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PLATE/SHEET NEST RELEASE AND THROUGHPUT SIMULATION FOR WSC '01

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ABSTRACT

The BT/Raymond Corporation is a manufacturer of narrow aisle electric fork-trucks and uses two Delmia simulation software packages: UltraArc® and Quest®. In the Greene NY facility, one of the Quest® simulations shows the start of the fabrication process. The plate/sheet line is a group of machines that punch, machine, profile, and form steel material ranging in thickness from 0.030" to 1.250". Since each product is built to customer order, the mix of parts to produce on the line is continually changing. The simulation of this process reads the data that schedules the work for the various machines, then runs the line showing capacity and throughput issues a day ahead of the factory floor run. The data that the model reads can also be changed to experiment with different product build quantities.

1 INTRODUCTION

The nature of the business and the variations within each product line demands a flexible front end of the factory. The part mix can have approximately 50% different content day to day. A model was created to simulate the plate/sheet cell to detail machine utilization, part flow, and nest releases to provide a "heads-up" to management. The order that the nests are released determine how the machines are utilized as well as the quantity of parts. Thicker parts run more slowly than the thin parts and are processed on different secondary machines.

A few definitions of terms to be used: A nest is a group of parts to be processed on a similar thickness plate or sheet. There may be multiple nests per thickness of steel. A plate is a 5'x10' piece of steel 0.5" thickness or greater, and a sheet is 10'x5' piece less than 0.5" in thickness. Nesting software accepts solid model geometry for all the parts for a day, and within a thickness arranges the parts to best utilize the plate or sheet. The plate side of the Plate/Sheet cell consists of 2 plate machining centers, flame cutter, plasma cutter, 2 laser cutters, 2 forming presses, roll former, and small machining center. The sheet side of the cell consists of a shear, 2 punch presses, 2 laser cutters, 2 forming presses, and a few drill presses. Primary operations on the plate side are considered to be plate machining by the plate machining center and profile cutting by lasers. plasma, and flame cutter. Primary operations on the sheet side are considered to be punch to laser or laser. Like parts on both the plate and sheet sides are grouped and sent to the secondary operations of brake presses, roll former and secondary machining. See Figure 1.

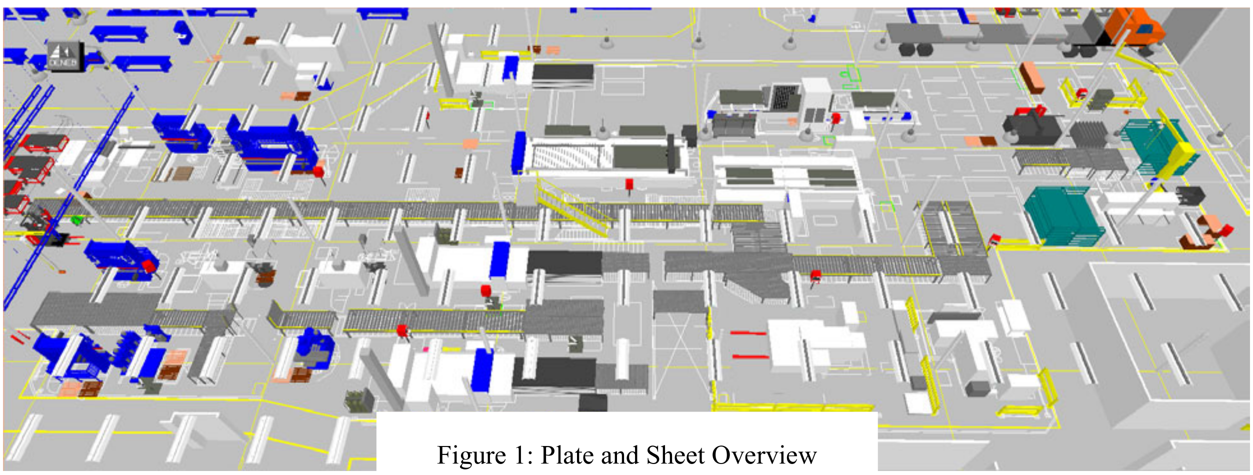

Figure 1: Plate and Sheet Overview

Information is generated by the Raymond Business System concerning the type, quantity, and thickness of parts needed to fulfil the daily order requirements. This information is translated to a software package that auto-generates nests, then another software creates the post to program the machines for each nest. For the simulation, the information created for the nest is formatted to be read by the simulation model at the initialization phase of the model simulation run. This contains the primary operation information. The secondary operation information is read in from a text file from the Raymond Business System.

