VALUE STREAM MAPPING

LLA

LEAN LEARNING ACADEMY

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VALUE STREAM MAPPING

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0. Introduction to Value Stream Maps

- In 1998, Mike Rother and John Shook introduced the concept of Value Stream Mapping (VSM) with their book, "*Learning to See*".
- The motivation behind the concept was:
  - Many companies have rushed into massive "muda" elimination activities and continuous improvement processes but these well intentioned approaches fix only one small part of the value stream for each product
  - In reality, the value flow continuously comes to a halt in the swamp of inventories and detours ahead of the next downstream step.

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0. Introduction to Value Stream Maps

- Mike Rother and John Shook presented the concept of Value Stream as:

"A value stream is all the actions (both value added and non-value) currently required to bring a product through the main flows of essential to every product:

1. The production flow from raw material into the arms of the customer
2. The design flow from concept to launch

- The challenge is:

"Whenever there is a product for a customer, There is a value stream. The challenge lies in seeing it.""

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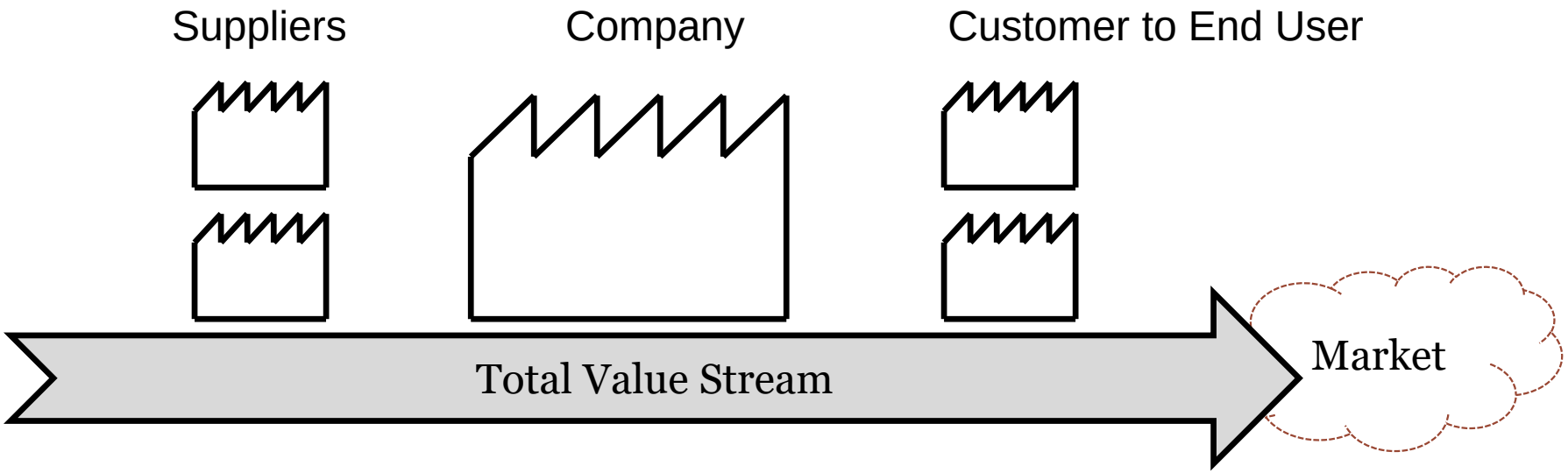
0. Introduction to Value Stream Maps

- Addressing the Value Stream perspective means looking to the big picture and not just the individual processes. Improving the whole and not just optimizing the parts.



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0. Introduction to Value Stream Maps

- Objectives of the Value Stream Mapping
  - Drawing value stream maps let the managers see the shop floor in a way that supports lean manufacturing
  - Supports the objective of implementing value-added flow
  - Ensures that the managers see a vision of how the flow should be

0. Introduction to Value Stream Maps

- Advantages of the Value Stream Mapping?
  1. Helps to visualize the whole flow and not only the single-process lever
  2. Helps to see the sources of waste in the value stream
  3. Provides a common language for manufacturing process definition
  4. Makes decision about the flow visible, so its possible to discuss them
  5. It forms the basis of an implementation plan, becoming the blueprint of the lean implementation
  6. Shows the link between the information flow and the material flow
  7. Is a qualitative tool to describe in detail how the facility should operate

0. Introduction to Value Stream Maps

- How should be done the Value Stream Mapping?
  1. Draw a visual representation of every process in the material and information flow from product's production path from customer to supplier
  2. Ask the necessary questions to comprehend the full extend of the material and informational flows
  3. Draw a future state map of how the value stream should flow in order the achieve leanness.

0. Introduction to Value Stream Maps

- Phases of the Value Stream Mapping
  1. Select a product family
  2. Define the value stream manager
  3. Draw the current state map
  4. Evaluate the current state of the value stream
  5. Draw the future state value stream map
  6. Achieve the future state of value stream

Product Family Selection

1. Product Family Selection

- Product Family Selection
  - In general is too complicated to try to map every product that goes through shop floor
  - It is necessary to focus on only one product family at a time
  - Value stream mapping involves the detailed processing steps of both material and information flows for one product family
  - A family is a group of products that pass through similar processing operations over common equipment
  - The identification of the product families starts from the customer end of the value stream

1. Product Family Selection

- How to define a Product Family
  - Seek for sets of products with similar or very similar process sequences and group them together
  - Create a matrix with process steps and equipment on one axis, and products list on the other axis
  - Apply a clustering algorithm when the number of products is to high

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1. Product Family Selection

- The process steps matrix
  - The operations necessary to manufacture the pieces in machines may be represented in the form of a matrix, which has m rows representing the machines, while the n columns refer to the pieces.
  - It is considered a_{ij} = 1 for the piece , which requires operation on the machine, and a = 0 for the piece j, which no needs operation.

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1. Product Family Selection

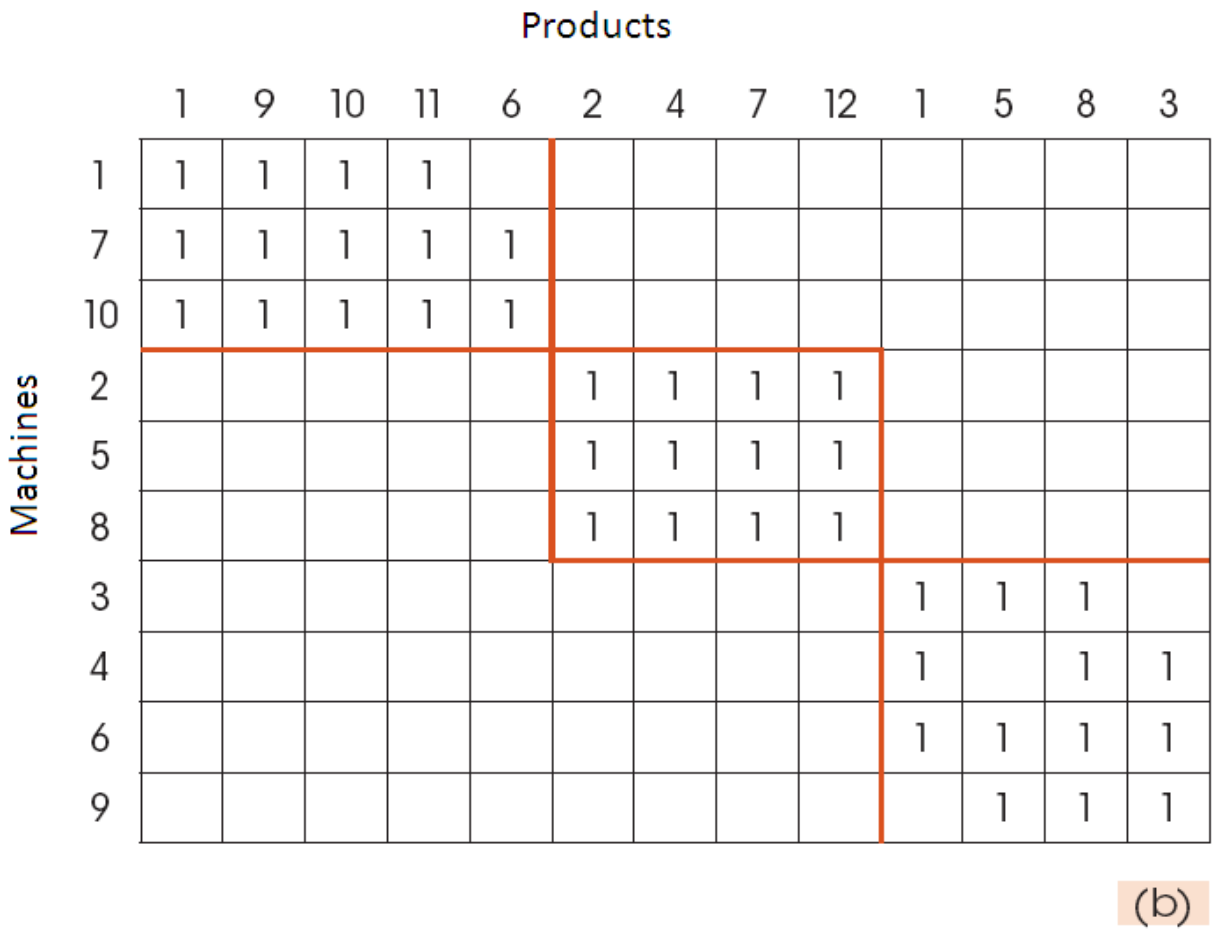
- Initial Matrix

Machines \ Products	1	2	3	4	5	6	7	8	9	10	11	12
1									1	1	1	
2		1		1			1					1
3	1				1			1				
4	1		1					1				
5		1		1			1					1
6	1		1		1			1				
7						1			1	1	1	
8		1		1			1					1
9			1		1			1				
10						1			1	1	1	

(a)

1. Product Family Selection

- Final Matrix



Machines \ Products	1	9	10	11	6	2	4	7	12	1	5	8	3
1	1	1	1	1									
7	1	1	1	1	1								
10	1	1	1	1	1								
2						1	1	1	1				
5						1	1	1	1				
8						1	1	1	1				
3										1	1	1	
4										1		1	1
6										1	1	1	1
9											1	1	1

(b)

1. Product Family Selection

- Some clustering algorithms applicable

  - *rank order clustering* (ROC) of King (1980)
  - *direct clustering analysis* (DCA) de Chan e Milner (1982)
  - *cluster identification algorithm* (CIA) de Kusiak e Chow (1987)

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1. Product Family Selection

- An example matrix to be solved

Machines \ Products	1	2	3	4	5	6	7
1		1		1			1
2			1		1		
3	1	1		1			1
4	1		1			1	
5			1	1	1	1	

1. Product Family Selection

- *Rank order clustering* (ROC) of King

1) For each matrix line define a binary score and calculate the equivalent decimal score

$$Score\ of\ Line\ i = \sum^{n} a_{ik} * 2^{n-k}; \quad n = number\ of\ products$$

Products

Machines	1	2	3	4	5	6	7	Decimal Score
Binary Score	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
1		1		1			1	41
2			1		1			20
3	1	1		1			1	105
4	1		1			1		82
5			1	1	1	1		30

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1. Product Family Selection

- *Rank order clustering* (ROC) of King

2) To sort the matrix lines by descending order of the decimal scores

Machines \ Products	1	2	3	4	5	6	7
3	1	1		1			1
4	1		1				1
1		1		1			1
5			1	1	1	1	
2			1		1		

1. Product Family Selection

- *Rank order clustering* (ROC) of King

  3) For each matrix colum obtained in 2) define a binary score and calculate the equivalent decimal score

$$Score\ of\ Colum\ j\ = \sum_{k=1}^{m} a_{ik} * 2^{m-k};\quad m = number\ of\ machines$$

Machines		Products 1	2	3	4	5	6	7
3	2^4	1	1		1			1
4	2^3	1		1				1
1	2^2		1		1			1
5	2^1			1	1	1	1	
2	2^0			1		1		
Decimal Score		24	20	11	22	3	10	20

1. Product Family Selection

- *Rank order clustering* (ROC) of King

4) To sort the matrix coluns by descending order of the decimal scores:

Machines \ Products	1	4	2	7	3	6	5
3	1	1	1	1			
4	1				1	1	
1		1	1	1			
5		1			1	1	1
2					1		1

1. Product Family Selection

- *Rank order clustering* (ROC) of King

5) Repeat the steaps 1 to 4 until there is no more coluns and lines change

Because there is no more position chages, the solution found is:

Machines \ Products	1	4	2	7	3	6	5
3	1	1	1	1			
4	1				1	1	
1		1	1	1			
5		1			1	1	1
2					1		1

1. Product Family Selection

- *Direct clustering analysis* (DCA) de Chan e Milner

1) Determine the total number of elements one in each row and each column in the matrix

Machines \ Products	1	2	3	4	5	6	7	
1		1		1			1	3
2			1		1			2
3	1	1		1			1	4
4	1		1			1		3
5			1	1	1	1		4
	2	2	3	3	2	2	2	

1. Product Family Selection

- *Direct clustering analysis* (DCA) de Chan e Milner

2) Rearrange the rows in ascending order of total number of elements 1

Machines \ Products	1	2	3	4	5	6	7
2			1		1		
1		1		1			1
4	1		1			1	
3	1	1		1			1
5			1	1	1	1	

