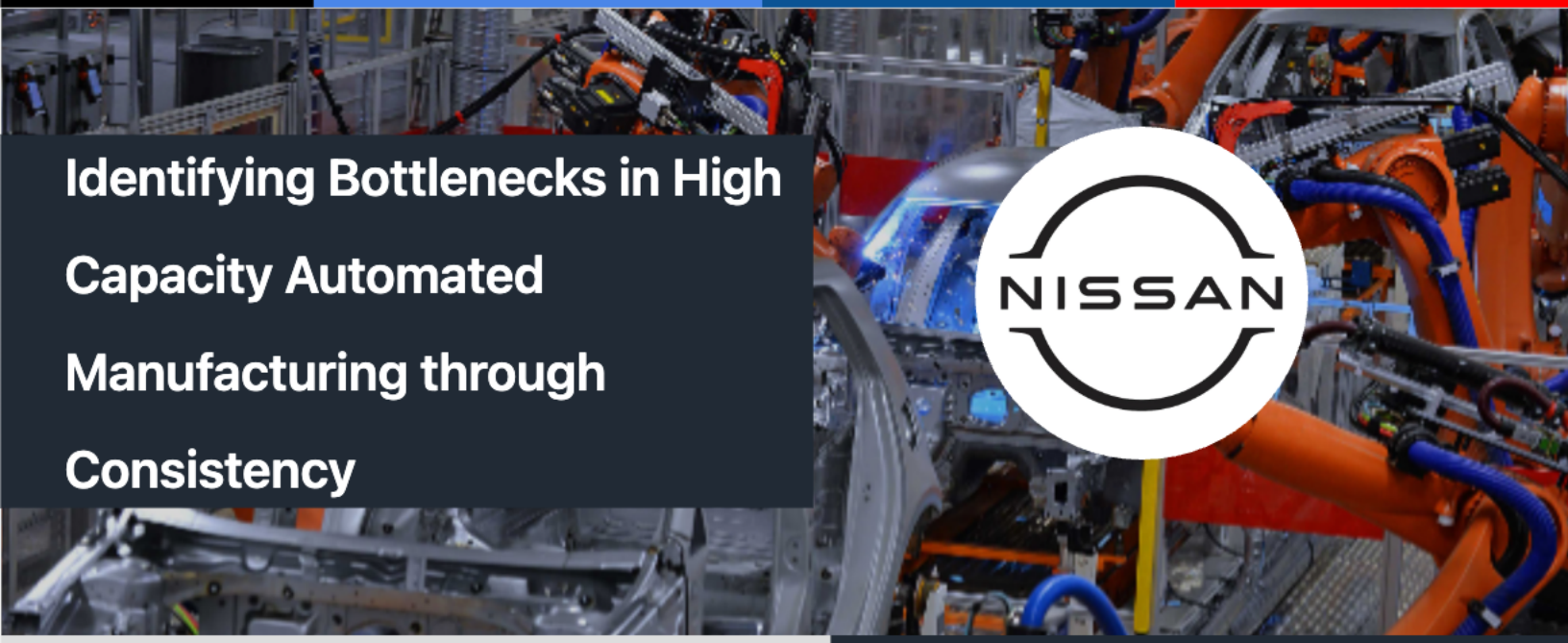
Manufacturing | Automobile manufacturing | Cycle time optimization | Discrete / Continuous



Identifying Bottlenecks in High Capacity Automated Manufacturing through Consistency

BUSINESS PROBLEM

Assembly lines can only produce parts as fast as their slowest process (the bottleneck). The bottleneck will govern the speed of production and implicitly set the maximum capacity of what can be produced in a given time period. Without making improvements to the bottleneck, production will never increase. In large complex automated manufacturing, it can often become difficult to determine which process is the bottleneck as there are thousands of processes happening simultaneously and random real-world events that also affect production rates. In order to improve production, operators require a quick and effective way to find the bottleneck.