2 THE SIMULATION MODEL

The first model created used only information from the business system and did not accurately represent reality. An assumption was that all parts made from the same thickness would need to be processed through the primary operations before any parts were released to the secondary operations. At the time, there were no means to capture and input the necessary data for the parts to flow as in reality.

The second simulation model reads the primary operation data from the nesting software in addition to secondary operation data from the business system. This allows the model to release the individual completed parts from the primary to secondary operations. Because the model can read the same information that runs the actual cell, a closer match to reality is attained.

3 INPUT FILE DATA

Data used to run the shop is generated a day before parts are to be started on the machines. This data is copied to the simulation computer and formatted in a folder that the model reads in at the initialization of the simulation run. Two data sets are utilized. One set, which is generated by the nesting software, contains the Primary operation data: part number, nest name, machine, number of parts per nest, and number of plates per nest. See Figure 2a. The second set of data comes from the Raymond Business System. It contains the part name (number), machines, revision, cycle time, and 3 presently unused fields. See Figure 2b.

4 GRAPHICAL REPRESENTATION

To begin the simulation model creation, an AutoCAD 2D drawing of the cell layout was imported. 3D representations of the machines were created. See Figure 3. The parts created in the model to represent plates and sheets are 5'x10'x0.50" or 5'x10'x0.25" respectively. The potential for part display going to the secondary operations is to have a CAD geometry part file that the simulation reads to display the actual geometry as they are removed from the profile machines. This would allow an accurate analysis of pallet flow along the central roller conveyor.

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838-010-117-C          ,ABJEX,PLA  ,    5,     1
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822-000-118-H          ,ABJEX,PLA  ,    1,     1
115-001-858-1          ,ABJEX,PLA  ,    2,     1
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838-010-041-A          ,ABJEX,PLA  ,    4,     1
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a

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b

Figure 2: Data Files to Run Simulation

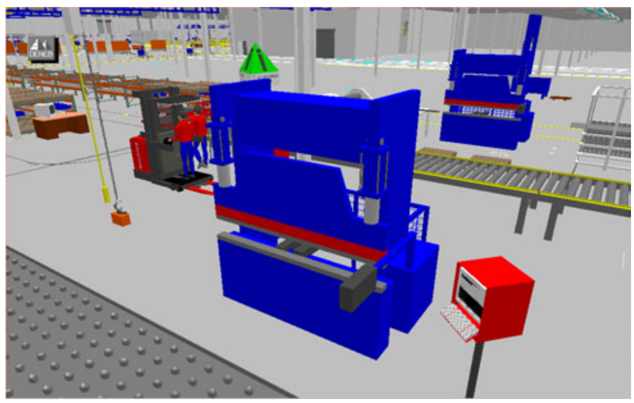

Figure 3: Machine Representation in 3D

5 OUTPUT DATA GENERATED

The model is run for a twenty-four hour period to mimic a days worth of manufacturing. This is the time allowed by management to complete the days run on the primary operation machines. The data used to run the model essentially is the following days run that will go out to the factory floor. The cell in reality should never run "dry" since the day's part will be finishing on the secondary operations while the next day's parts start up on the primary operation machines. To operate the simulation cell closer to reality, the data read in would include one weeks worth or one months worth of nests to prevent the "dry" start-up. The simulation run time would correspond to the data time span for an accurate output data set.

6 BENEFITS FROM MODEL

One of the benefits gained from this simulation model is the 3D virtual work cell. When the appropriation requests are submitted, included in the package circulated through upper management are screen shots of the particular machine or workcell printed in full color. This helps upper management to easily understand why the capital funds are needed by manufacturing to spend on equipment. This model has verified capital equipment purchases of a forth brake press and a new plate machining center.