1. Product Family Selection

- *Direct clustering analysis* (DCA) de Chan e Milner

3) Rearrange the columns in descending order of total number of elements 1

Machines \ Products	1	2	5	6	7	3	4
2			1			1	
1		1			1		1
4	1			1		1	
3	1	1			1		1
5			1	1		1	1

1. Product Family Selection

- *Direct clustering analysis* (DCA) de Chan e Milner

4) Repeat steps 1-3 until there is no change of position of the matrix elements

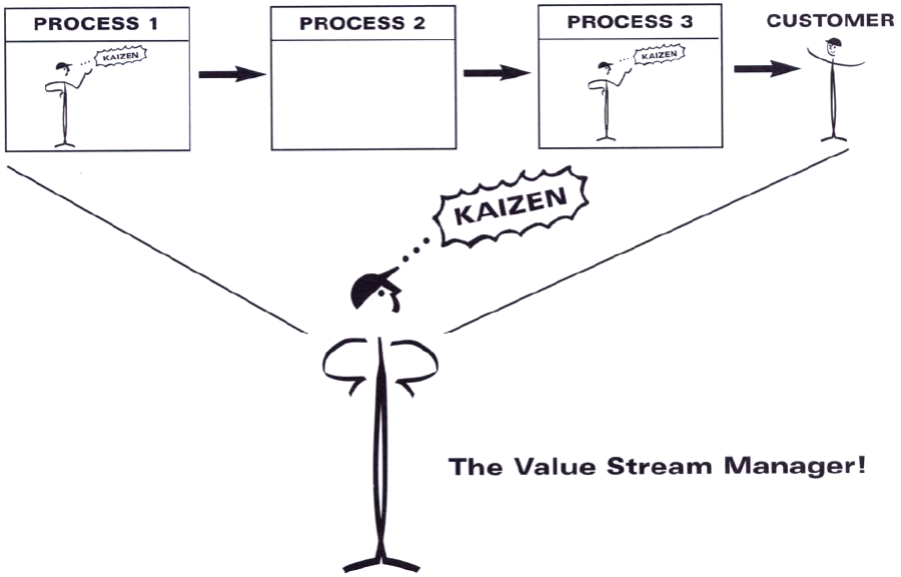
Made the necessary changes of the first three steps, the solution is

Machines \ Products	2	4	7	1	3	5	6
1	1	1	1				
3	1	1	1	1			
5		1			1	1	1
2					1	1	
4				1	1		1

Value Stream Manager Definition

2. Value Stream Manager Definition

- Role of the Manager:
  - Envision the whole value stream
  - Lead the responsibility for understanding a products family value stream and improve it



2. Value Stream Manager Definition

- Difficulties in the identifying the manager:
  - Companies are organized by departments and functions
  - Each Department lacks an overall value stream perspective
  - Each individual processing areas normally operate in a way that seeks an optimum from their perspective, not the value stream perspective
  - In most cases there is an absence of a person who knows the entire material and information flow for a product

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2. Value Stream Manager Definition

- Job Description for a value stream manager:
  - Reports lean implementation progress to the top person on the site
  - A line person, not staff, with the capability to make change happen across functional and departmental boundaries
  - Leads the creation of the current state and future state maps and the implementation plan for getting from present to future
  - Monitors all aspects of implementation

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2. Value Stream Manager Definition

- Job Description for a value stream manager (cont.):
  - Walks and checks the flow of the value stream daily or weekly
  - Makes implementation a top priority
  - Maintains and periodically updates the implementation plan
  - Insists on being a hands-on person driven by results

And most important:

Have a full commitment with the value stream mapping project

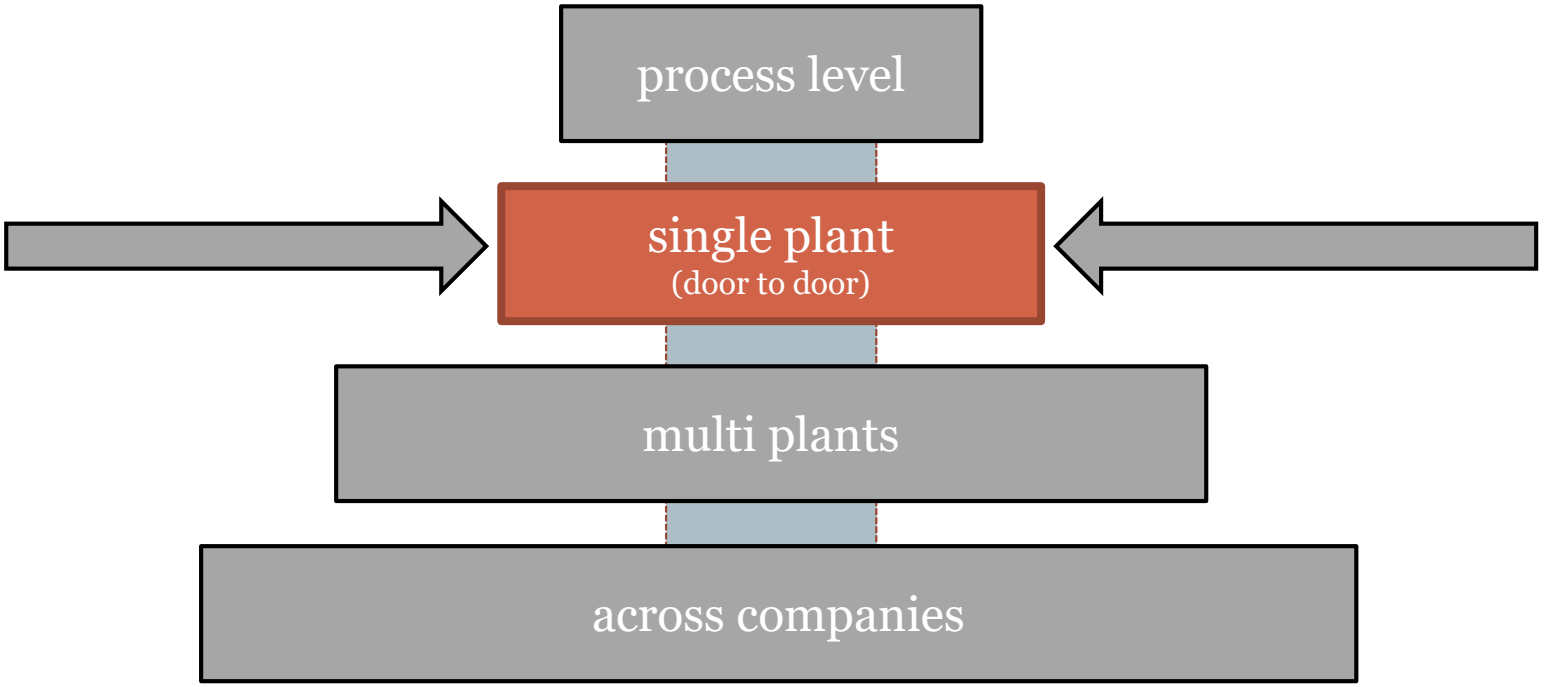
Current State Map Drawing

3. Current State Map Drawing

- Purpose of the Current State Mapping:
  - To make clear the current production situation by drawing the material and information flows
  - Support the development of a future state based on the analysis of the current production situation

3. Current State Map Drawing

- Levels of mapping the value stream for a product family



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3. Current State Map Drawing

- Starting Tips for Current State Mapping:
  - Collect personally the current-state information while walking along side the pathways of the material flows
  - Start the mapping by doing a quick walk overview along the entire door-to-door value stream to get a sense of the flow and the sequences of the process
  - Begin at the shipping end and map upstream starting from the processes that are linked most directly to the customer.

3. Current State Map Drawing

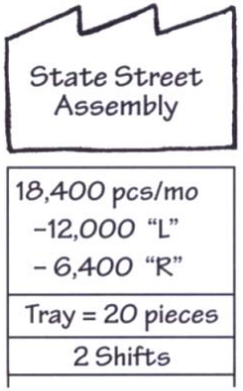
- Starting Tips for Current State Mapping:
  - Bring you stopwatch and do not rely on the previous collected information
  - Map the whole value stream yourself in order to fully understand the whole flow
  - Draw the map by hand in pencil right on the shop floor as you conduct your current-state analysis

3. Current State Map Drawing

- Steps to draw current state mapping:
  1. Get a blank sheet of paper (e.g. A3) and a pencil
  2. Map the customer requirements

  Example:

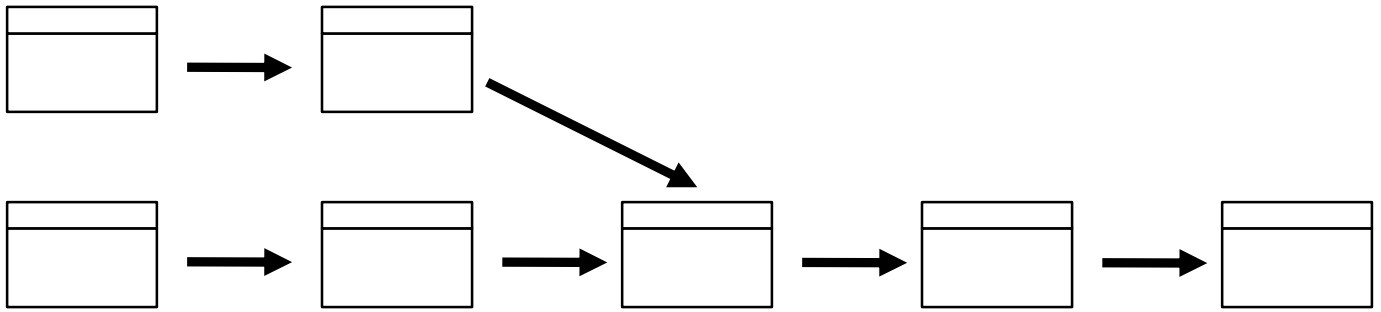
  Draw a Factory icon for the customer in the upper right portion of the map and a data box recording the customer requirements



3. Current State Map Drawing

- Steps to draw current state mapping:
  3. Draw the basic production processes
     - Material flow is drawn from left to right in the order of the processing steps
     - Processes are represented by a process box and flows by arrows

Example:



3. Current State Map Drawing

- Steps to draw current state mapping:
  4. Collect data for each process box
     - Typical process data:
       - Cycle Time (C/T) – time that elapses between one part coming off the process and the next part coming off;
       - Changeover time (CO) – time to switch from one product type to another;
       - Number of operators – number of people required to operate the process;
       - Available working time – working time per shift at the process;
       - Machine uptime – on-demand machine uptime;
       - Production batch sizes (EPE – every part every ...day, week etc.);
       - Number of products variations;
       - Lot size;
       - Working time – processing time minus breaks

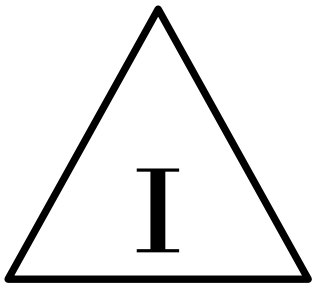
3. Current State Map Drawing

- Steps to draw current state mapping:

5. Draw inventory accumulation

- Use a warning triangle icon to capture the location and the amount of the inventory

Example:



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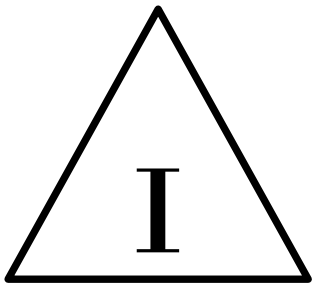
3. Current State Map Drawing

- Steps to draw current state mapping:

5. Draw inventory accumulation

- Use a warning triangle icon to capture the location and the amount of the inventory

Example:



