Lean Manufacturing – Exam Simulation

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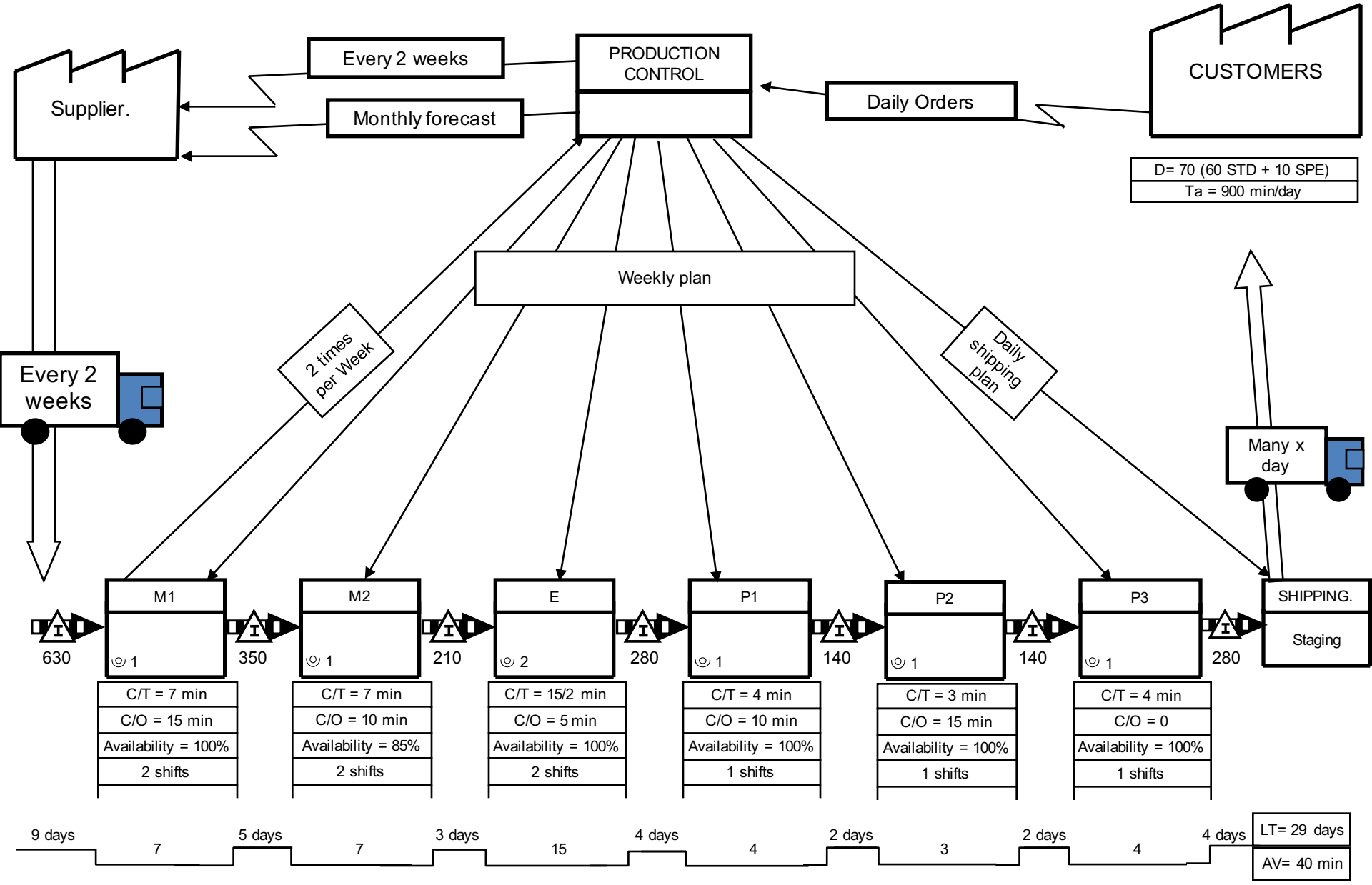
Kashmiro Spa

Question 1) Draw the Current State Map of the company (with the timeline).

Question 2) Compute the EPE for each stage and indicate the most rigid one.

