MACHINE SCHEDULING OPTIMIZATION

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Kimberly-Clark

Group Members

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1. Introduction

Kimberly-Clark is leading the world in essentials in a better life. It manufactures and sells health care and personal care products in more than 150 countries. Kimberly-Clark Asia Pacific, located in Singapore, is the regional production and distribution site for Huggies diapers. The site houses a few state of the art high speed manufacturing assets.

2. Objectives

To determine the optimal product scheduling while considering the production line utilization rate, product cycle time and inventory cost.

Challenges:

1. Schedule low demand items across periods to improve utilization
2. Determination of the optimal planning horizon
3. Determination of optimal production sequence between two planning horizon

3. Problem Description

There are three tiers of diapers; with each tier having different characteristics. Each tier consists of six sizes. Each type of Product is packed with a specific number of pieces in one package, called count number. For example,

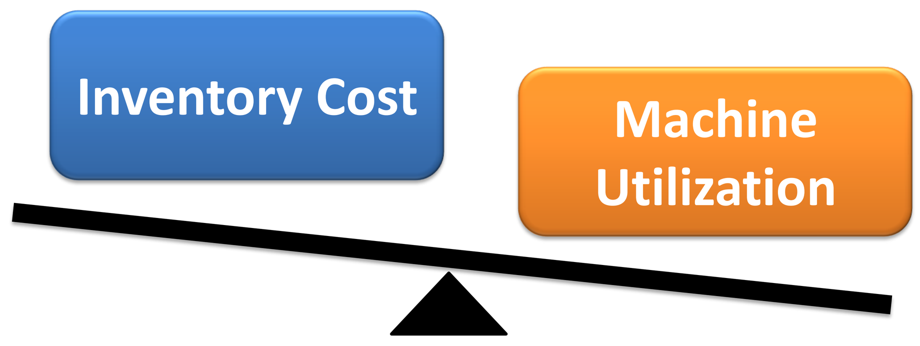
Tier change: a hour | Size change: b hour | Count change: c hour

PL N (T2M84)(T2M80)(T2M42)|(T2L22)....(T3L66)|(T2XL84)(T2XL20)....

Definition:

- Stock Keeping Unit(SKU) as tier/size/count
- Product cycle time: from the moment a product is produced until the time that the same SKU is produced again.
- Low demand item: Annual demand of the SKU is less than 6 day production run.

Current production scheduling of several SKUs is manually done and purely based on planner's experience ; It is very time-consuming and optimal solution is not guaranteed. This project investigates on how to optimally schedule the production in a suitable planning horizon, as such, all the production lines will be better utilized with less change over time lost; at the same time, inventory should be kept at a relatively low level.



4. Methodology

Input

- Forecasted 12 months demand
- Current Inventory level

Step 1

- High demand versus low demand categorization

Step 2

- Schedule high demand SKUs

Step 3

- Dynamically schedule low demand SKUs accordingly to time left

Output

- Production line scheduling
- New Inventory level

5. Mix Integer Programming

Objective Function: Minimize the longest production cycle among the n production lines.

Variables:

X_{ijk}: time to produce product i on line j for size k

i - type of product ***j*** - line number

k - size of the product (1: NB, 2: S, 3: M, 4: L, 5: XL, 6: XXL)

a_{ijk}: binary variable indicating if product i is produced on line j for size k

w_{kj} : binary variable indicating if the size k products are produced on line j

Parameters:

D_i: demand in terms of hour for product i C_j: number of size changeover for line j

Minimize v

$$T_j \le v \quad \text{where} \quad T_j = \sum_i X_{ijk} + \sum_i a_{ijk} - 1 + (b-1) \times (\sum_i w_{kj} - 1)$$

Subject to:

Time constraint	Demand constraint	Size change indicator
$T_j \le 720$ $X_{ijk} \le D_i \times a_{ijk}$	$\sum_j X_{ijk} = D_i$	$\sum_i a_{ijk} \le C_j w_{kj}$

6. Result

Key Performance Indicators: 1) Inventory Level; 2) Total Revenue ; 3) Production Volume * The results shown are modified by a constant.