MPI Corp: Optimization of Material Movement and Delivery

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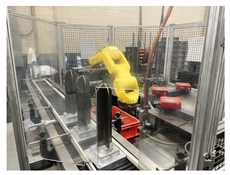
Client Background

MPI Corp. is an investment holding company and a leader in precision metal stamping and heat treating with experience in manufacturing, design, and tool fabrication. With four manufacturing sites across North America, they serve a variety of customers in automotive, electrical, and industrial applications. While the headquarters of MPI is located in Indianapolis, IN, this project will focus on Small Parts Inc., a stamping company under MPI Corp, located in Logansport, IN. The focus of this project deals with optimizing material delivery and movement throughout the stamping plant. Currently, there is not a great way of prioritizing and coordinating the movement of raw materials and WIP throughout the manufacturing process.

Products of Small Parts Inc.



Highly automated production line

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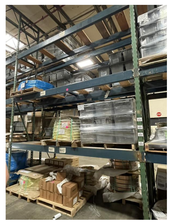
smallparts INCORPORATED

Problem Statement

Small Parts Inc. currently has issues in minimizing the idle time of each machine and worker due to inhibited movement of materials. The main factors of this impeded flow are disorganized placement of raw materials, inefficient forklift truck movements in the plant, and lack of methods to prioritize material flow. The goal is to reduce five man-hours, directly reducing time spent in moving materials, which will both encourage shorter production cycles and diminish machines' idle time.

Over stacking of different materials



Inefficient use of shelving space

System Model

The primary manufacturing of Small Parts Inc. facility is comprised of several components, including administrative offices, a workshop for equipment repair, stamping machines, an area for loading and unloading, a storage location for materials, and a space to store completed products and work-in-process. To comply with supplier regulations, Small Parts would order large quantities of raw materials, despite not having a proper system in place to manage them. This led to the storage area being filled with randomly placed materials and the limited number of workers only makes the situation worse. In addition, the finished products, like the raw materials, do not have an efficient layout system.

Methodology

Determining priorities in deliveries

The team's proposal involves setting up an "urgency index" ranging from 1 to 5, which will be an additional input selected by machine operators upon requesting a delivery to indicate the urgency of the task. The index number will be determined based on how soon a machine will be idle. That way urgent requests will be prioritized to streamline material delivery and minimize machine's idle time. Meanwhile, plant managers and supervisors will have the ultimate power to decide the urgency index.

Time created	Created by	Ser. Num	From Location	To Location
12:02	Purdue Pete	SL***	815	STP
12:05	Purdue Pete	SL***	Pack 5	STP
12:06	Purdue Pete	SL***	834	Pack 5
12:09	Purdue Pete	SL***	810	808
12:11	Purdue Pete	SL***	WIP	808

Old system delays urgent tasks

Time created	Created by	Ser. Num	From Location	To Location	Urgency
12:06	Purdue Pete	SL***	834	Pack 5	1
12:09	Purdue Pete	SL***	810	808	2
12:02	Purdue Pete	SL***	815	STP	3
12:05	Purdue Pete	SL***	Pack 5	STP	3
12:11	Purdue Pete	SL***	WIP	808	5

New system prioritizes urgent tasks

Redesign of the raw material inventory

An algorithm is designed to improve raw material allocation efficiency by reducing forklift retrieval time based on the height and demand of each material type from historical delivery data. The first level of each shelf is set to accommodate large materials to compensate for height variations. Then, the algorithm calculates different combinations of height categories to determine the height of each level on the shelf. Following is the specific steps for the algorithm:

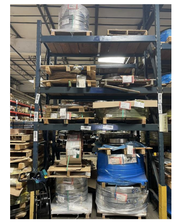
1. Classify raw materials as small (type S), medium (type M), and large (type L) based on the bundle height
2. Measure the shelf height and each category preset above
3. Prioritize raw materials based on the delivery history
4. Set the first level height of each shelf to be able to contain large materials to compensate different heights of materials with high priority
5. Calculate different combinations of height category based on the measurement in Step 2
6. Determine the height of each level on the shelf from previous combinations calculated

The team also recommends adding extra shelving units next to the walls of the raw material inventory. This is to eliminate the situation where raw material occupies too much space and obstructs fork truck movement.

More labeling for WIP and raw material inventory

The team recommends putting barcodes at the top center of the WIP crates to track material delivery. It is also recommended to use a one-to-one label system for individual storage units on shelves for raw materials. The barcodes will be stapled together for a single shelving unit and placed at a visible and reachable height for forklift drivers. Color coding will also be used to indicate the size of materials that can be stored in each location.

Two options of barcode labeling



Lack of labeling for top and bottom levels

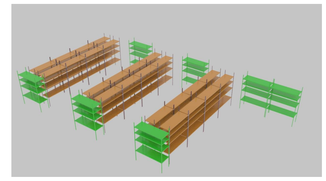
Results

The goal of the first approach is to help forklift operators prioritize multiple material delivery requests based on the urgency of each request. Examples of two levels of the recommended priority index is listed below:

1. The request needs to be completed immediately. The machine will be idle within 10 minutes without new material, or the material needs to be transferred to the next work center within 10 minutes.
5. The request needs to be completed eventually. The machine will be idle within 30 minutes without new material, or the material needs to be transferred to the next work center within 30 minutes.

The second approach aims to create sufficient raw material storage space by fitting items with various sizes to the right place and ensuring that one storage slot only contains a single type of material, as well as adding extra shelving units. The way this is done is by having hooks (openings on shelves that make shelf levels adjustable) determine how many shelf levels each shelf can have, so it can also decide how many bundles of raw material will be placed in each shelf. Below are the preliminary design of the inventory using 3DSMAX:

3 sizes to fit raw materials



Additional shelving units

The expected result of the last approach is to systematize the WIP area and raw material inventory and facilitate material deliveries, which aligns with the goals of the other approaches. Properly labeling these two areas can significantly reduce the time takes for operators to locate and track items instead of leaving them unsorted.

Discussion

The team developed five urgency indices that has five levels of urgency and could reduce idle time and free up operators, but they are based on subjective decision making and only takes foreseeable machine downtime into consideration. Other variables such as shortage, overage or machine malfunction may affect the urgency index. Therefore, the index can only act as a general guideline for scheduling delivery tasks.

The methods to organize the raw parts storage have changed over the course of this project: from a CRAFT algorithm to demand multiplied by weight sorting metric and finally to height category presets. The final method recommended considers the simplicity to implement, the effectiveness to sort, and the cost-efficiency to maintain.

By creating urgency indices, redesigning how material bundles are placed in shelves, and implementing more labeling, the team believes that Small Parts Inc. will have a more organized flow of materials from the raw parts storage to delivery to finished goods storage.