



PIPE INSULATION MANUFACTURING PROCESS

Background

A large *construction materials company* that produces *pipe insulation* has *hundreds of different products* that need to be *produced on a daily, weekly, or monthly basis*. Each *product is described* by the type of material, the *internal pipe diameter and the thickness of the insulation*, and is manufactured on one or more of several available *production lines*. The production facility *works on 365x24 schedule*.

Highlights:

- **500+** SKUs
- **Multiple** production lines
- Inventory constraints (*minimum WIP, maximum storage*)

The challenge

The company was dealing with:

- Many "emergency", *last-minute small orders*
- **Limited number of production capacity** thru' shared "mandrels" (3 for all lines)
- They were **operating at then-current capacity** but could sell more, therefore needed to **maximize production**

Objective:

- **Increase throughput**, without adding any manufacturing capacity, and **reduce overtime costs**.

Current scheduling limitation

Following is a *simplification for example*; The company must **produce five products** for which **demand can fluctuate greatly from one day to the next**. There is a **minimum level of finished goods** that should be **on-hand** at the end of each day **to avoid stock-outs the following day**. At the same time, there is **limited storage capacity** in the plant, so maximum **levels of inventory must also be enforced**. The **production requirements**, and **machine assignment constraints**, are shown as follows:

(A) Product ID	(B) Processing Rate (lbs/minute)	(C) Day's Demand (lbs)	(D) Inventory On-hand (lbs)	(E) Minimum Inventory (lbs)	(F) Maximum Inventory (lbs)	(G) Machine Assignments
1	150	66,000	25,000	33,000	50,000	1, 2
2	150	27,000	20,000	20,000	35,000	1, 2
3	75	90,000	35,000	45,000	50,000	1, 2, 3
4	75	48,000	35,000	30,000	50,000	1, 2, 3
5	75	60,000	40,000	40,000	45,000	2, 3

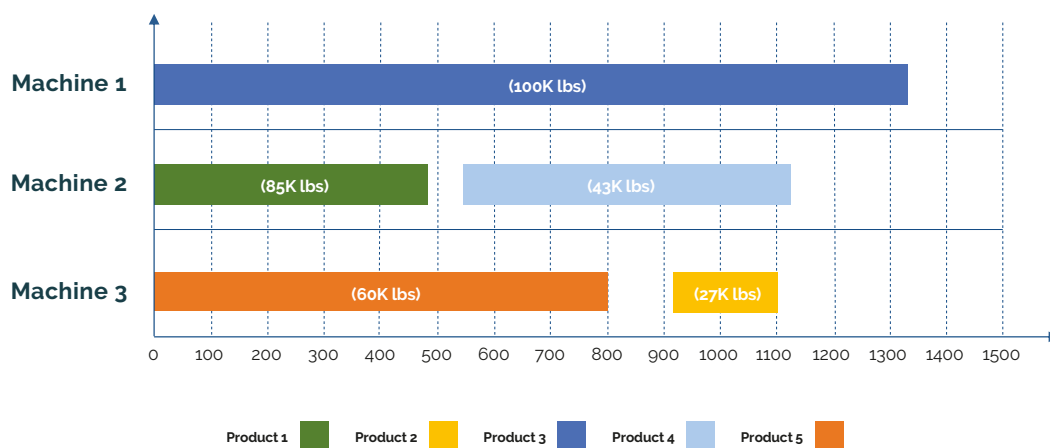
· Note that the inventory on-hand for Products 1 and 3 is lower than the minimum allowed, presumably due to disruptions in the previous day's production, so this difference needs to be addressed.

There are also **sequence-dependent changeover times** incurred when **changing a machine from production** of one product to another, as shown (in minutes) in Table 2.

Table 2: changeover times

Product	1	2	3	4	5
1		0	60	60	60
2	120		60	120	180
3	180	120		60	120
4	180	180	120		120
5	60	180	120	120	

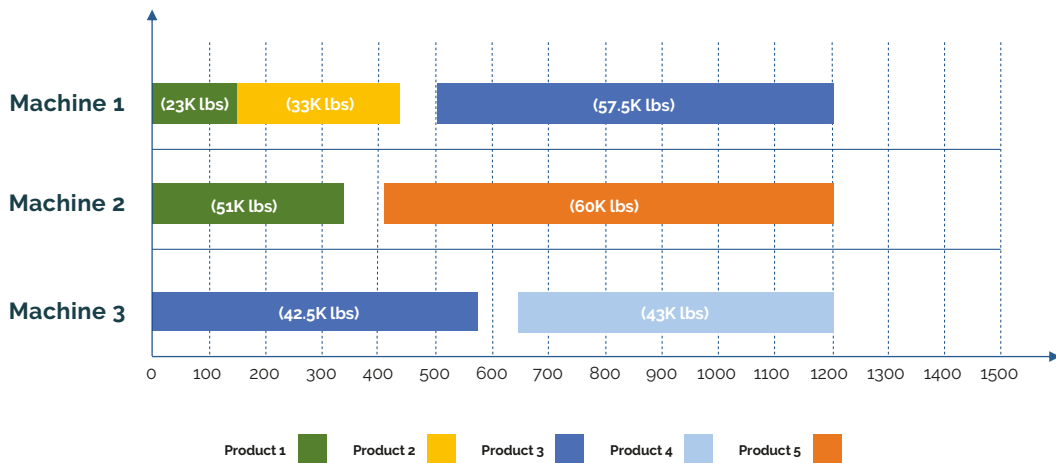
The company's **current scheduling approach** was an entirely **manual process**, carried out on a series of **complex spreadsheets**. Taking all the above into account, the existing **manual scheduling** would produce a schedule as shown below, which incurs **133 minutes of overtime costs** on Machine 1.



OptPro Solution

OptPro combines *mathematical optimization technology* with a digital twin representation of the actual process.

In the **OptPro-driven** schedule, as can be seen, *all machines finish their production at exactly 20 hours* (1200 minutes). To achieve this, *both Products 1 and 3 are split into two batches*, to be *produced on different machines*. Even so, the total changeover cost incurred in this plan is the same as in the current schedule (*so no worse*) with 180 minutes; however, *the total cost is much less*, because the *company avoids paying its operators* for more than 133 minutes of overtime.



Results

This simple example illustrates *the benefits* of the **OptPro** approach in *terms of maximizing throughput and minimizing costs*, including changeover costs and *operational expenses* related to *overtime*.

Actual **OptPro** results at the company indicated a *9% increase in throughput and elimination of required overtime*, all with existing manufacturing capacity and *no additional Capex required*.



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