Optimization of the Production Process of Transfer Switch in a Manufacturing Environment

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Abstract

This project aimed to optimize the manufacturing process of ATS-100A automatic transfer switches in a manufacturing environment. Production was limited to 11 units per week on average due to inefficiencies, bottlenecks, and non-value-added activities. When the project began, in the first five weeks 55 units were produced compared to 120 planned units, evidenced by a difference of 65 units. The DMAIC methodology was applied to analyze the process, including time studies at workstations and the use of tools such as the Pareto chart to identify root causes. In the improvement phase, actions such as the establishment of standards, unification of production plans, and definition of minimums and maximums in inventories were implemented. These improvements aimed to reduce cycle times and increase the manufacturing production output and capacity to 24 units per week.

Introduction

RK Power is a manufacturing plant in the Caribbean dedicated to the production of electrical components, including automatic transfer switches (ATS). Among its standard products, the ATS-100A represented a relevant component due to its high market demand and strategic importance within the manufacturing portfolio.

Figure 1 illustrates the weekly production outputs of the ATS-100A production line during the first evaluation period. Weekly production fluctuated between 8 and 14 finished units, with an average of 11 units per week, remaining below the target production goal of 24 units per week. These production limitations were associated with operational inefficiencies, process bottlenecks, workstation variability, and non-value-added activities identified through the manufacturing process of the ATS-100A. Consequently, a significant gap existed between current production capacity and market demand.

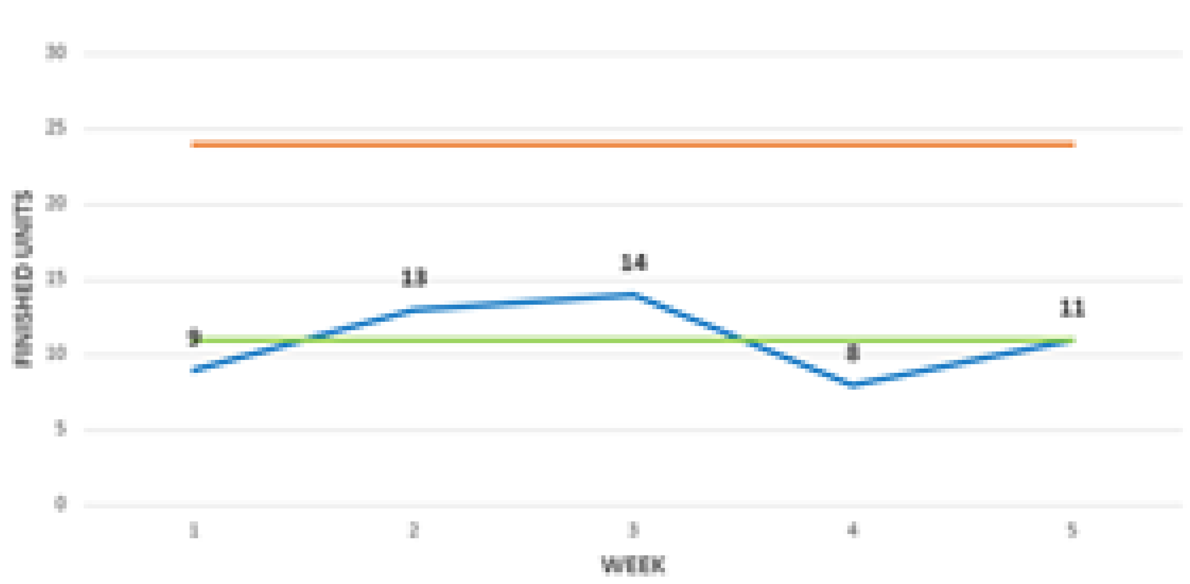

Figure 1
Finished ATS-100A per Week

The objective of this project was to increase the weekly production capacity of ATS-100A units from 11 units per week to 24 units per week by improving production efficiency, reducing operational constraints, minimizing workstation variability, and eliminating non-value-added activities. Improving the manufacturing output of the ATS-100A production line would support RK Power's ability to meet market demand, improve production efficiency, and strengthen the company's competitive position within the electrical components market in the Caribbean.

Literature Review

DMAIC methodology provides a structured approach to improve processes through the phases Define, Measure, Analyze, Improve, and Control, allowing the identification of inefficiencies and bottlenecks in production. However, to achieve a more complete improvement, it is necessary to complement it with methodologies focused on reducing waste.

Lean Manufacturing focuses on eliminating unnecessary movements, waiting times, and inefficient processes, improving workflow and increasing production capacity.

Bottlenecks are constraints that affect system performance. To identify them and measure their impact, tools such as time studies and process mapping are used. Time studies allow measuring task duration and detecting inefficiencies, while process mapping helps visualize workflow, identify redundancies, and find opportunities for improvement.

Methodology

This project was executed using DMAIC (Define, Measure, Analyze, Improve, and Control) methodology to improve the production performance of the ATS-100A assembly line at RK Power.

During the Define phase, the main problem identified was a production capacity limited to 11 units/week, below market demand and the desired production level. The project objective was to increase production to 24 units/week by improving process flow and reducing operational constraints.