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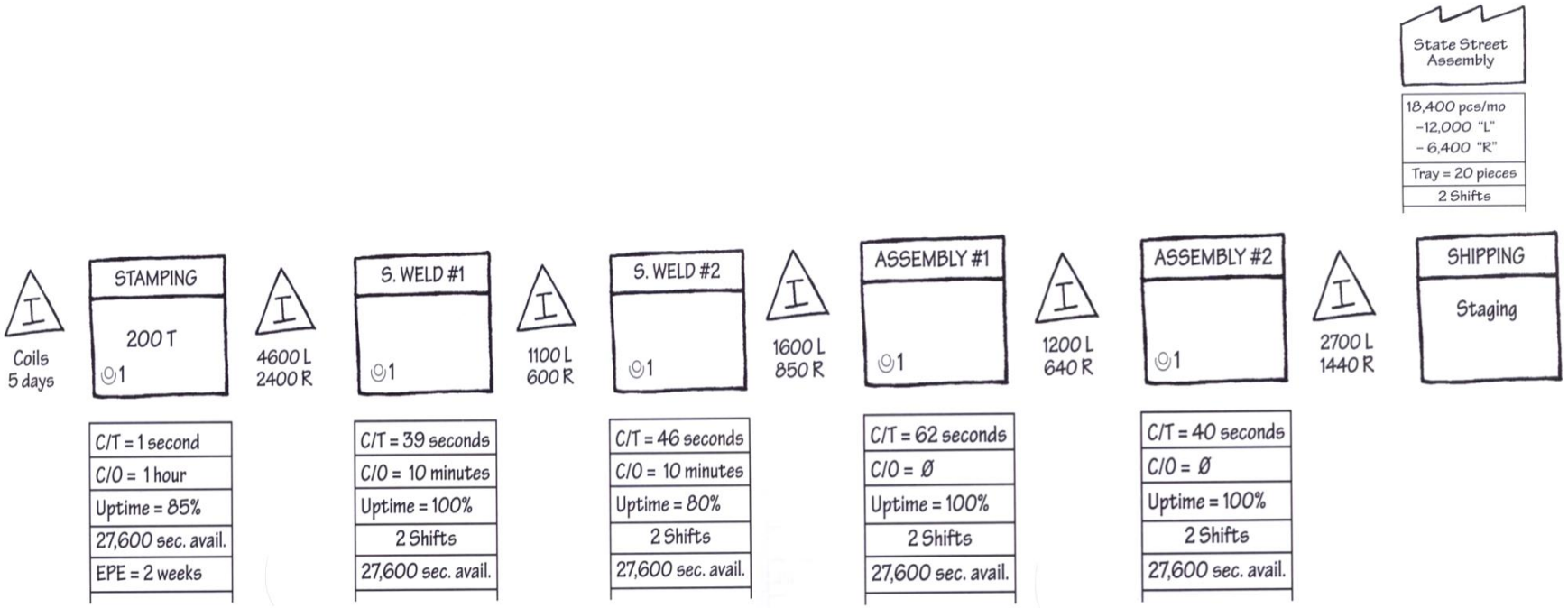
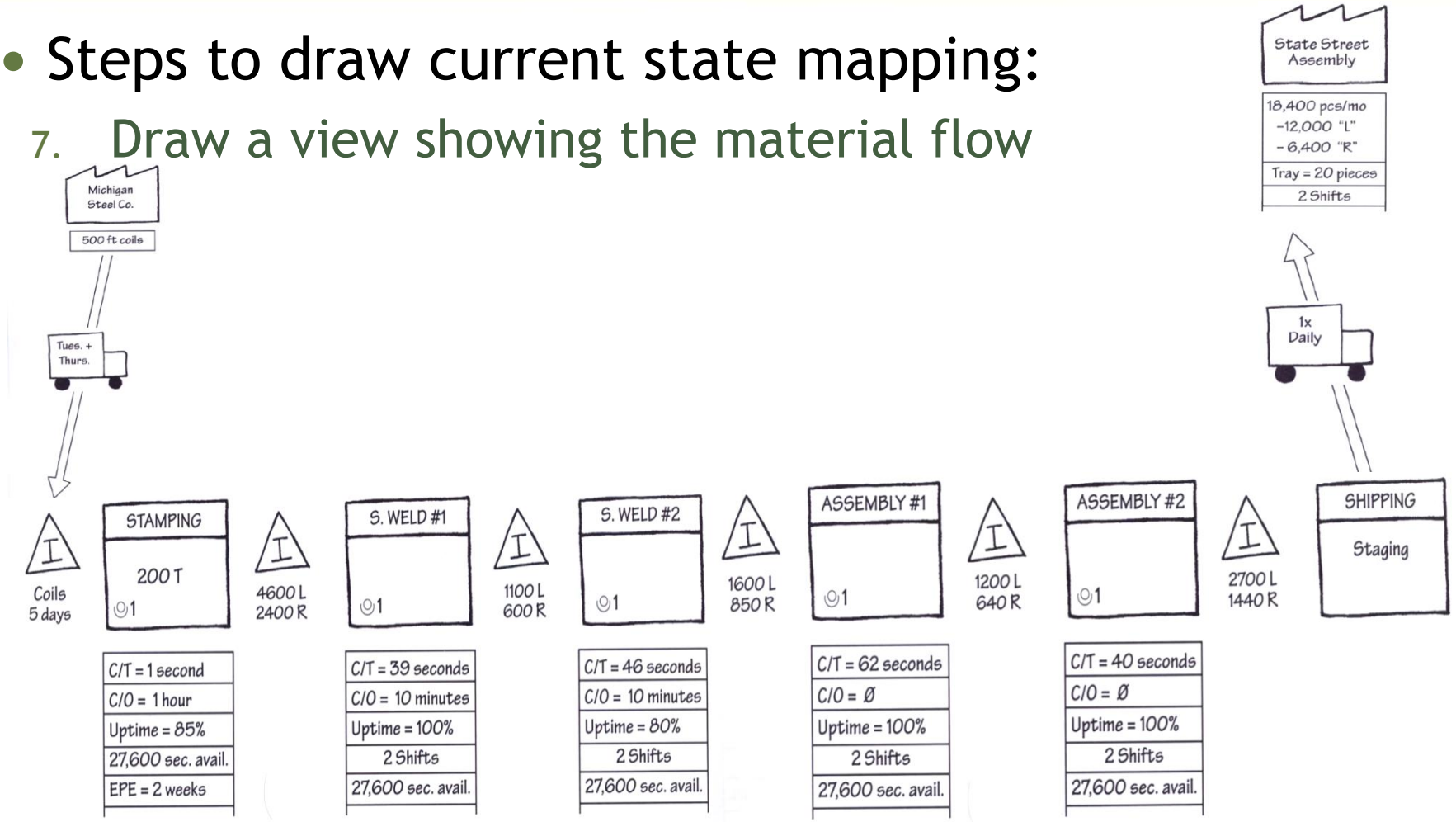
3. Current State Map Drawing

- Steps to draw current state mapping:
  6. Draw a view with processes, data boxes and inventory



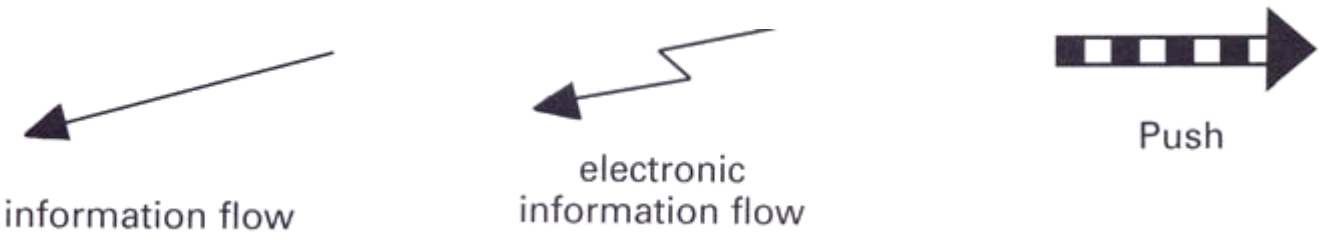
3. Current State Map Drawing

- Steps to draw current state mapping:
  7. Draw a view showing the material flow



3. Current State Map Drawing

- Steps to draw current state mapping:
  8. Draw a view showing the information flow
     - Information flow is drawn from right to left in the top half of the map space



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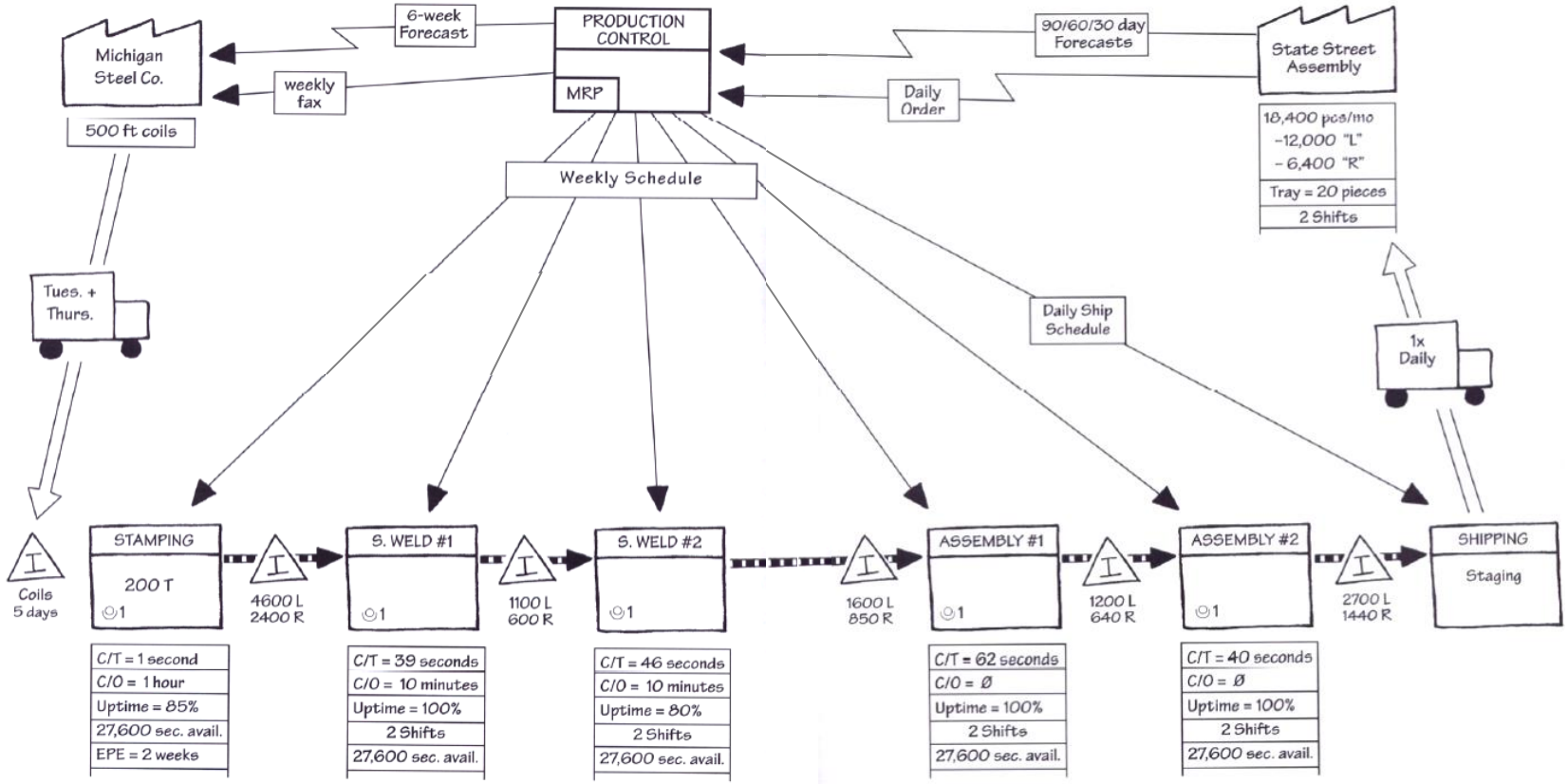
3. Current State Map Drawing

- Steps to draw current state mapping:
  8. Draw a view showing the information flow



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3. Current State Map Drawing

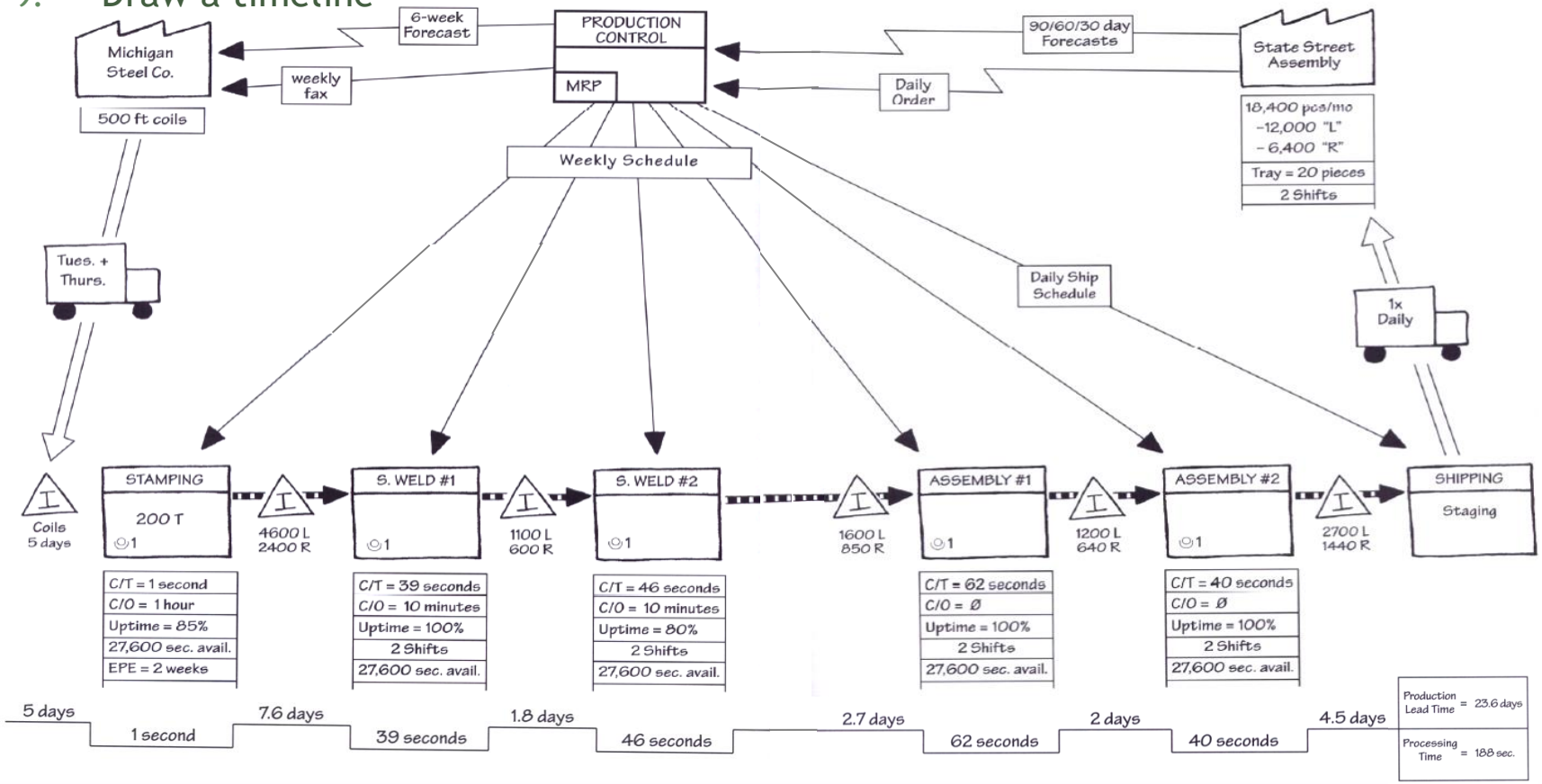
- Steps to draw current state mapping:

