Improving Airframe Wing Manufacturing Processes with ProModel Simulation

The Boeing Company

Success Story

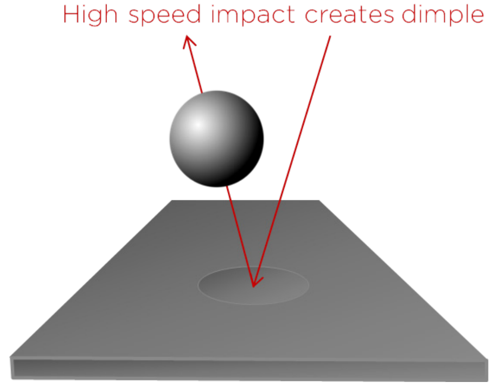
Automotive, Aviation, Marine Manufacturing

ProModel

CHALLENGES

Boeing is one of the biggest airframe manufacturers in the US and has become a major defense contractor and the biggest aerospace manufacturer in the world. In the past several decades, increasing competition in the airline industry has created downward pressure on prices and increased quality expectations for commercial airplane products. As a result, airlines have sought to reduce procurement and operating costs and Boeing has launched a number of lean manufacturing initiatives.

The Forming Corridor, a critical part of airframe manufacturing, is considered a capacity limiting constraint. The Forming Corridor contains five large machines that perform shot peening operations on various parts. Shot peening entails impacting a surface with shot (round metallic, glass, or ceramic particles) with force sufficient to create deformation. Shot peening consists of fifty different parts, each with different run and setup times on each machine sharing five different routings through the area. An overhead material handling system consisting of a rail network, load bars, cranes, storage locations and a transfer bridge ties the five machines together. The load bars act like rail cars each holding a part vertically and the transfer bridge is analogous to a switching yard, allowing load bars to move from one rail segment to another. Area management didn't want to risk experimenting with the system for fear of causing additional production slowdowns.



Shot Peening

OBJECTIVES

There was a sense that the Forming Corridor area could run more efficiently, but no one knew how to identify a solution. Given the incredible complexity of shot peening, it was difficult with a normal process improvement approach. The excessively long flow times of the Forming Corridor needed to be eliminated. Shorter lead and cycle times, and lower WIP inventories were also an important goal. Sr. Management wanted to see if more capacity could be freed up for additional work. R & D support employees concluded the area was a good candidate for ProModel simulation modeling, because of its complexity and the desire to model random effects. It was a good way to compare alternatives using virtual quantitative measures.

SOLUTION

The most difficult tasks in building the model proved to be defining and quantifying the system. A lot of work was required to break the system down into manageable pieces. This was done by asking the following questions:

- What parts are worked on?
- What are the part routings?
- How is part release controlled?

It was also a challenge to find useable data. It was necessary to adapt the modeling approach to fit the types of information that were readily available. Operator logs, NC programming, ERP system data and tribal knowledge were tapped. One electronic system monitored machine status, so that data was used to create probability distribution parameters for ProModel's downtime functions. All of this data turned out to be useful in its own right, even without modeling.

A proven approach for convincing the doubters is to create a model that is largely reflective of actual performance as a baseline for experimentation. If the process owners agree that the baseline model is valid, they will have confidence in conclusions drawn from the alternatives. After creating the baseline model, additional code was written to permit experimenting with the parameters of interest, including the number of load bars in the system, prioritization of transfer bridge usage, machine operation schedules, and how machine downtimes affected the system.

VALUE PROVIDED

Load Bars
Analysis of model data showed that as the number of load bars was reduced, system performance improved. Further analysis established a safe lower limit for load bars based upon minimum throughput requirements and practical limitations such as storage availability. The model showed that cutting the number of load bars from 22 to 14 was practical and would reduce average flow time by about 7%. Best of all, the implementation cost of this improvement was negligible. Cutting down on load bars reduced the number of parts in the system at any given time, so WIP inventory would also drop by 1/3. In addition, the model predicted that delivery performance would improve as a result of this change (part delivery times would be more predictable.)

The Area Supervisor had suspected this, but never had any qualitative data to support a change. Seeing the animation, along with the supporting analysis, helped management understand and have faith in the viability of the model and the improvements. After seeing model results, senior managment implemented the changes immediately.

Operating Policies
The model was also helpful in understanding the effects of operating policies. For example, increasing one machine's usage from two to three shifts per day had a noticeable impact on performance. Increasing utilization on another machine also helped. Contrary to what had been anticipated, creating prioritization schemes on part usage of the transfer bridge did not help in most cases. The model could be used to understand how to get more capacity out of the system, if needed in the future.

Modeling clearly showed the impacts of machine failures on system performance. The data can be used in the future to help justify machine reliability improvement efforts. The model resulted in:

- Improved cycle time
- improved delivery performance
- Reduced inventory holding costs

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