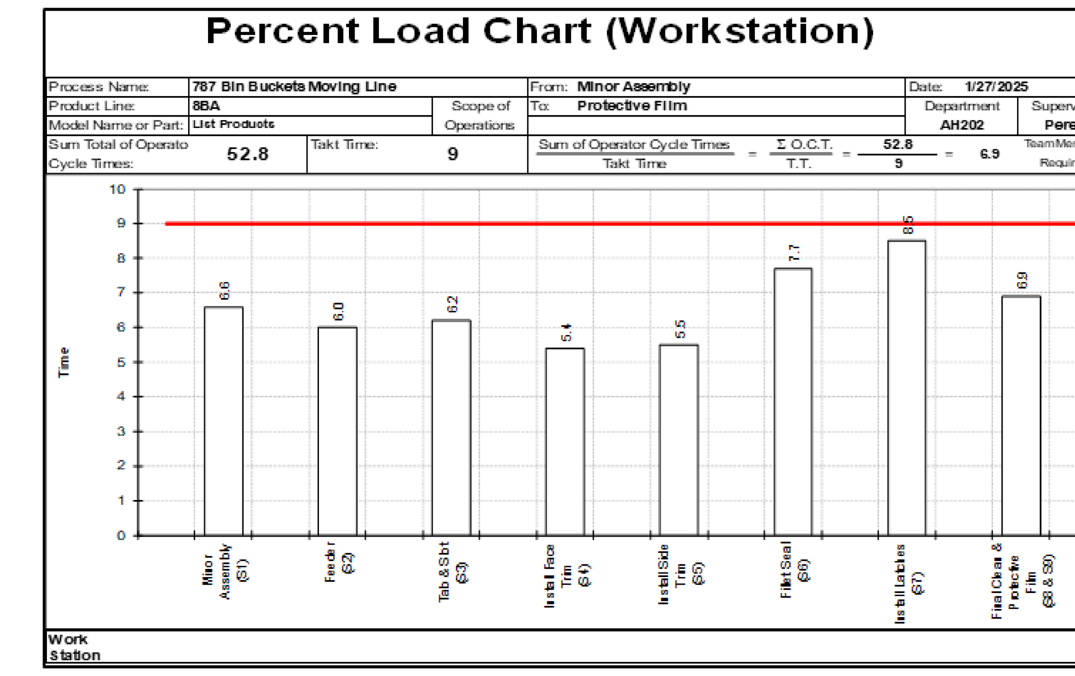

Figure 4
Load Chart after improvements

The introduction of a dedicated runner significantly reduced lost time due to missing parts, while staff reallocation balanced workload between high and low cycle-time tasks. These changes led to a smoother production flow and removed the primary bottleneck at Station 3.

Conclusion and Recommendations

The analysis and implemented changes on the Moving Bin Buckets Line successfully addressed the inefficiencies that hindered the achievement of Rate 7. By reallocating tasks, adjusting staffing, and introducing a dedicated runner, all stations aligned with the new takt time of 9.2 minutes. These results demonstrate that targeted lean interventions can optimize production flow without sacrificing quality or employee well-being.

For continued improvement, it is recommended that the layout and staffing be periodically re-evaluated using cycle time data, additional lean training be provided to reinforce continuous improvement principles and the runner model be considered for other production lines facing similar bottlenecks.

References

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