In the Measure phase, time studies were conducted at each workstation to establish a production baseline. Cycle times, waiting times, downtime events, and weekly production output were monitored during multiple production cycles. The analysis showed that only 55 units were completed over a five-week period compared to the planned target of 120 units.

Figure 2 shows the ATS-100A process flowchart, including the sequence of operations and estimated processing times ranging from 5 to 40 minutes per activity. The initial assembly operations required between 20 and 40 minutes, while testing, cabinet assembly, inspection, and packaging required approximately 5 to 10 minutes each. The process analysis identified a total lead time (LT) of approximately 720 minutes and a value-added time (VA) of 360 minutes, indicating that nearly 50% of the total production time corresponded to waiting periods, delays, and non-value-added activities. These findings confirmed operational inefficiencies and process bottlenecks affecting ATS-100A production capacity.

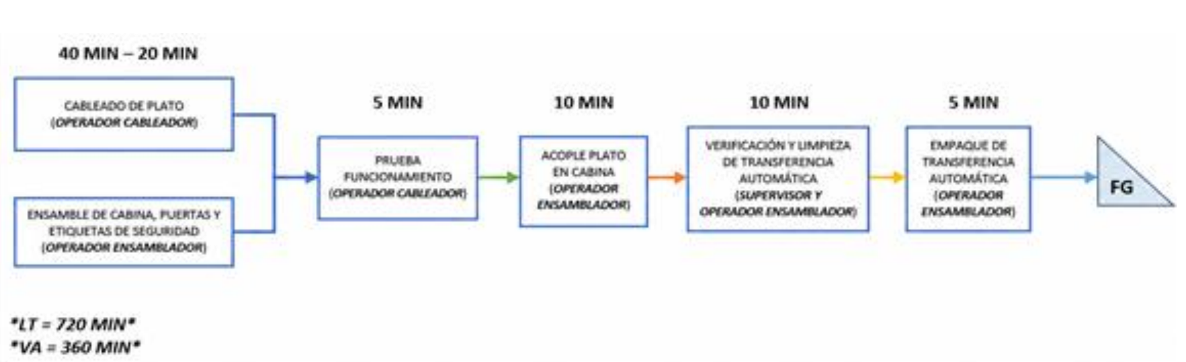

Figure 2
ATS-100A Process Flowchart

During the Analyze phase, cycle time data and production records were evaluated to identify bottlenecks affecting the ATS-100A manufacturing process. The analysis showed variability in processing times, workstation delays, and production inconsistencies that contributed to a production gap of 65 units, with only 55 units completed compared to the planned target of 120 units over a five-week period. A Pareto analysis was performed to identify the primary factors contributing to low throughput and reduced manufacturing efficiency.

Figure 3 illustrates the fishbone diagram developed to classify the root causes affecting production performance. The analysis identified critical issues such as process variability, inconsistent work instructions, supplier delivery delays, inventory shortages, lack of operator training, equipment downtime, inaccurate production records, and absence of real-time monitoring. These inefficiencies affected workflow stability and restricted ATS-100A production capacity.

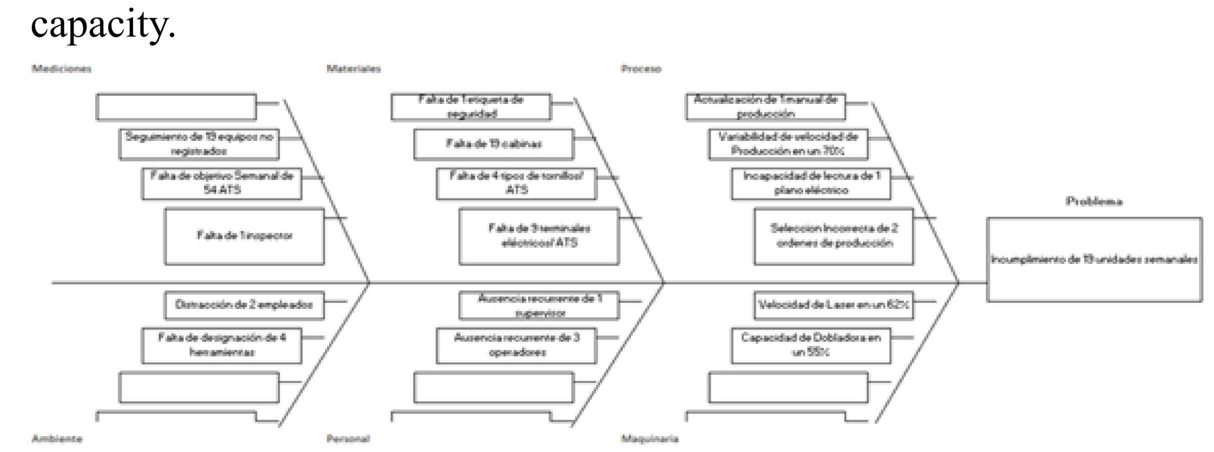

Figure 3
Fishbone Diagram

In the Improve phase, work procedure standards and operations were modified to reduce variability, workflow was reorganized, personnel were redistributed to balance workloads, and inventory controls were implemented to prevent material shortages and production interruptions.