Question 3) Draw the Future State Map of the company to design the future state, answering in detail to the first six questions of the eight questions. The target of the company is to define the minimum changes in order to have each buffer size for standard scarfs not exceeding 420 units and raw-material maximum stock equal to 700 pieces.

Question 1: Current State Map Kashmiro Spa



Q2: EPE

EPE (every part every) = time required to produce the whole product range

$$EPE_{STD} * Tp_{STD} + Ts_{STD} \leq EPE_{STD} * (Ta - Tp_{SPE} - Ts_{SPE})$$

$$EPE_{STD} \geq \frac{Ts_{STD}}{(Ta - Tp_{SPE} - Ts_{SPE}) - Tp_{STD}}$$

Ta (2 shifts) = 900 min/day

Ta (1 shift) = 450 min/day

Q2: EPE

M1

$$EPE \geq \frac{Ts}{Ta - Tp} = \frac{6 * 15min}{(900\ \text{min} - 10 * 15\ \text{min} - \frac{10 * 7min}{100\%}) - \frac{60 * 7min}{100\%}} = \mathbf{0,346\ days}$$

M2

$$EPE \geq \frac{Ts}{Ta - Tp} = \frac{6 * 10min}{(900\ \text{min} - 10 * 10\ \text{min} - \frac{10 * 7min}{85\%}) - \frac{60 * 7min}{85\%}} = \mathbf{0,268\ days}$$

E

$$EPE \geq \frac{Ts}{Ta - Tp} = \frac{30 * 5min}{(2 * 900\ \text{min} - 10 * 5\ \text{min} - \frac{10 * 15min}{100\%}) - \frac{60 * 15min}{100\%}} = \mathbf{0,214\ days}$$

P1

$$EPE \geq \frac{Ts}{Ta - Tp} = \frac{2 * 10min}{(450\ \text{min} - 10 * 10\ \text{min} - \frac{10 * 4min}{100\%}) - \frac{60 * 4min}{100\%}} = \mathbf{0,285\ days}$$

P2

$$EPE \geq \frac{Ts}{Ta - Tp} = \frac{2 * 15min}{(450\ \text{min} - 10 * 15\ \text{min} - \frac{10 * 3min}{100\%}) - \frac{60 * 3min}{100\%}} = \mathbf{0,33\ days}$$

Q3: FUTURE STATE

Draw the Future State Map of the company to design the future state, answering in detail to the first six questions of the eight questions. The target of the company is to define the minimum changes in order to have each buffer size for standard scarfs not exceeding 420 units and raw-material maximum stock equal to 700 pieces.

FROM PRESENT STATE TO FUTURE STATE

THE 8 QUESTIONS

Q3: FUTURE STATE

1. **What is the takt time?**

TT (2 shifts) = 900 min/70 pc = **12,85 min/pc**
TT (1 shift) = 450 min/70 pc= **6,42 min/pc**

2. Do we produce for finished goods supermarket or directly for shipping?

First step: Verify the characteristics of the product and of the market.

Standard Products: very short delivery lead times, fluctuations in demand… They are produced for **supermarket**.

Special Products: delivery lead times around 10 days, stable demand, customized product. The aim is to produce for **shipping**

3. Where can the company use the continuous flow processing?

General methodology :

- Start from the final stage and go upstream thinking stage by stage where to put CONTINUOUS FLOW and where to decouple (with SUPERMARKET or FIFO).
- Verify DECAF Conditions.
- Fix intermediate targets (not necessarily all at once in a continuous flow, but also FIFO and supermarket).

Q3: FUTURE STATE

P1+P2+P3

WCT=(4+3+4)min = 11 min → They are manual activities

#operators=$\left\lceil \frac{WCT}{TT1} \right\rceil = \left\lceil \frac{11}{6{,}42} \right\rceil = \lceil 1{,}71 \rceil =$ **2 operators**

We can save one operator

CT (cell) = $\frac{WCT}{\#operators} = \frac{11}{2} = 5{,}5$ min/pc → Since they are manual activities, we are able to split them.