9. Draw a timeline

  - Represent under the processes boxes and inventory triangles the production lead time, which is the time it takes one part to make its way through the shop floor
  - Begin with the arrival of the raw material through to shipment to the customer
  - To calculate lead times for inventory triangle is necessary to divide inventory quantity by the daily customer requirement
  - By adding the lead times trough each process and each inventory triangle in the material flow, we arrive to a good estimate of the total production lead time

3. Current State Map Drawing

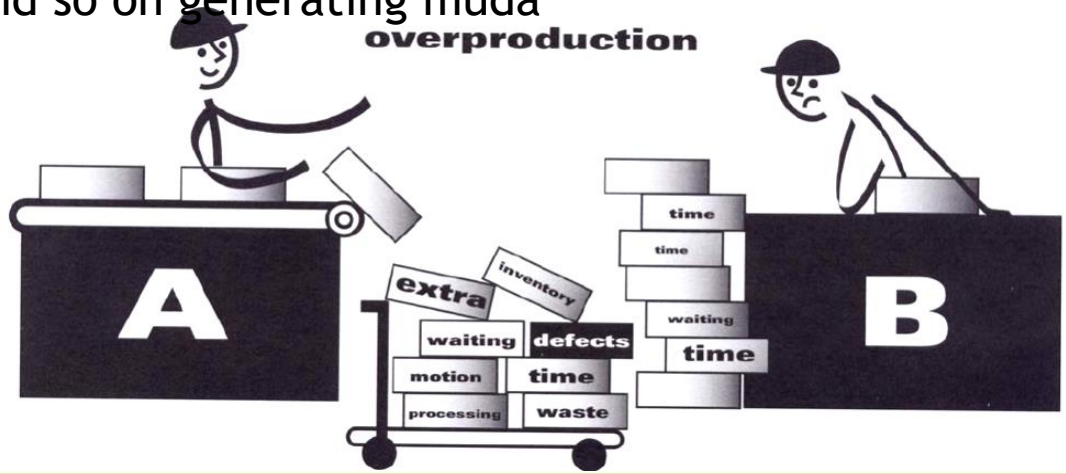
- Steps to draw current state mapping:
  9. Draw a timeline



Value Stream Current State Evaluation

4. Value Stream Current State Evaluation

- Main obstacle to obtain a Lean Value Stream:
  - Overproduction – producing more, sooner or faster than is required by the next process:
    - each process in the value stream operates as an isolated island
    - each process produces pushes products forward before any actual customer needs
    - since this material output is not yet needed it must be handled, counted, stored and so on generating muda



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4. Value Stream Current State Evaluation

- Main obstacle to obtain a Lean Value Stream:
  - Overproduction causes all kink of wastes:
    - Unnecessary parts storing and handling
    - Shortages because processes are busy making the wrong parts
    - Requires extra equipment and resources capacity because the production of parts not yet needed
    - Lengths the lead time
    - Reduces the flexibility to respond to customer requests

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4. Value Stream Current State Evaluation

- Characteristics of a Lean Value Stream
  - Main objectives:
    - To get one process to make only what the next process needs when it needs it
    - Link all the processes from the final consumer back to the raw materials in a smooth flow without detours that generates the shortest lead, highest quality and lowest cost

How to achieve this???

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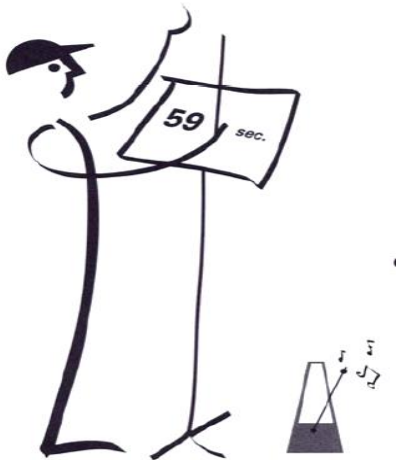
4. Value Stream Current State Evaluation

- Guidelines to a Lean Value Stream
  1. Produce to your takt time
  2. Develop continuous flow wherever possible
  3. Use supermarkets to control production where continuous flow does not extend upstream
  4. Try to send the customer schedule to only one production process
  5. Distribute the production of different products evenly over the time at the pacemaker process
  6. Create an initial pull by releasing and withdrawing small, consistent increments of work at the pacemaker process
  7. Develop the ability to make every part every day in fabrication processes upstream of the pacemaker process

4. Value Stream Current State Evaluation

1. Produce to your takt time
   - Takt time is how often a part should be produced, based on the rate of sales, to meet customer requirements
   - Takt time is calculated by dividing the customer demand rate per shift in units, into the available working time per shift in seconds
   - Is used to synchronize the pace of the production with the pace of sales



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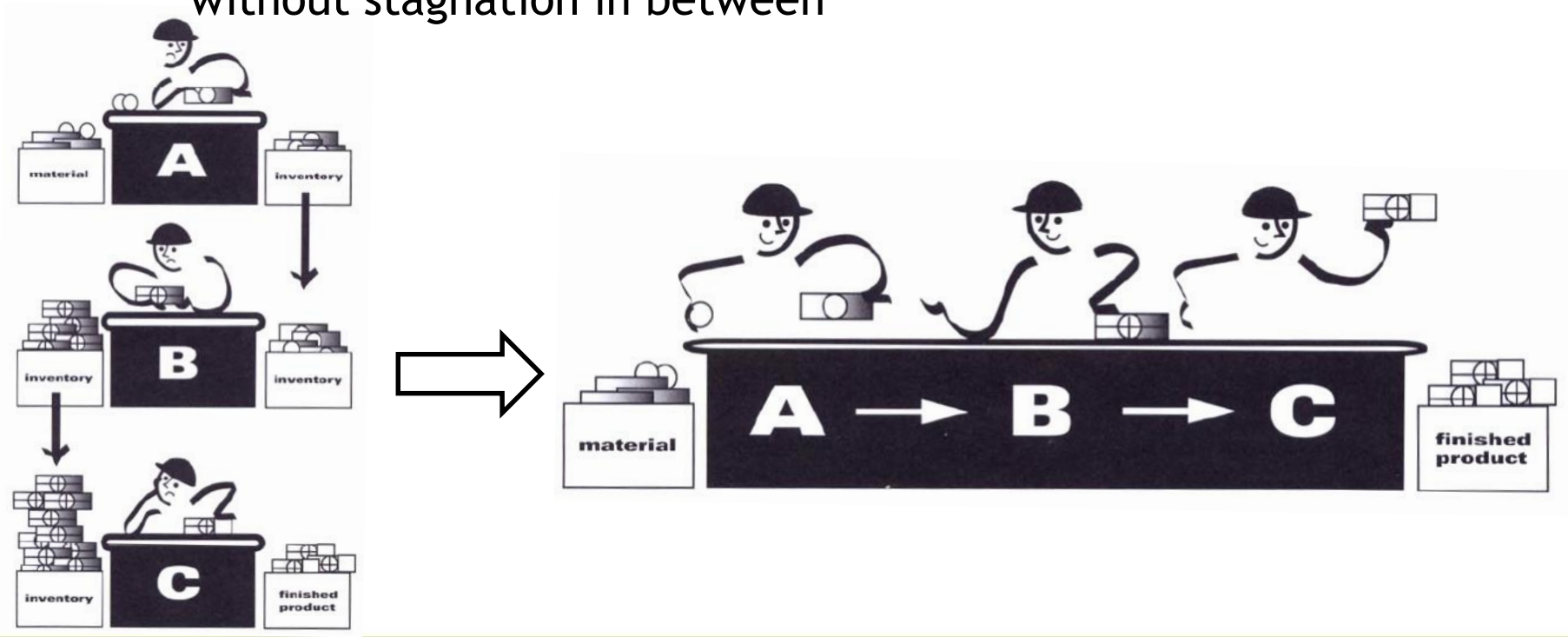
4. Value Stream Current State Evaluation

2. Develop continuous flow wherever possible

- Continuous flow refers to producing one piece at a time, with each part passed immediately from one process step to the next without stagnation in between



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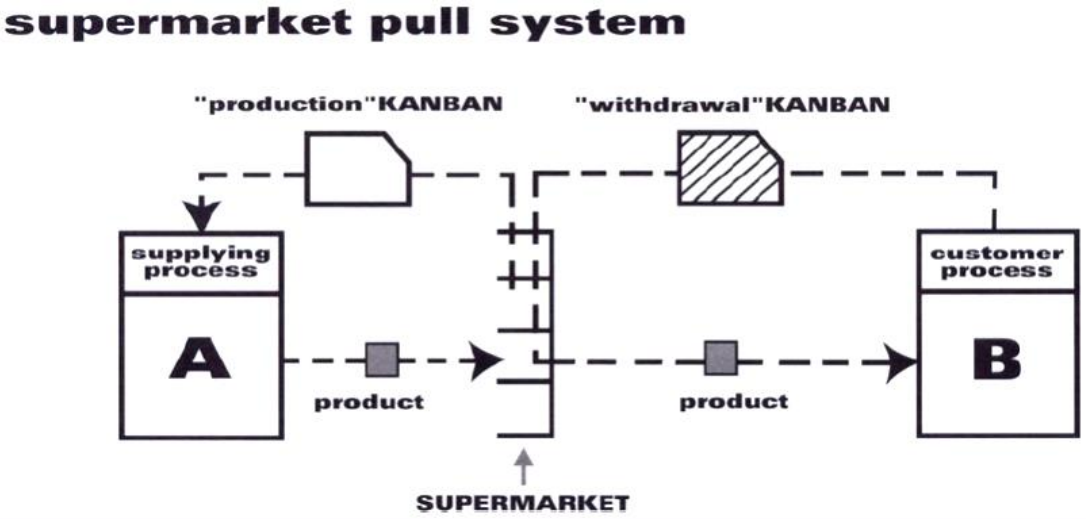
4. Value Stream Current State Evaluation

3. Use supermarkets to control production where continuous flow does not extend upstream
   - There are spots in the value stream where continuous flow is not possible and batching is necessary
   - Control the production through a link with a downstream customer via supermarket based pull system



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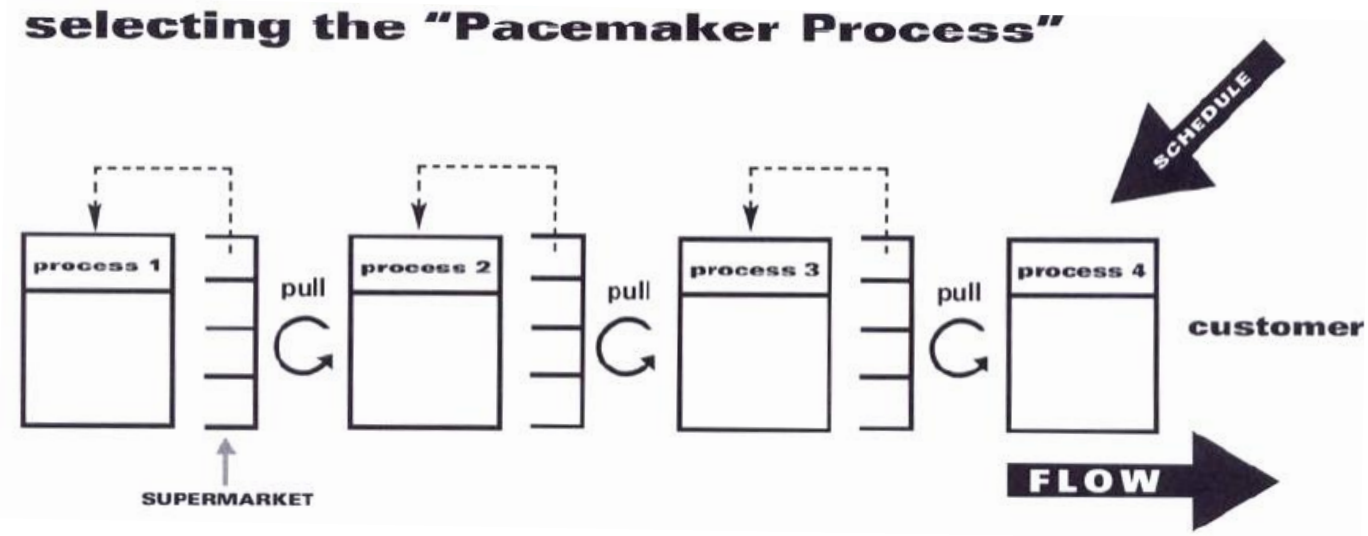
4. Value Stream Current State Evaluation

