

Capacity Multipliers: Rapidly Scaling Production through Line Balancing and Critical Path Reduction

LFMcapital

BUSINESS PROBLEM

ShopSabre has achieved explosive growth over the past several years. The company's backlog has increased substantially as demand approaches and exceeds production capacity. Organically grown processes that were efficient at small volumes are creating challenges and production bottlenecks at scale. By the conclusion of this investigation, ShopSabre expects to double its factory space and needs to determine the best production methods to magnify the benefit of the added space. ShopSabre needs to reimagine its manufacturing processes and increase its production capacity to work down the backlog and recognize the revenue contained therein.

DATA SOURCES

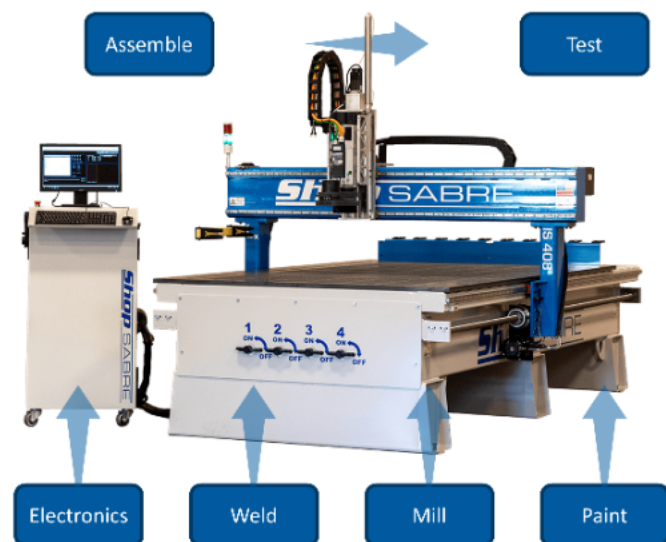
Most data used in this investigation was collected manually. The methods developed in this investigation require minimal data collection because data-deprived environments are common in small manufacturing companies. ShopSabre subsequently deployed its first ERP system. Data driven tools developed in this investigation will be even more effective when leveraging the ERP database.

Data Types and Format

The majority of data is contained in excel spreadsheets. The methods used in this investigation are robust to data-deprived environments, which are common in small, rapidly-growing operations.

APPROACH

The investigation proceeded with shadowing each production department and collecting process data; thus, creating a capacity and utilization analysis. The researcher then isolated challenges and opportunities in individual departments, creating case studies to develop and test solution methods. These methods build on one another and contribute to solving the business problem.



IMPACT

The results of each case study had a unique impact on operations, but all contributed to alleviating bottlenecks, balancing labor, and increasing production capacity. The tools developed in the case studies apply in a variety of applications. Purchased-to-order cable carriers were used to develop a base-stock model for unsteady demand that pooled inventory and allowed ShopSabre to decrease the volume of stock it holds on hand and while dramatically decreasing stockout events. The electrical department was used to study three methods with the following findings: department layouts that decrease material movement increase production efficiency, strategically placed push-pull material barriers through Kanban inventory systems improve production agility and robustness to uncertainty, and quality controls protect the critical path and increase production capacity. The final assembly department effectively illustrated the impact of parallelizing tasks as a method of reducing the critical path, which drives down cycle time and increases capacity. As a capstone, all of these methods were applied to the final assembly and inspection processes in addition to development of a digital twin to analyze the effect of line balancing on throughput capacity. The results of this final case study found that increasing the factory space by a factor of two, in conjunction with alleviated bottlenecks, a shortened critical path, and a balanced line, resulted in a five-fold increase in capacity.

DRIVERS

The single most important factor that led to the success of this project was the preexisting exceptional culture at ShopSabre. The entire team accepted me into the team, invested time to help me learn and understand the ShopSabre way, and freely provided feedback to help refine ideas into practical tools and effective practices. Their openness and tenacity supported the pace required to complete four case studies within the research period.

BARRIERS

The lack of granular, historical data could be considered a barrier to this project; however, the methods selected intentionally did not rely upon vast amounts of data. Additionally, various factors, including ShopSabre's rising backlog, applied enormous pressure to maintain production rates. Most changes made as part of this research were developed under the constraint that they could not interrupt production.

ENABLERS

In addition to the exceptional culture, the current state of change at ShopSabre enabled the success of the project. The company was already planning on expanding the factory space and was in the process of implementing an ERP system at the outset of the investigation. The company had a sustained record of exponential growth, so redefining processes to adapt to increasing volume was normal.

ACTIONS



Early case studies, including cable carriers and the electrical department, were fully implemented by the researcher. The outcomes of these sections are based on actual realized and observed results. The assembly case study was partially implemented, including full kitting for all lines and subassembly production for select lines. The final case study relied upon the expanded factory, which was not available until after the research concluded.

INNOVATION

The method of isolating problems into case studies to quickly develop tools that are later combined for a factory-wide challenge creates a novel playbook future researchers may follow. Another innovation of this project is the novel development of the base-stock model to accept non-steady demand as an input and return suggested stocking levels for a specified time period.

IMPROVEMENT

Preliminary case studies resulted in various improvements including reduced inventory, increased service levels, increased productivity, increased agility, improved quality, and shortened critical path. The final case study improved balance in resource utilization in key areas of the factory, enabling a five-fold increase in production capacity following a two-fold increase in factory space.

BEST PRACTICES

First and foremost, the culture must fit. The success of this project, and others like it, hinges on the receptivity of the team. If that is accomplished, this investigation suggests that breaking a big problem into parts, and then solving its parts using analogous problems is an effective way to develop tools and practices that apply well through a company or factory.

OTHER APPLICATIONS

This project should be of particular interest to companies with a track record of rapid growth. In particular, companies recognizing that processes that were effective at low production volumes may no longer be viable as the operation grows may glean insight from this project.