Many problems have become apparent as well as a more complete understanding of the whole process because of the thorough evaluation for the details. One example of a problem is the part flow from primary operations to secondary operations. To satisfy the MES system, an order for parts must be completed for one operation before it can even be started on the next operation. So the question was asked if the secondary operation should “starve’ for work to satisfy the MES system, or should there be a change made to the system to allow a more smooth flow from primary to secondary ops. The decision was made to release nests by thickness to minimize the wait time of the secondary machines yet maintain the MES system scheduling control.

7 CONCLUSIONS

In the future, this Plate/sheet simulation model will be directly linked to the nesting software. A day prior to the nest releases to the shop floor, the area manager will be able to analyze the impact on the cell and plan his workforce accordingly.

Simulation technology is a powerful toolbox for the manufacturing engineer and process engineer to use. Processes can be verified, what-if scenarios can be explored, pictures and videos can be generated, and communication can be enhanced. Some of the keys to good simulation practice are accurate data and a clear understanding of expectations.

ACKNOWLEDGMENT

This model was originally developed by Joe Hugan of Forward Vision. Thanks to him for the successful start of simulation technology at The Raymond Corporation in Greene, NY. Figure 4 shows the progress since the first simulation project.

AUTHOR BIOGRAPHY

Leland Weed has been employed for 7 years and is currently an Engineering Tech Specialist at The Raymond Corporation in Greene, N.Y. His responsibilities include: arc-welding robot simulation and off-line programming, factory tour guide, and discrete event simulation and 3D modeling. Leland’s education includes a Masters degree from Ithaca College and a BM from Penn State University - both in music performance on trombone.

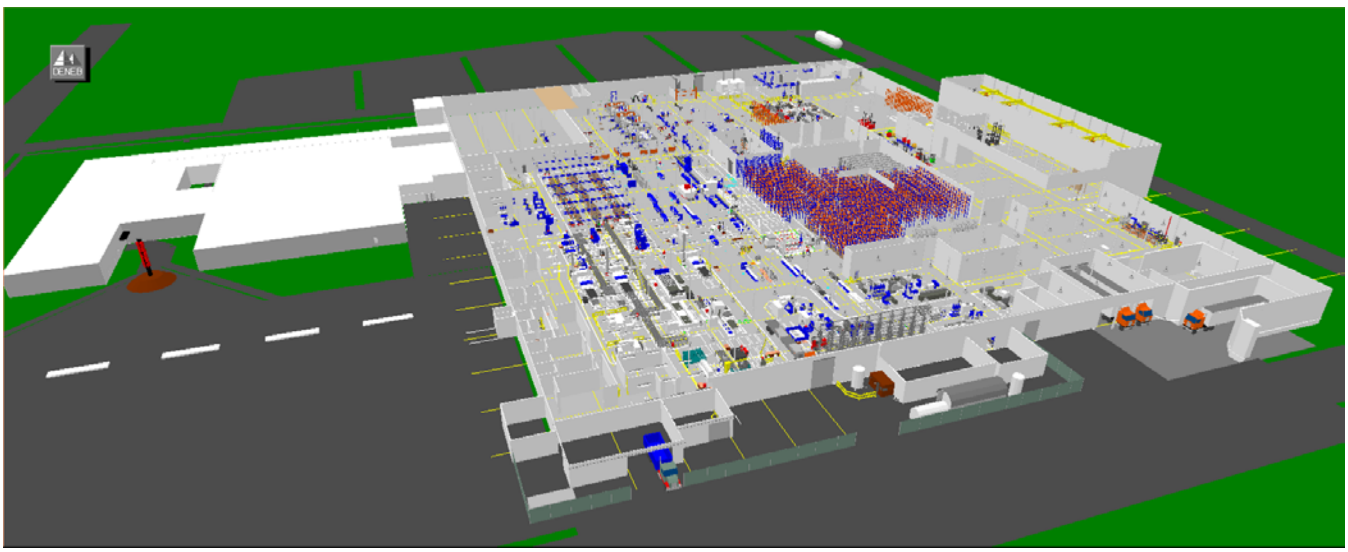

Figure 4: Current Plant