4. Try to send the customer schedule to only one production process
   - Using supermarket pull systems, it is only necessary to schedule only one point in the value stream
   - This point is called the **pacemaker process** - because it sets the pace for all the upstream processes



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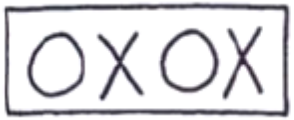
4. Value Stream Current State Evaluation

5. Distribute the production of different products evenly over the time at the pacemaker process

- **Grouping the same products and producing them all at once makes difficult to serve customers who want something different from the batch being produced now.**
- **Batching in production also means in process inventories**
- **Levelling the product mix means distributing the production of different products evenly over a period of time**
- **The more the levelling is achieved at the pacemaker process, the more able will be the process to respond to different customer requirements in a short lead time without holding finished goods inventory**

The icon for levelling which is inserted into the information flow arrow



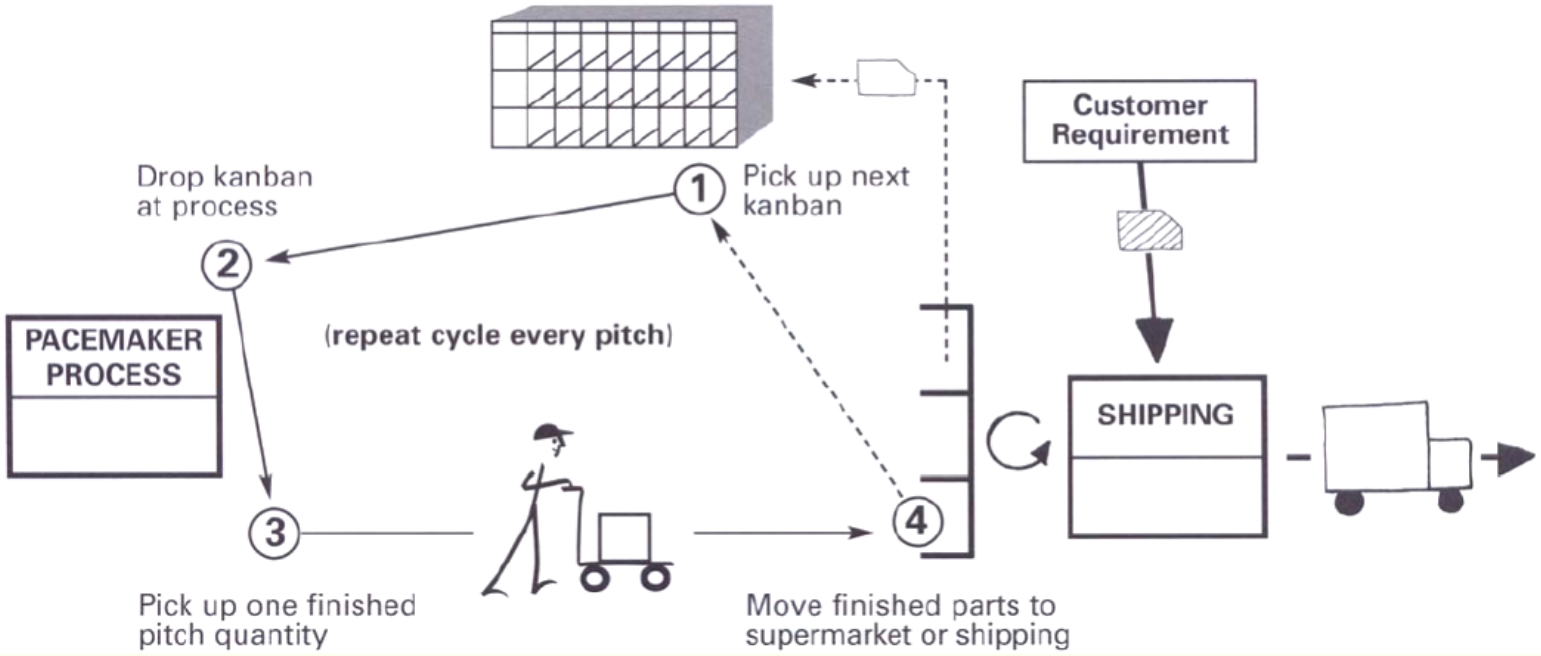
Load Leveling

4. Value Stream Current State Evaluation

6. Create an initial pull by releasing and withdrawing small, consistent increments of work at the pacemaker process
   - **Establishing a consistent or level production pace creates a predictable production flow**
   - **In order to support a quick corrective actions is necessary to implement a paced withdrawal**
   - **A paced withdrawal is achieved by releasing only a small, consistent amount of production instruction (usually between 5-60 min) at the pacemaker process and simultaneously take away an equal amount of finished goods**

4. Value Stream Current State Evaluation

6. Create an initial pull by releasing and withdrawing small, consistent increments of work at the pacemaker process
   - **Example of a paced withdrawal**



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4. Value Stream Current State Evaluation

7. Develop the ability to make every part every day in fabrication processes upstream of the pacemaker process

- **With short changeover times and smaller batches, the processes will be able to respond to changing downstream needs more rapidly**
- **Processes also will require less inventory to be held in their supermarkets**
- **With EPE (every part every ...) it is described how frequent a process changes over to produce all part variations**
- **In order to run smaller batches is necessary to reduce the changeover time and/or improve overall uptime**

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Future State Value Stream Map Drawing

5. Future State Value Stream Map Drawing

- Future State Map:
  - The purpose of the value stream mapping is to highlight sources of waste and eliminate them by implementing a lean value stream
  - The goal is to build a chain of production where the individual processes are linked to their customers either by continuous flow or pull mechanisms
  - The ideal scenario is when each process produces only what is customer need, when they need it
  - The first iteration of a future state map should take product designs, process technologies, and plant locations as given and seek to remove as quickly as possible all sources of waste
  - An useful aid for helping people draw future state maps is the following questions:

5. Future State Value Stream Map Drawing

- Future State Map:
  1. What is the takt time based on the available working time of the downstream processes that are closest to the customer?
  2. Will you build to a finished goods supermarket from which the customer pulls, or directly to shipping?
  3. Where can you use continuous flow processing?
  4. Where will you need to use supermarket pull systems in order to control production of upstream processes?

5. Future State Value Stream Map Drawing

- Future State Map:
  5. At what single point in the production chain will you schedule production?
  6. How will you level the production mix at the pacemaker process?
  7. What increment of work will you consistently release and take away at the pacemaker process?
  8. What processes improvements will be necessary for the value stream to flow as you future state design specifies?

5. Future State Value Stream Map Drawing

- Drawing the future state map example:

1. What is the takt time based on the available working time of the downstream processes that are closest to the customer?
   - Available working time for one shift= 28800 s (8 hours)
   - Subtract non-working time 2*10 min per shift
   - Customer demand of 460 units per shift

$$\frac{Available\ Working\ Time}{Customer\ Demand} = \frac{27600s}{460\ units} = 60s$$

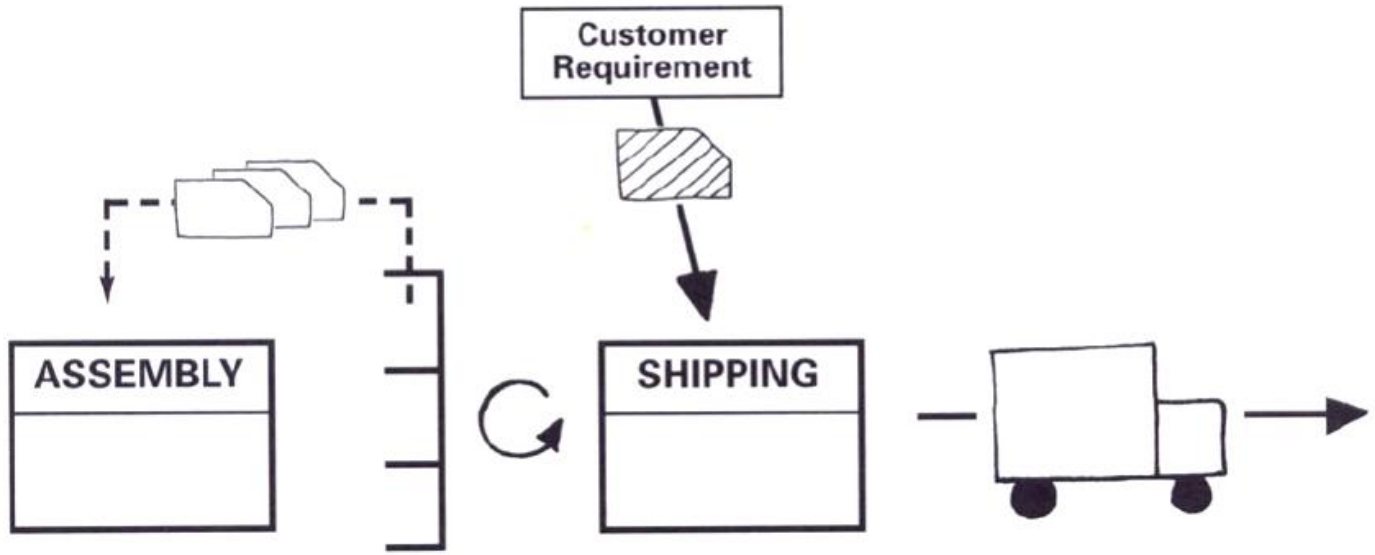
5. Future State Value Stream Map Drawing

- Drawing the future state map example:

2. Will you build to a finished goods supermarket from which the customer pulls, or directly to shipping?

Example: Building to a Supermarket

The supermarket schedules assembly (Acme's choice)



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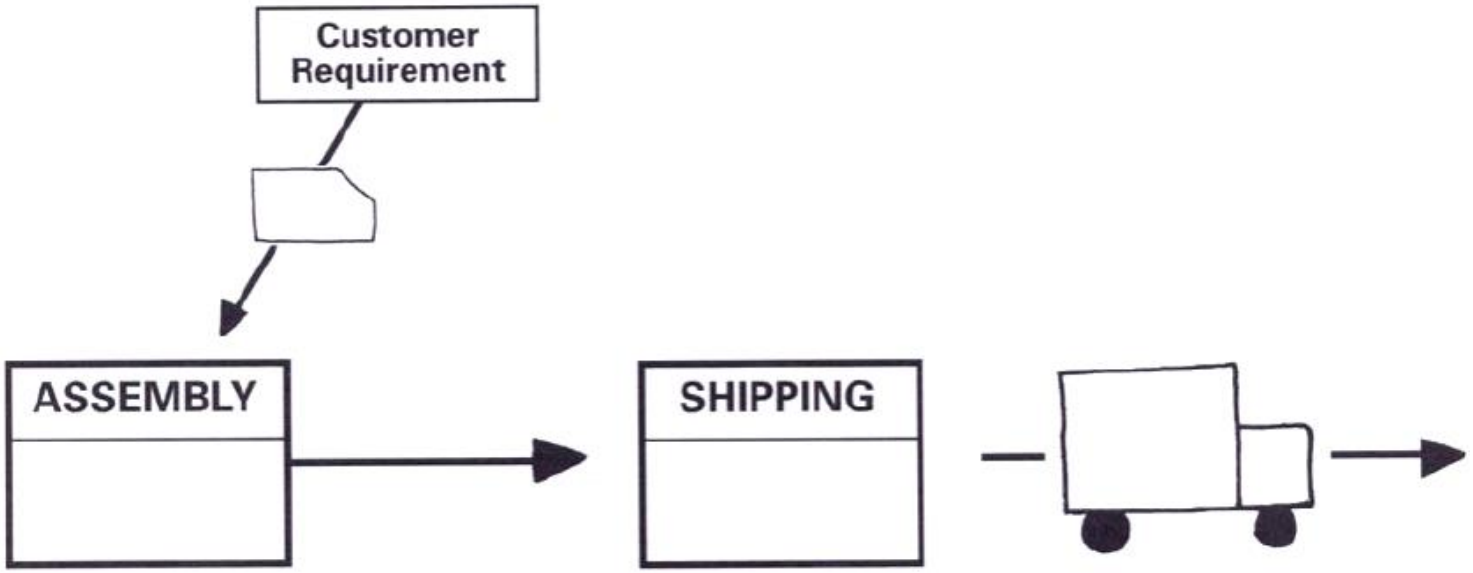
5. Future State Value Stream Map Drawing

- Drawing the future state map example:

