Improving Production Schedules in Textile Manufacturing

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1.
Background Info

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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:

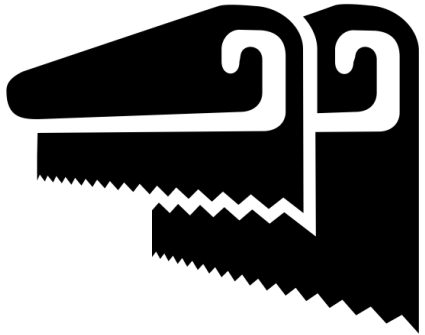
1. Knitting
2. Dyeing
3. Cutting
4. Sewing
5. Packing

Each step corresponds to a different set of machines, processes, and technical requirements like dyes and measurements.

Background Info

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.

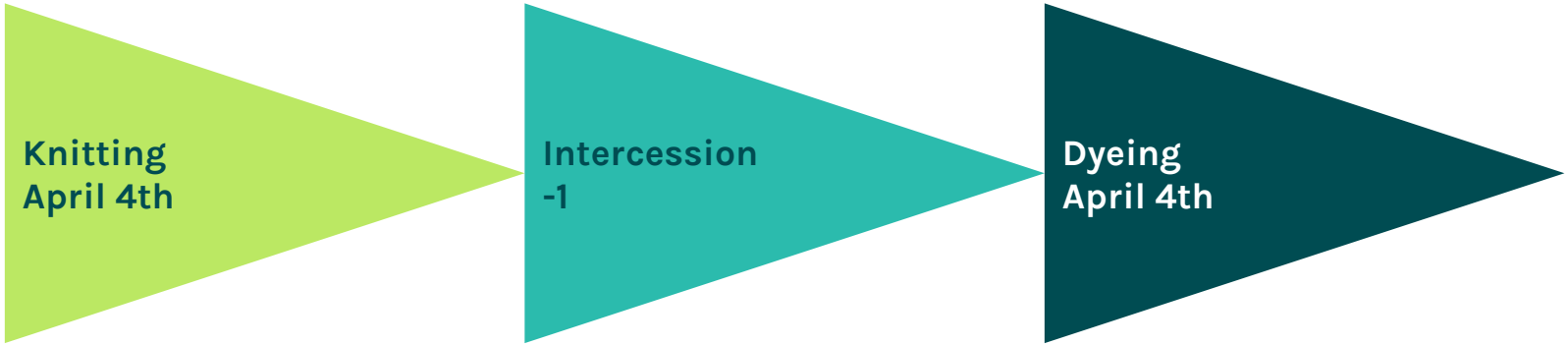
Speeds

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

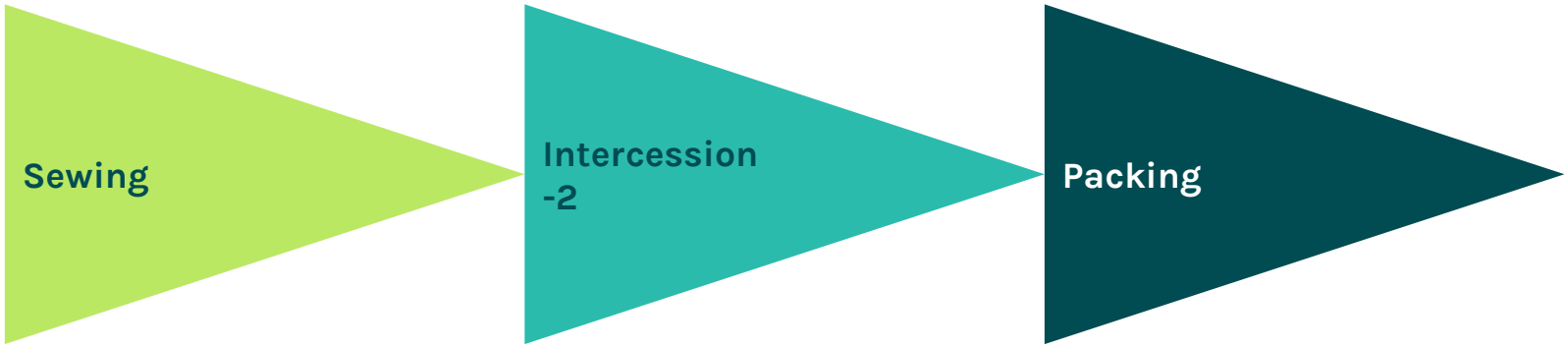
A significant portion of makespan is made up of time taken ***between steps***

