Increasing Production Rate of Laminate through Process Efficiency

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***Abstract*— For this project, a student team was assigned to a local manufacturer to demonstrate the engineering tools and skills being taught in the Industrial and Systems Engineering department at Northern Illinois University. The manufacturer, Nobelus, is a value-added reseller of laminate rolls that is interested in increasing production throughput through investigating and addressing any inefficiencies and bottlenecks in their current process. Production processes will be investigated to determine areas for improvement and a current state of production will be developed for the company. Data-driven recommendations will be formulated for Nobelus as well as an initial plan for how these strategies should be implemented. Through implementing recommended strategies, the student team hopes that Nobelus can make significant progress in reaching their throughput goal.**

Keywords – 5S, capacity planning, time studies, bin-packing, layout optimization, process improvement

I. Introduction

Nobelus is a value-add processor of laminate film located in Schaumburg, Illinois. Nobelus sells custom and specialty laminate products to several companies and industries, with short turn around rates. Nobelus uses MSI to measure output, where 1 MSI is 1000 square inches of laminate.

II. Problem Description and Statement

Production targets for Nobelus are expected to increase this year, and the company must find ways to increase production capacity accordingly. Since demand is somewhat seasonal, production capacity must be balanced to keep costs low while maintaining their short turnaround times. Nobelus currently has an average throughput of about 3,500 MSI/hour and would like to increase throughput to at least 10,000 MSI/hr. The objectives of the project include:

- Reduce Non-Value Added time through minimizing movement and Non-Value Added tasks.
- Minimize downtime between runs through process efficiency.
- Improve raw material quality

III. Methods and Materials

A. *Time Studies*

Time studies were performed at each slitter station to develop a current state of production capacity and processing rates. These studies also identified setup times as a large area of opportunity for potential improvements. Average percent time distributed per type of work can be seen in Figure 1.

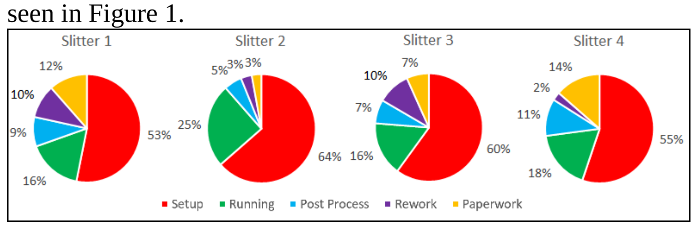

FIGURE 1. TIME STUDY AVERAGE WORK DISTRIBUTION

B. *5S Audits*

5S audits were conducted to assess the current states of each Slitter and identify areas for improvement. Audit scores will also provide a current baseline that can be used for future comparisons. Average scores per station are shown in Table 1.

TABLE 1. 5S AUDIT AVERAGE SCORES

Audit 1	**Slitter 1**	**Slitter 2**	**Slitter 3**	**Slitter 4**
Sort	62.5%	62.5%	56.3%	93.8%
Set-in-order	45.0%	47.5%	42.5%	72.5%
Shine	57.5%	55.0%	50.0%	60.0%
Standardize	55.0%	55.0%	55.0%	55.0%

C. *Capacity Analysis*

Historic demand information was used to provide insight into demand trends and Nobelus production throughput in past months. As the demand trends are seasonal over the course of the year, the focus for production requirements will be placed on the periods of highest demand.

D. *Bin Packing*

While the historic data contained much information about production outputs, data about inputs was not in a format that the student team could use, so a bin packing algorithm was used to assume master roll usage. A visual representation of the program's functions can be seen in Figure 2.

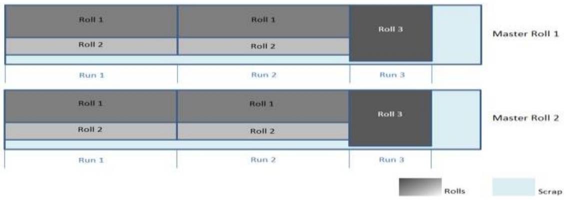

FIGURE 2. MASTER ROLL BIN PACKING REPRESENTATION

IV. SOLUTION APPROACH

A. Runner Position

Since Nobelus has significant setup and post-process times compared the machine run times, a runner position was suggested to help with setup and decrease average cycle times. The runner will be a position that redistributes some setup tasks between the operator and themselves, with these tasks being performed in parallel, decreasing average total cycle times, as visualized in Figure 3.