2. Will you build to a finished goods supermarket from which the customer pulls, or directly to shipping?

Example: Building Directly to Shipping

Production Control schedules assembly



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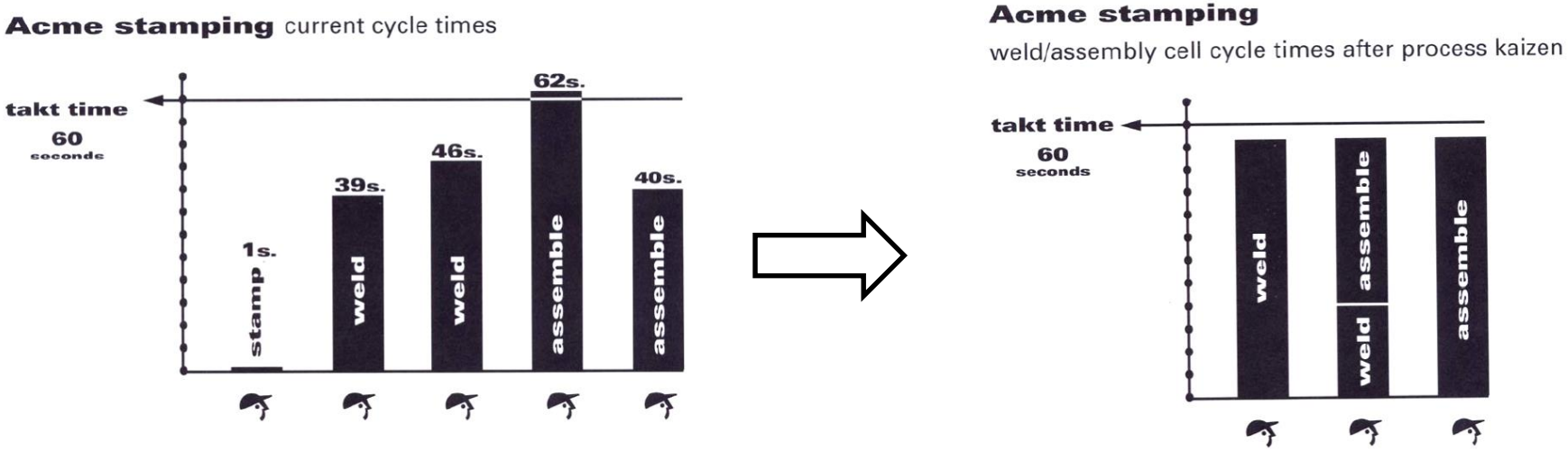
5. Future State Value Stream Map Drawing

- Drawing the future state map example:

3. Where can you use continuous flow processing?

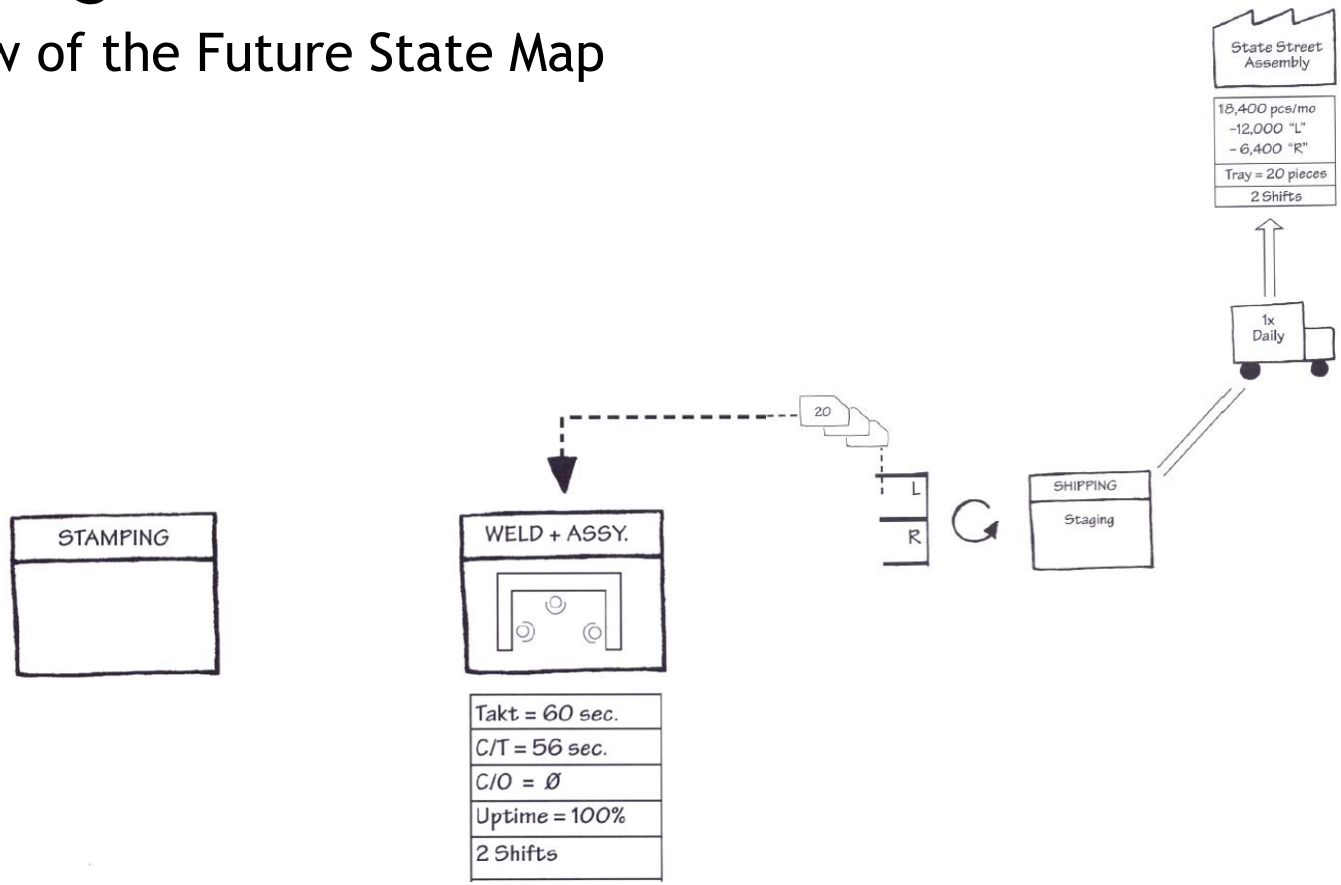
The lean approach is to place the four processes from welding to assembly immediately adjacent to each other (cellular arrangement) and distribute the work elements so that each operators work content is just below takt time.



5. Future State Value Stream Map Drawing

- Drawing the future state map example:

First View of the Future State Map

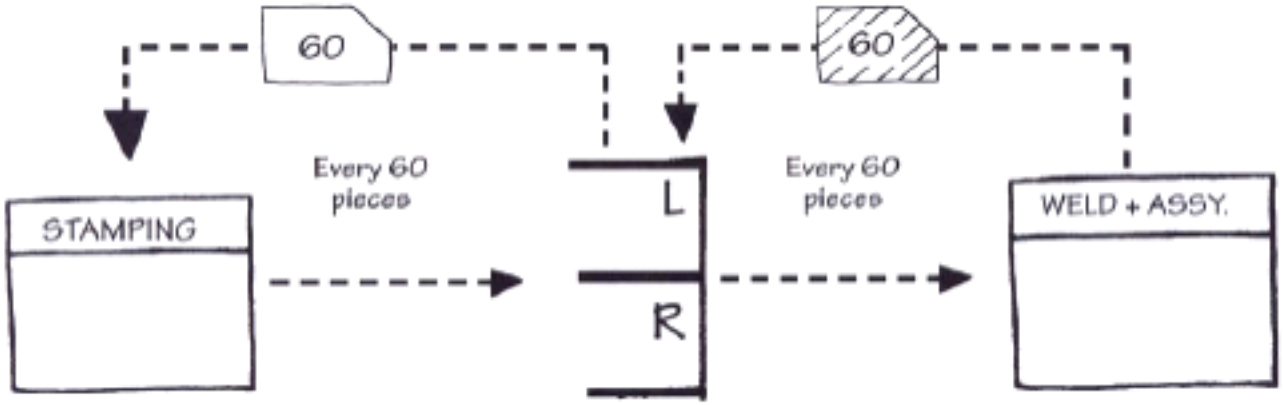


5. Future State Value Stream Map Drawing

- Drawing the future state map example:

4. Where will you need to use supermarket pull systems in order to control production of upstream processes?

Acme has decided to produce steering brackets to a finished-goods supermarket. Two additional supermarkets – one for stamped parts and one for coils – are necessary to complete Acme in plant value stream for steering brackets.

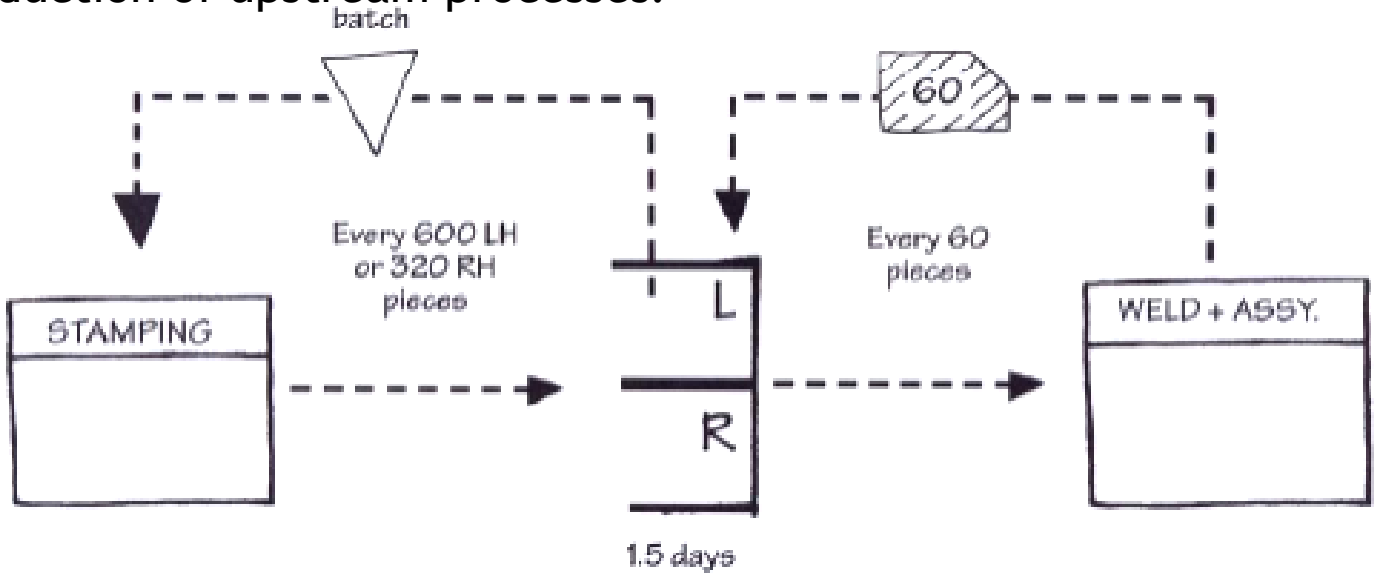


Stamped parts – withdrawal kanban triggers the movement of parts

5. Future State Value Stream Map Drawing

- Drawing the future state map example:

4. Where will you need to use supermarket pull systems in order to control production of upstream processes?



Coils – Even supplier can't receive kanbans, Acme can attach a internal withdrawal kanban to every coil and send those kanban to the production department

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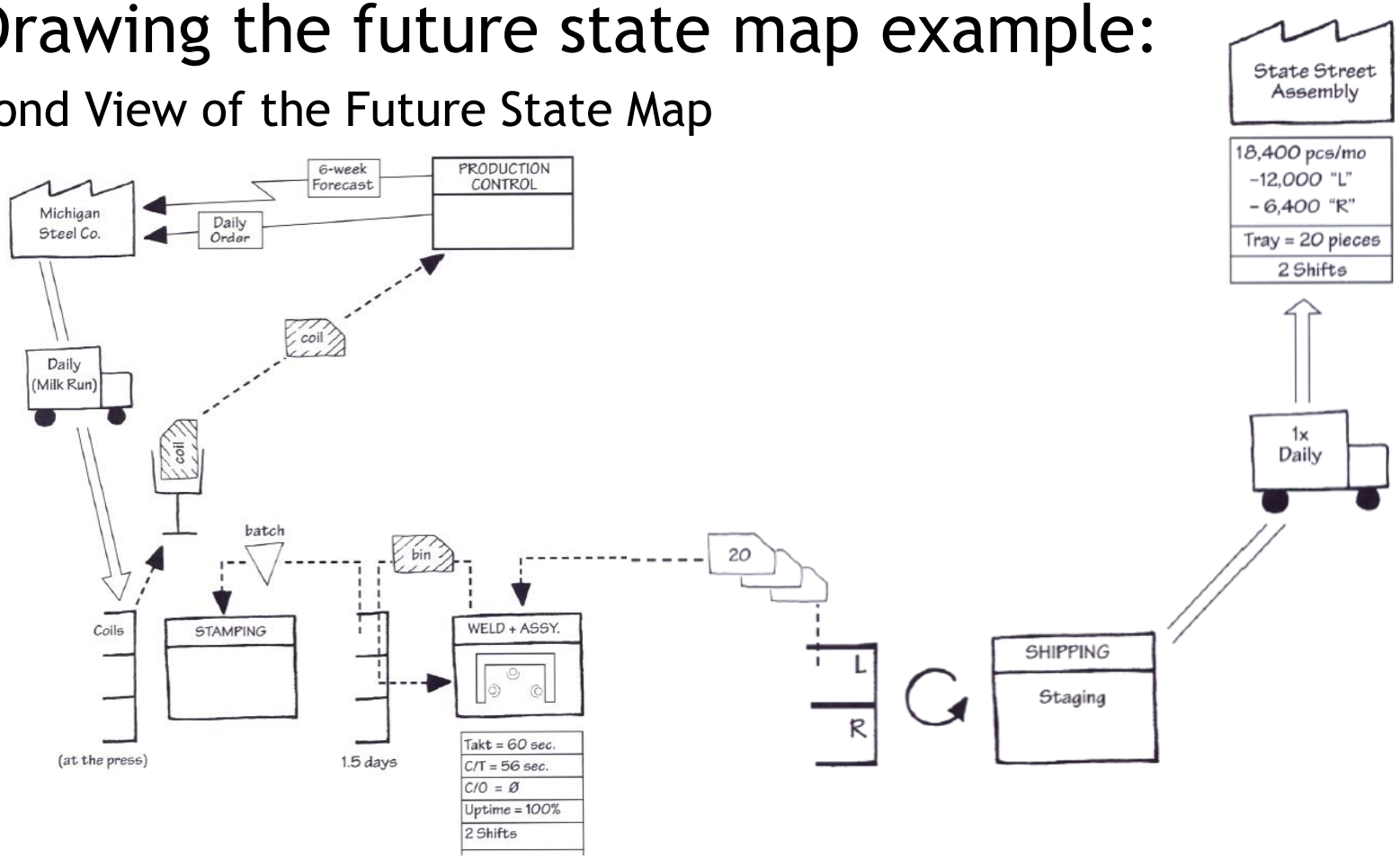
5. Future State Value Stream Map Drawing