CO (cell) = 15 min (it is done in parallel by the two operators, therefore it is the longest one)

Availability= 100%

Q3: FUTURE STATE

DECAF

- **Dedicated**: yes ✓
- **Capable**: CT<TT

  5,5 min < 6,42 min

  yes ✓
- **Available**: CT/A<TT

  5,5 min < 6,42 min

  yes ✓

Q3: FUTURE STATE

- **Flexible**:

EPE target

Buffer size for STD Scarfs = 420 pc = $2^{*}EPE^{T} * D$

EPE^{T} **= 3,5 days**

$$EPE^{T} * \frac{5{,}5\ \text{min} * 60}{100\%} + 2CO' \leq EPE^{T} * (450\ \text{min} - \frac{5{,}5\ \text{min} * 10}{100\%} - 10 * \text{CO}')$$

$CO' \leq$ **6,14 min**

SMED NEEDED

Embroidering from parallel to line

$$\#\text{operators} = \left\lceil \frac{6+9}{TT2} \right\rceil = \left\lceil \frac{15}{12{,}85} \right\rceil = \lceil 1{,}16 \rceil = \textbf{2 operators}$$

CT (E) = 9 min → It is not possible to equally split workloads on operators

Q3: FUTURE STATE

M1+M2+E

$$\#\text{operators (cell)} = \left\lceil \frac{6+9+7+7}{12{,}85} \right\rceil = \mathbf{3\ operators}$$

CT (cell) = 9 min (ironing – last phase)

CO (cell) = 15 min

Availability= 85%

Q3: FUTURE STATE

DECAF

- **Dedicated**: yes ✓
- **Capable**: CT<TT
  9 min < 12,85
  yes ✓
- **Available**: CT/A<TT
  9 min/85% < 12,85
  yes ✓

Q3: FUTURE STATE

- **Flexible**:

EPE target

Buffer size for STD Scarfs = 420 pc = 1,5*$EPE^T * D$

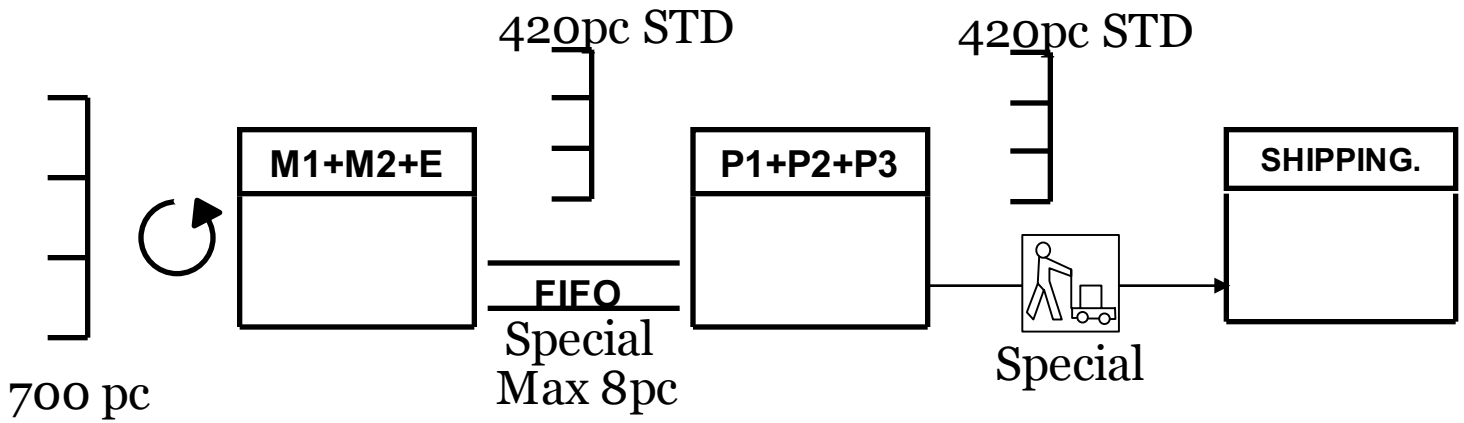
EPE^T = **4,67 days**

$$EPE^T * \frac{9\,\text{min} * 60}{85\%} + 30\,CO' \leq EPE^T * (900\,\text{min} - \frac{9\,\text{min} * 10}{85\%} - 10 * \text{CO}')$$