-1 Intercession Times



Dyeing begins on the same day knitting is completed

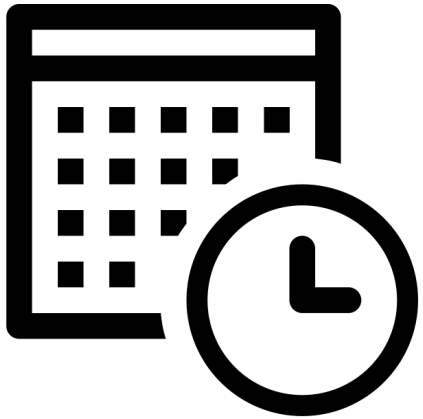
-2 Intercession Times



Packing begins the day before sewing is completed

3.

New Schedule Proposal

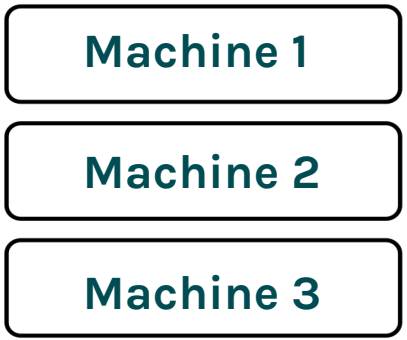


Shortest Processing Time

Shortest Processing Time

Continuously Reevaluate

As jobs complete, we reevaluate the SPT protocol to ensure that they are scheduled appropriately in the queue.



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.

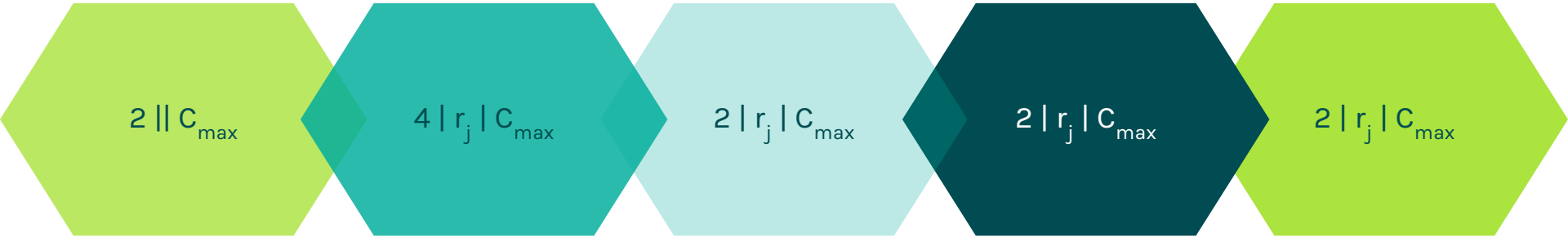
Processing Time: 24 Days

An improvement of 1 day using SPT over EDD

4.

Analysis and Algorithm Formulation

Algorithm


$2 \mid\mid C_{max}$
$4 \mid r_j \mid C_{max}$
$2 \mid r_j \mid C_{max}$
$2 \mid r_j \mid C_{max}$
$2 \mid r_j \mid C_{max}$

Algorithm Walkthrough

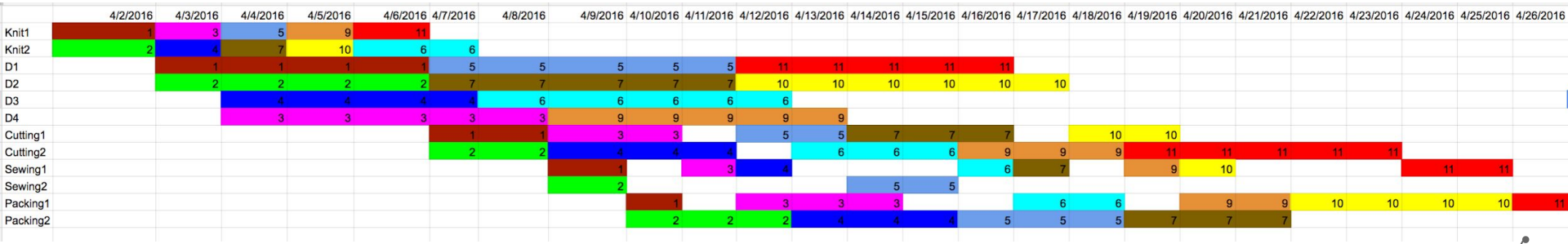
Processing Length
The algorithm collapses each step with its successive intercession time for a total “process length.”

