

Automated Nesting for Throughput Improvement in High Mix-Low Volume (HMLV) Manufacturing



BUSINESS PROBLEM

Re:Build CDI is a site capable of sheet metal fabrication for aerospace and defense parts. To maximize material use when cutting parts out of material, R:CDI batches jobs which use the same material on sheets before cutting them with lasers, water jets, and routers. This job of determining which jobs to batch together and laying them out in an efficient manner currently requires significant manual work which increases lead times, reduces throughput, and reduces flexibility. R:CDI needs to increase the speed of nesting to keep up with significant growth expected in the coming years.

DATA SOURCES

This project used data from the Enterprise Resource Planner (ERP) on numbers of jobs completed at each machine to get throughput estimations. Time studies were conducted to estimate how long jobs took generally and specifically how long nesting took. Further interviews were conducted with operators and management to understand how delays in nesting affect production operationally and financially.

Data Types and Format

Numerical data, text transcriptions of interviews.

APPROACH

This project used process flow analysis to determine opportunities for automation within the nesting process. The project involved understanding and navigating tradeoffs between user input and automation in a HMLV shop by creating a Python program to automate collection of job information from databases and operators to write scripts that run commercial nesting software instantly.

Nestimizer workflow



IMPACT

This project significantly reduced the amount of time it takes to batch and nest jobs properly, saving hours of time for several critical stakeholders. Machine programmers at R:CDI are capable of nesting and re-nesting parts within minutes whereas the previous technique took hours to nest several together. This not only significantly reduces the lead time from job received to job ready to cut, but also makes the manufacturing system as a whole much more responsive to change. Whenever customer or production requirements cause a change, the work centers are able to respond with minimal effort. Additionally, the increased automation makes it easier for new people to learn how to program machines without a lengthy train up on nesting software. This makes the skill more democratized and will allow for people with the correct information (material handlers, laser operators, etc.) to program the lasers rather than a separate person that is more separated from the physical process. Finally, in the spirit of Re:Build's Lean Operating System and Lean operations in general, the extra time that has been freed up for the laser programmer can now be used to up-skill and increase his education so that they can work on other automation projects throughout CDI. This will allow the improvement efforts here to "snowball" into further successful improvement projects later.

DRIVERS



Low volume manufacturing for aerospace and defense customers involves significant variability in production. This variability increases lead times and causes stress among operators. Speeding up the process of nesting allows for better customer service while increasing quality of life for workers.

BARRIERS



It was ambiguous what exact needs and resources would be required to implement the project. This means that I needed to work closely with members of the company to quickly get access and resources when the needs arise. Coordinating with commercial nesting software providers was also difficult because they often try to sell their own version of the solution that we are implementing.

ENABLERS



Openness to change and good self-awareness helped push the project along. We needed to make sure that the problem we are solving is important to the people involved since it was a very collaborative process. The solution never could have been developed without leadership and worker buy-in to the concept of developing a small solution, rapidly implementing and experimenting with it, and then revising it.

ACTIONS



Built and iterated on a tool that takes data from the ERP and a custom material availability database to interface with commercial nesting software. My tool automatically feeds information into the software which automatically nests the required parts and programs cutting machines. The solution allows for the minimal amount of interaction from the machine programmer to deal with variability in the production environment while speeding the process

INNOVATION



This solution uses lean methodology to enact a digital change that is specific to the company's needs while being versatile enough to be applied to other similar contexts. The implementation is simple and easy to understand for management and operators. This is what makes it work well.

IMPROVEMENT



Testing of the solution on a line of parts which typically have similar order quantities showed a decrease in nesting time of 83% while the time required to re-nest parts when a production schedule change occurs was reduced by 95%.

BEST PRACTICES



Begin with aligning stakeholders at the very beginning so that the people involved agree that this is an important problem to solve and are willing to work with you to implement it. This solution required significant work with line operators to determine requirements and required buy-in from management to test the solution so that we could make many iterations towards a useful solution. Without this buy-in this solution could not be developed.

OTHER APPLICATIONS



This solution can be expanded to other cutting operations and the general methodology of applying lean principles to digital automation can be applied broadly to any process.