Finally, actions corresponding to the Control phase were started through the definition of key performance indicators (KPIs), such as weekly production and cycle time per station, to monitor the impact of the improvements implemented.

Results and Discussion

In the first five weeks, ATS-100A production reached 55 units vs. 120 planned, creating a 65-unit gap and maintaining 11 units/week vs. the 24-unit target. Time and workflow analyses identified operational variability, high wait times, and workload imbalance. Figure 4, Pareto analysis showed process inconsistencies (28 units) and deviations from operational objectives (19 units) caused ~72% of lost production, followed by inventory delays (9), staff absences (6), and quality issues (3).

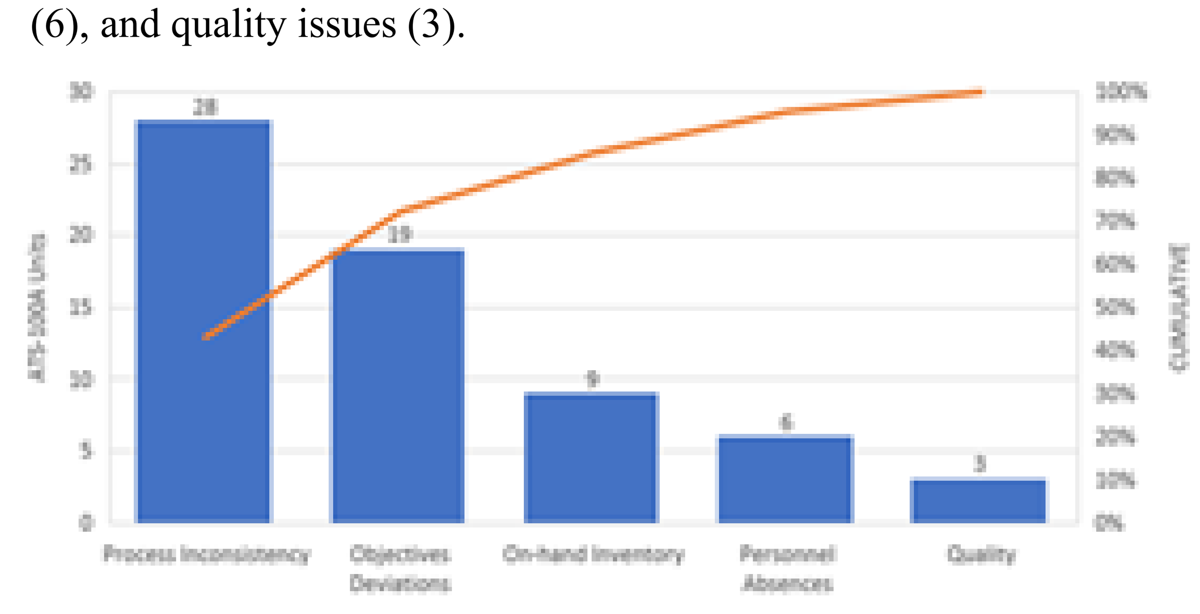

Figure 4
Pareto Analysis of ATS-100A Production Losses

Corrective actions implemented in the Improve phase included standardizing operational procedures, reorganizing workflow, redistributing personnel between stations, and establishing inventory controls through minimums, maximums, and cycle counts. These improvements increased production from 11 to the target of 24 units/week, reduced wait times from 8 to 1.5 hours, and lowered production time from 12 to 8 hours per batch of 5–6 ATS-100A units. The main causes of production losses—process inconsistencies (28 units) and operational deviations (19 units)—were significantly reduced, helping position the manufacturing line to meet RK Power's production and market demand targets. These results demonstrated the effectiveness of the implemented Lean Six Sigma corrective actions in reducing inefficiencies and improving operational performance.

Table 1
Before and After KPIs

Indicador	Before	After
Weekly Production Output	11 units/week	24 units/week target
5-Week Production Output	55 units	120 planned units
Production Gap	65 units	Reduced after improvements
Wait Times Between Activities	8 hours	1.5 hours
Standard Production Time	12 hours	8 hours
Main Cause #1	Process inconsistencies (28 units)	Reduced after standardization
Main Cause #2	Operational deviations (19 units)	Reduced after workflow improvements

Conclusions

The results confirmed that ATS-100A's production processes were limited by operational inconsistencies, variability in task execution, and interruptions in production flow and inventory management. These conditions limited production capacity to 11 units/week on average and generated a cumulative difference of 65 units during the first five weeks of evaluation.

The implementation of these improvements focused on the standardization of operational processes, workflow improvement, personnel redistribution, and inventory control, allowing optimization of production line performance and reduction of delays. Significant reductions were observed in wait times and in the standard time required to complete operations. Preliminary results demonstrated a positive impact on operational efficiency and supported the objective of increasing the production capacity of the ATS-100A to 24 units/week over a three-month period.

References

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