- Drawing the future state map example:

Second View of the Future State Map



5. Future State Value Stream Map Drawing

- Drawing the future state map example:

Second View of the Future State Map

Lead Time Improvement

	Coils	Stamped Parts	Weld/Assy WIP	Finished Goods	Production Lead Time	Total Inventory Turns
Before	5 Days	7.6 Days	6.5 Days	4.5 Days	23.6 Days	10
So Far	2 Days	1.5 Days	Ø	4.5 Days	8 Days	30

5. Future State Value Stream Map Drawing

- Drawing the future state map example:

5. At what single point in the production chain will you schedule production?

  - Since all process steps downstream of the pacemaker process need to occur in a flow, the scheduling point is clearly the welding/assembly cell.
  - It's not possible to schedule further upstream because it is planned to introduce a pull system between stamping and welding/assembly
  - This single scheduling point will regulate the entire steering bracket value stream

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5. Future State Value Stream Map Drawing

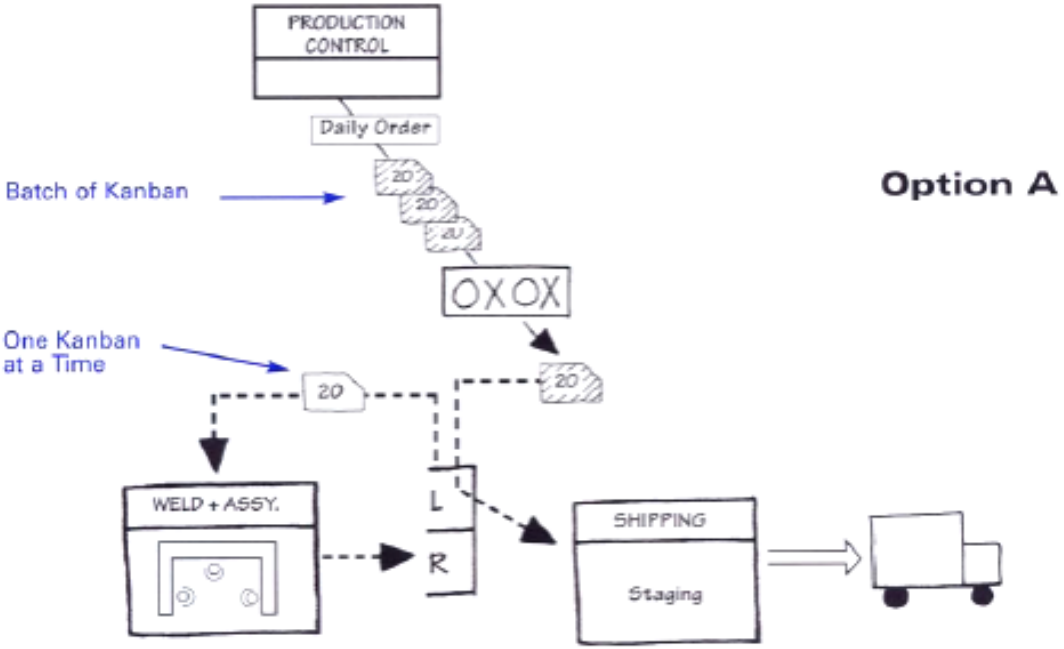
- Drawing the future state map example:

6. How will you level the production mix at the pacemaker process?
   - Daily delivery is 600 brackets left and 320 right
   - With levelling, the cell's production mix is:

5. Future State Value Stream Map Drawing

- Drawing the future state map example:

6. How will you level the production mix at the pacemaker process?
   - Option A – production control can place withdrawal kanban corresponding to customer order in a load levelling box near in a mixed sequence



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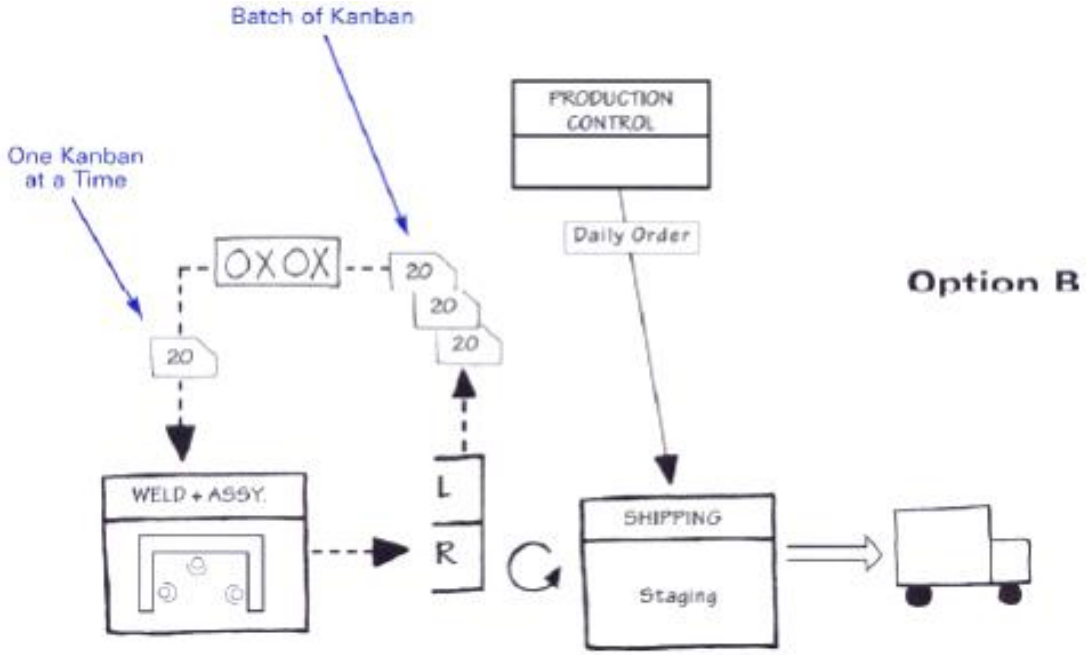
5. Future State Value Stream Map Drawing

- Drawing the future state map example:

6. How will you level the production mix at the pacemaker process?
   - Option B – production control can send today customer orders to the material handler for shipment



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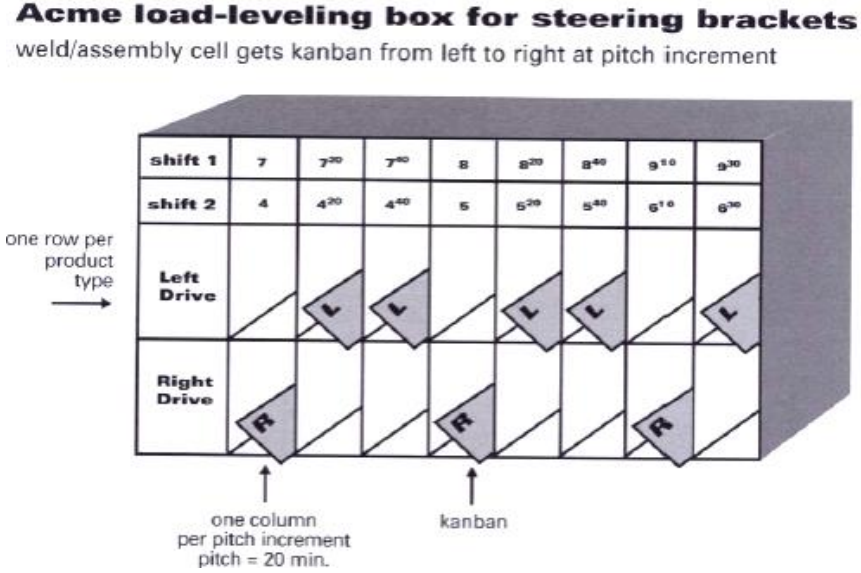
5. Future State Value Stream Map Drawing

- Drawing the future state map example:

7. What increment of work will you consistently release and take away at the pacemaker process?
   - A natural increment of welding/assembly work is 60 second takt time * 20 pieces per tray = 20 minutes, this is the steering bracket pitch, which corresponds to one kanban for one tray of 20 steering brackets



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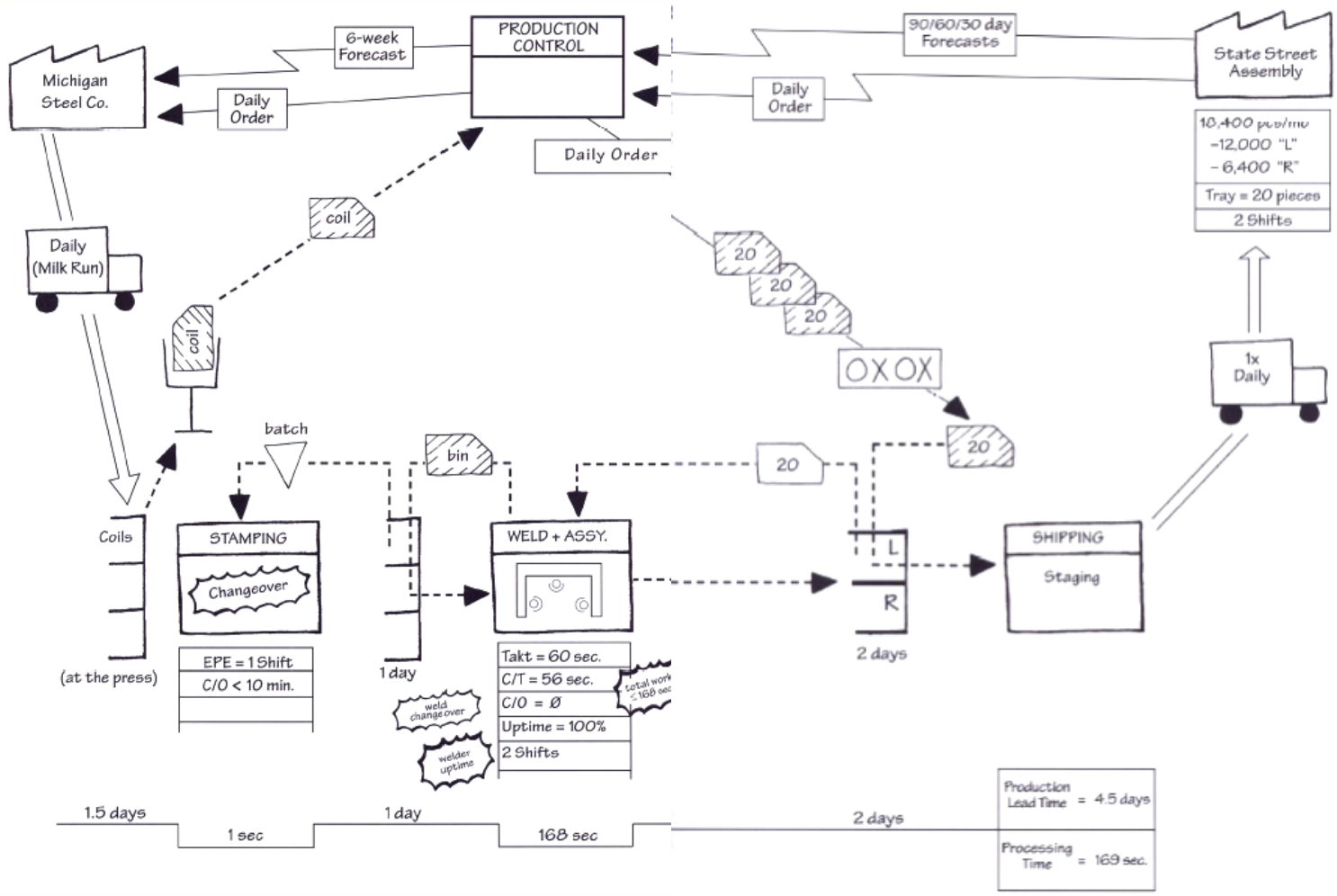
5. Future State Value Stream Map Drawing

