Improving Production Schedules in Textile Manufacturing

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1. Background Info
Analyzed real world data from Kazareen Textile Company (KTC), an apparel company that manufactures, sources, and retails various textile products.

KTC deploys orders according to a 5-step production process:

1. Knitting
2. Dyeing
3. Cutting
4. Sewing
5. Packing

Each step corresponds to a different set of machines, processes, and technical requirements like dyes and measurements.
Management receives the following items prior to production:

- Order quantity
- Due date
- Specifications
  - Materials
  - Colors
  - Dimensions

KTC purchases **pre-processed synthetic materials** from third party processors, and begins scheduling production of a garment according to an **EDD algorithm**
2. Methodology
General Assumptions

\( r_j = 0 \)

For jobs received between 1/16 and 3/12, all materials were preordered on 3/30. Therefore every job is assumed to release at the same time.

Virtual Machines
To accommodate for the option of a job ending halfway through the day and then starting a new job on that same day, we added a “virtual machine” to each stage.

Speeds
We take into account each job’s weight when calculating the number of days required to process a job, serving as a de facto processing time.
Intercession Times

A significant portion of makespan is made up of time taken *between steps*
Dyeing begins on the same day knitting is completed.
Packing begins the day before sewing is completed.
3.
New Schedule Proposal
Shortest Processing Time
Continuously Reevaluate
As jobs complete, we reevaluate the SPT protocol to ensure that they are scheduled appropriately in the queue.

Machine 1
Machine 2
Machine 3

Effective Release Dates
Depending on which jobs have been completed, we consider effective release dates that either place or delay each job’s entry to the next machine slot.
Processing Time: 24 Days

An improvement of 1 day using SPT over EDD
4. Analysis and Algorithm Formulation
Algorithm

2 || C_{max}

4 | r_j | C_{max}

2 | r_j | C_{max}

2 | r_j | C_{max}

2 | r_j | C_{max}
Algorithm Walkthrough

**Processing Length**
The algorithm collapses each step with its successive intercessation time for a total “process length.”

**Same Processing Time**
If two jobs have the same processing time, we order by EDD

1. Jobs are scheduled successively according to SPT in **knitting**.
2. At every point at which a job becomes available for **dyeing**, jobs are scheduled if possible according to SPT - in the case that a job hasn’t been released from knitting, we move on to the next job and reevaluate at the next release date.
3. We repeat this process for **cutting, sewing, and packing**. The final schedule is presented.
The first job begins on April 2nd

The last job ends on April 26th
Preemption

It is unlikely that a textile manufacturing operation can introduce preemption, as when dyes and materials are loaded into a machine the entire job must be completed as opposed to interrupted and then completed at a later date.

This prevents the schedule from being completely efficient, as we can see there is a sewing machine that is idle for four days due to this phenomenon.
Other Scheduling Inefficiencies

- A job's overall lateness can be determined by its performance in a specific department: for example, many jobs with similar sewing, cutting, dyeing, and knitting times can be subject to a different packing time.
- This indicates that the order in which jobs are scheduled (by virtue of the intercession times phenomenon especially) is significant.
- Keeping a job in intercession might incur costs that are more serious than lateness - areas for future research.
Thanks!

Any questions?