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.

Final Schedule

The first job begins on April 2nd



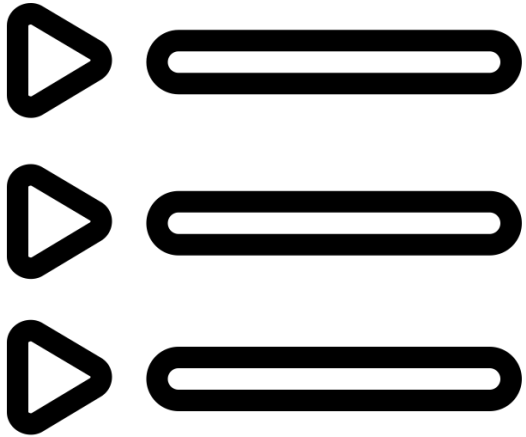
	4/2/2016	4/3/2016	4/4/2016	4/5/2016	4/6/2016	4/7/2016	4/8/2016	4/9/2016	4/10/2016	4/11/2016	4/12/2016	4/13/2016	4/14/2016	4/15/2016	4/16/2016	4/17/2016	4/18/2016	4/19/2016	4/20/2016	4/21/2016	4/22/2016	4/23/2016	4/24/2016	4/25/2016	4/26/2016
Knit1	1	3	5	9	11																				
Knit2	2	4	7	10	6	6																			
D1		1	1	1	1	5	5	5	5	5	11	11	11	11	11										
D2		2	2	2	2	7	7	7	7	7	10	10	10	10	10	10									
D3			4	4	4	4	6	6	6	6	6														
D4			3	3	3	3	3	9	9	9	9	9													
Cutting1						1	1	3	3		5	5	7	7	7		10	10							
Cutting2						2	2	4	4	4		6	6	6	9	9	9	11	11	11	11	11			
Sewing1								1		3	4				6	7		9	10				11	11	
Sewing2								2					5	5											
Packing1									1		3	3	3			6	6		9	9	10	10	10	10	11
Packing2									2	2	2	4	4	4	5	5	5	7	7	7					

The last job ends on April 26th

Preemption

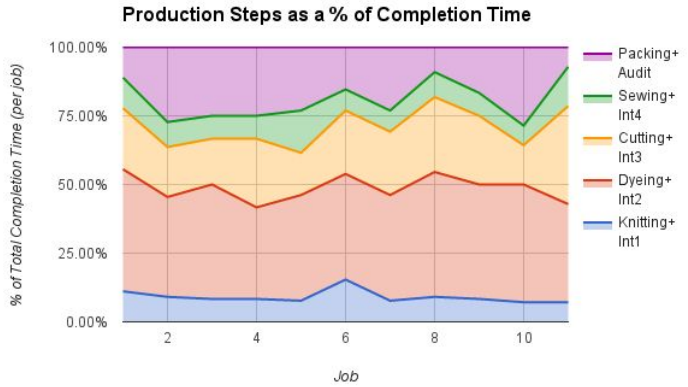
It is unlikely that a textile manufacturing operation can introduce preemption, as when dyes and materials are loaded into a machine the entire job must be completed as opposed to interrupted and then completed at a later date.

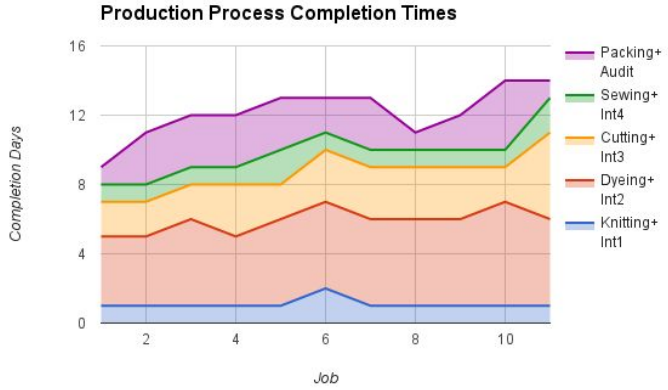
This prevents the schedule from being completely efficient, as we can see there is a sewing machine that is idle for four days due to this phenomenon.



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?