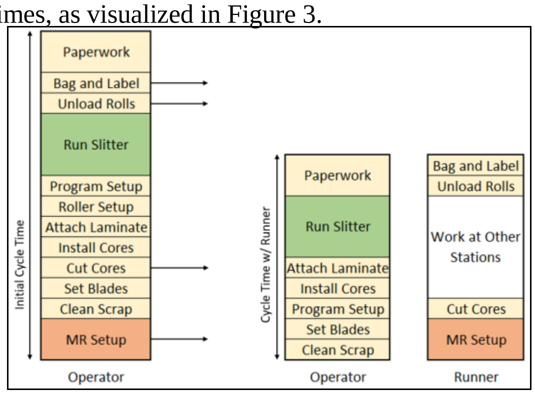

FIGURE 3. WORK REDISTRIBUTION VISUALIZATION

B. Andon Lights

To improve visual communication across the production floor, the implementation of Andon lights at each station was suggested. Once a policy for the lights is set, miscommunications and response times from other workers should be reduced.

C. Defect Forms

To combat the quality issues of raw materials, defect forms were created to begin collecting better information about poor quality master rolls. This information can later be used to make decisions about vendor material quality. A sample defect form is shown in Figure 4.

Vendor Defect Form / Forma de Defecto					
Date / Fecha					
Operator Name / Nombre del Operador					
Master Roll Number / Número de Rollo Maestro					
Material Type / Tipo de Material					
Vendor / Vendedor					
Defect Notes / Defecto Notas					
Vendor Defect Classification / Clasificación de Defectos					
	Pass / Pasar				Fail / Fallar
Wrinkles / Arrugas	1	2	3	4	5
Splices / Empalmes	1	2	3	4	5
Tension / Tensión	1	2	3	4	5
Tearing / Lagrimeo	1	2	3	4	5
Sticky Edges / Bordes Pegajosos	1	2	3	4	5
Uneven Surface / Superficie Irregular	1	2	3	4	5
Acceptable Dyne / Dyne Aceptable	1	2	3	4	5

FIGURE 4. DEFECT FORM SAMPLE

D. Facility Layout Suggestions

With data collected so far, initial calculations for a new layout were made using Distance Flow Analysis algorithms to minimize movement of workers and materials. These layout planning algorithms can also be used to plan the location of any future machine changes or additions.

V. DISCUSSION OF RESULTS

A. Spaghetti Diagrams

Spaghetti Diagrams were created to analyze the impact the runner has had on the operator's movement. It can be seen in Figure 5 that the station operator had a reduction in movement of about 60% due to the runner. This should mean that the operator now has more time to focus on their station instead of moving across the production floor.

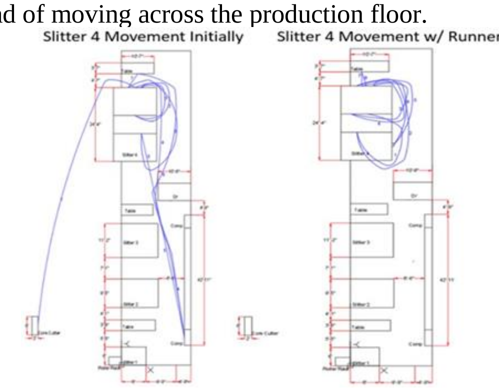

FIGURE 5. OPERATOR 4 SPAGHETTI MAPS

B. Capacity Planning

With information collected through the capacity analysis, a tool was created for simple capacity planning. This tool would use estimated hourly MSI rates per machine and would determine any staffing changes, overtime hours, or other throughput improvements needed to achieve production targets.

VI. CONCLUSIONS

The student team determined some of the largest opportunities for improvement in throughput were in machine setup times and quality of input materials. The main solution strategies of the runner and tracking quality should result in improved cycle times and increased overall average throughput.

Currently, the runner position has been implemented and is in training, which has made initial improvements to slitter cycle times. Nobelus also had an opportunity to use defect forms to address vendor quality and receive material credit.

VII. ACKNOWLEDGEMENTS

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