$CO' \leq$ **9,67 min**

SMED NEEDED

4. Where to put the pull-supermarket?



700 pc for raw material warehouse
700 pc = 2*D*LT
LT = 5 days
Supplier can deliver once per week

5. Where is the company single scheduling point?

Standard products → pacemaker is the second cell (P1+P2+P3)

Special products → pacemaker is the first cell (M1+M2+E)

Q3: FUTURE STATE

6. How should the company level the product mix to pacemaker process?

Volume:

- Finished good supermarket for std products
- Pre shop pool for custom made products

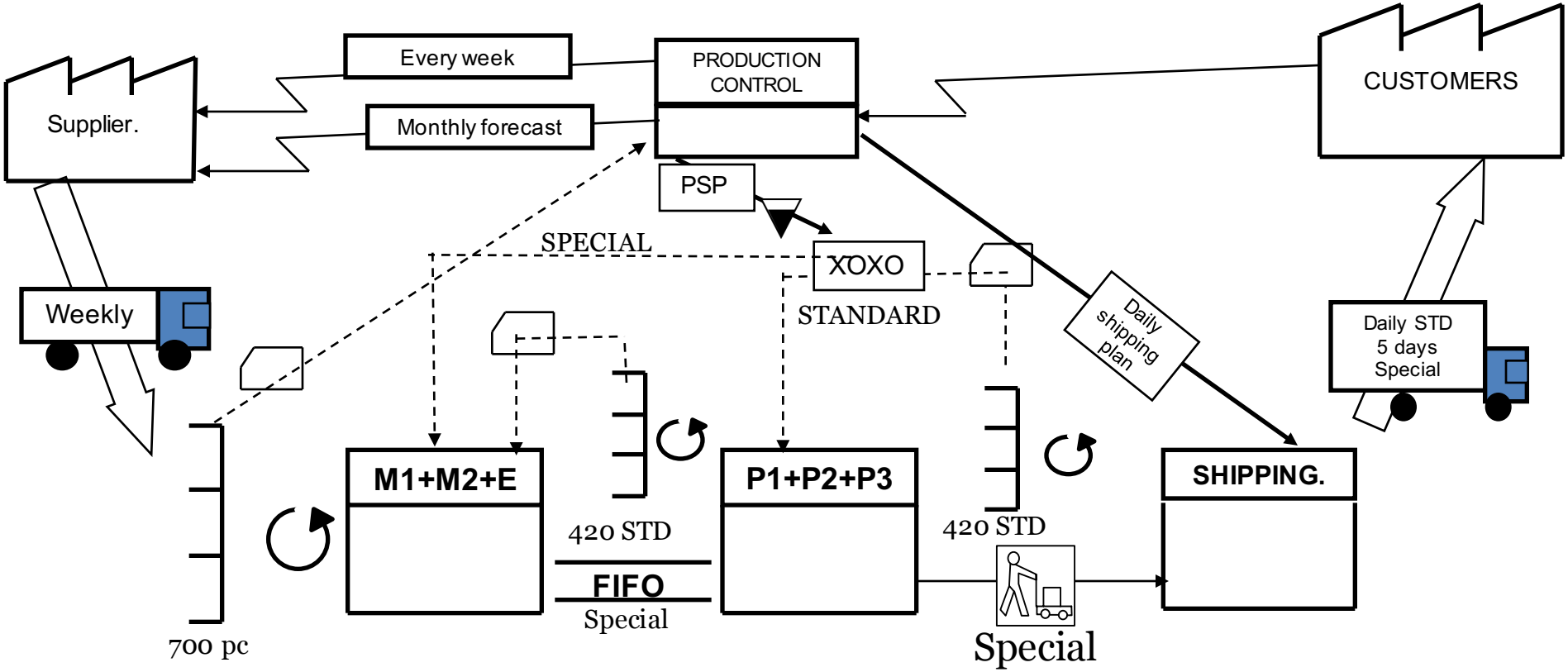
Mix

A Heijunka box where there are 60 kanbans for standard products, and 10 orders for custom made products

Standard products → Replenishment Kanban System
According to shipments that are made, the finished goods warehouse sends upstream the kanban.

Special products → Sequential PULL
The company collects customized orders, releasing them in a levelled mix and volume.

Q3: FUTURE STATE



POLITECNICO
MILANO 1863