APPROACH

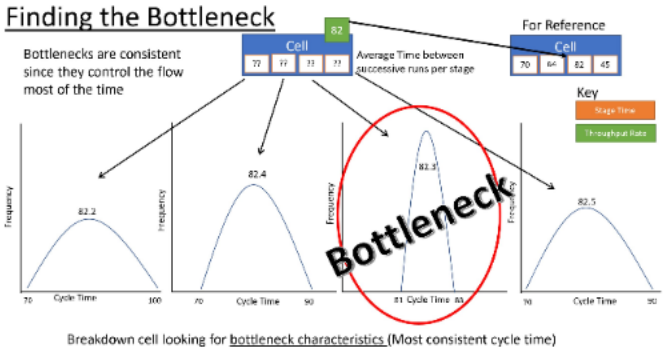
By selecting a single point in the process of a robot making a part, and timing until the exact same process is performed in the next part produced, you can break down the system to find the bottleneck. When comparing robots in series to one another, all robots will operate at the bottleneck's production rate but the bottleneck will operate at this time more consistently than any other robot.

DATA SOURCES

Timestamps of data strips, self reported by robots

Data Types and Format

Excel, Continuous, Histograms, Probability Density Diagrams, PowerBI



Breakdown cell looking for bottleneck characteristics (Most consistent cycle time)

Author: Kyle Lux

IMPACT

Enabling the finding of bottlenecks in a complex system, has drastically reduced the time required to find the bottleneck. Previous practice required several industrial engineers, with stopwatches, to go out and manually measure every robotic process in the plant. This took several days to perform and often did not lead to the actual bottleneck being found. Most of this inaccuracy was due to issues with manual timing of machinery. This new approach produced a dashboard that was updated automatically every hour, to identify issues in the plant. The new process takes less than 2 minutes by a single person once an issue is determined. An active decision was made not to fully automated the bottleneck finding process. Using this technique takes some finesse and understanding of what was going on in the overall system. This tool was designed to be an aid to human operators to streamline the time to find a bottleneck, verify issues found are the issue, and allow for additional time/resources to be applied to improving the bottleneck. This process found bottlenecks that were improved to increase daily production by 20 vehicles per day (4% increase).

DRIVERS

In order to improve production, you must improve your bottleneck. If the bottleneck is unknown or difficult to find, you will end up wasting resources improving areas that do not increase production capability.

BARRIERS

Data is the most important part of this analysis. It is important to understand what your data is measuring and where it is coming from. Without a consistently measured datapoint, it is not possible to perform this analysis. Due to limited time and research, this analysis can currently only be performed on single product assembly lines.

ENABLERS

The people where the biggest enablers. Without the support of management on this project, I would not have been able to succeed. Everyone at Nissan was excited for the new tool when it was rolled out and embraced the change.

ACTIONS

In order to ensure continuity, I tried to make the tool as easy as possible to use. First, I created an easy to access dashboard that could be seen anywhere in the plant. Second, I ensured the dashboard would be auto populated with new data as frequently as possible. Finally, I held classes to teach operators how to use the new tool and recommended a frequency of use that made sense based on their role in the plant.

INNOVATION

This process can be implemented almost immediately in automated manufacturing facilities that produce only a single product on their assembly line. The main datapoint used to perform this analysis is the timestamp associated with the report most robot automatically send off after each production cycle. So long as this data is collected and presumed accurate, the analysis can be performed.

IMPROVEMENT

Identified bottlenecks were improved to increase production by 20 vehicles per day, a 4% production improvement. Additionally, in the first 2 weeks of operation, the dashboard identified over five abnormal conditions that were systemically impacting production. Some of these events persisted for multiple days and resulted in a real loss of over 100 vehicles. All conditions were fixed once identified.

BEST PRACTICES

First, understand your data. This process can not be replicated with bad data and will lead to incorrect bottleneck identification.

OTHER APPLICATIONS

This solution can be implemented in any system that produces a single product, using mostly automated processes. There is a need to also have a database collecting the information for analysis.