- Drawing the future state map example:

8. What processes improvements will be necessary for the value stream to flow as you future state design specifies?

  - Improvements:
    - Reduction in changeover time and batch sizes at the stamping press, to allow faster response to downstream usage – goal is every part every day
    - Elimination of the long time (10 min) required to change between left-drive and right-drive fixtures in welding, to make possible continuous flow and mixed production form welding through assembly
    - Improvements in on-demand uptime of the second spot-weld machine, as it will now be tied to other processes in the continuous flow
    - Elimination of the waste in the welding/assembly cell, to reduce total work content down to 168s or less (use of three operators)

5. Future State Value Stream Map Drawing

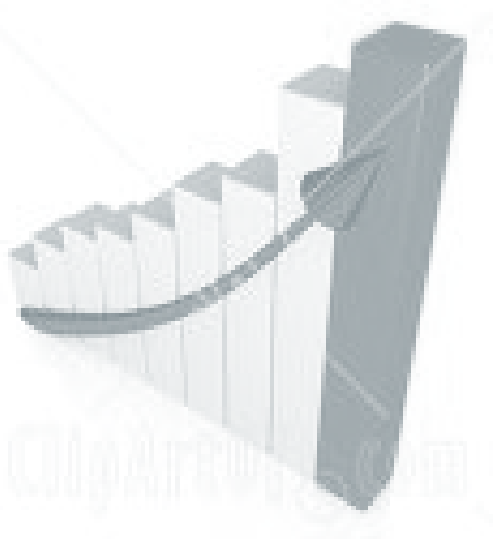


5. Future State Value Stream Map Drawing

- Future state Lead Time Improvement

	Coils	Stamped Parts	Weld/Assy WIP	Finished Goods	Production Lead Time	Total Inventory Turns
Before	5 Days	7.6 Days	6.5 Days	4.5 Days	23.6 Days	10
Continuous Flow & Pull	2 Days	1.5 Days	Ø	4.5 Days	8 Days	30
With Leveling	1.5 Days	1 Day	Ø	2 Days	4.5 Days	53

Achieving the future state of value stream



6. Achieving the future state of value stream

- Achieving Future State:
  - Value Stream Mapping is only a tool
  - Unless the future state that was drawn are achieved totally or in parts, the value stream maps are worthless

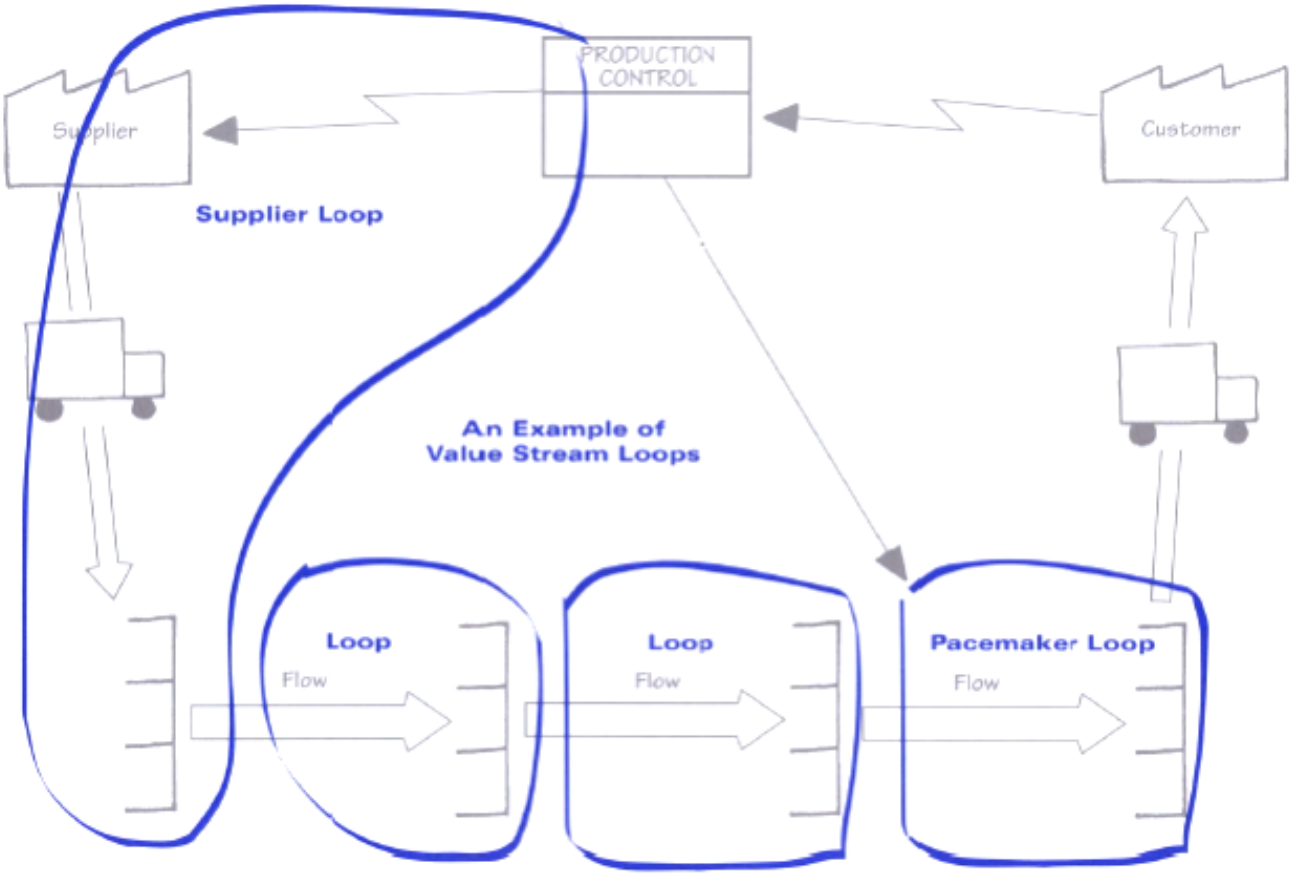
- Plan for Achieving Future State Value Stream includes:
  1. Future state map
  2. Detailed process level maps and layouts that are necessary
  3. A yearly value stream plan

6. Achieving the future state of value stream

- Breaking implementation into steps:
  - Divide your future state value stream into segments or loops:
    - **Pacemaker Loop**: The pacemaker loop encompasses the flow of material and information between your customer and your pace-maker process.
      - This is the most downstream loop in the facility, and how is managed this loop impacts all the upstream processes in that value stream
    - Additional Loops: Upstream of the pacemaker loop there are material flow and information flow loops between pulls.
      - Each pull system supermarket in the value stream corresponds with the end of another loop
      - These loops are an excellent way to break the future state implementation into manageable pieces

6. Achieving the future state of value stream

- Breaking implementation into steps (example):



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6. Achieving the future state of value stream

- Breaking implementation into steps (Acme example):
  - **Loop 1 – Pacemaker loop**
    - Actions:
      - Develop continuous flow from welding through assembly cell
      - Eliminate weld-fixture changeover time
      - Develop pull system with finished goods supermarket (eliminate schedules)
      - Develop material handler routes between the supermarket and the cell
    - Goals
      - Only two days of finished goods inventory in supermarket
      - No inventory between workstations
      - Operate the cell with 3 people (at current demand rate)
      - Kaizen work elements to reduce total cycle time to 168 s or less
      - Improve uptime on welder 2 to 100%

6. Achieving the future state of value stream

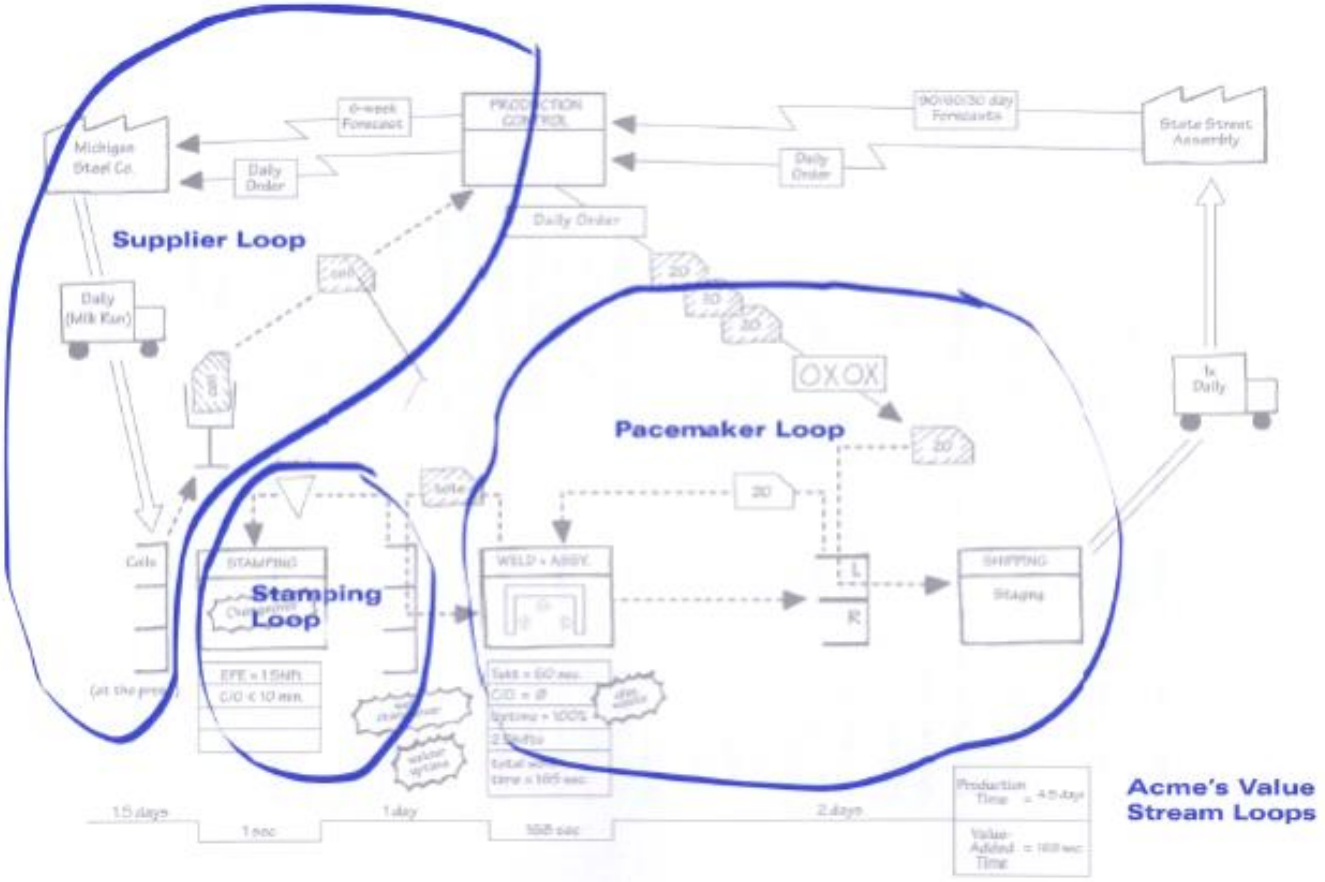
- Breaking implementation into steps (Acme example):
  - **Loop 2 – Stamping loop**
    - Actions:
      - Establish pull system with stamped parts supermarket (eliminate stamping schedule)
      - Reduce stamping batch sizes
      - Apply SMED to reduce stamping changeover time
    - Goals
      - Only one day of stamped bracket inventory in the supermarket
      - Batch sizes to 300 (LH) and 160 (RH) between changeovers
      - Reduce stamping changeover time to less than 10 minutes

6. Achieving the future state of value stream

- Breaking implementation into steps (Acme example):
  - **Loop 3 – Coil-Supplier loop**
    - Objectives:
      - Develop pull system with steel-coil supermarket
      - Introduce daily coil delivery
    - Goals
      - Only 1.5 days of coil inventory in the supermarket

6. Achieving the future state of value stream

- Breaking implementation into steps (Acme example):



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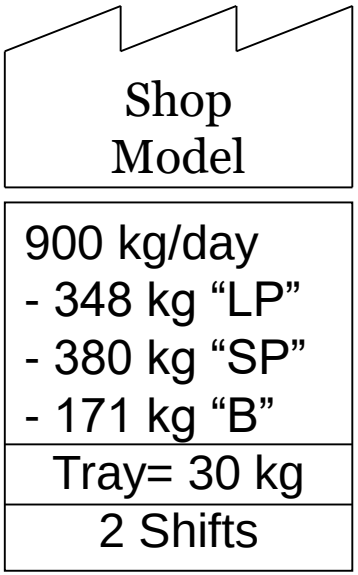
- Current State Map (Farmland application case):
  - Farmland Ham produces pork ham for Shop Model a network of supermarkets
  - The pork ham is presented in three forms:
    - LP - Large pear (5,8 kg)
    - SP - Small pear (3,8 kg)
    - B - Bar (3,0 kg)
  - Week demand: 900Kg
    - LP – 60 un. (348 kg)
    - SP – 100 un. (380 kg)
    - B – 57 un. (171 kg)



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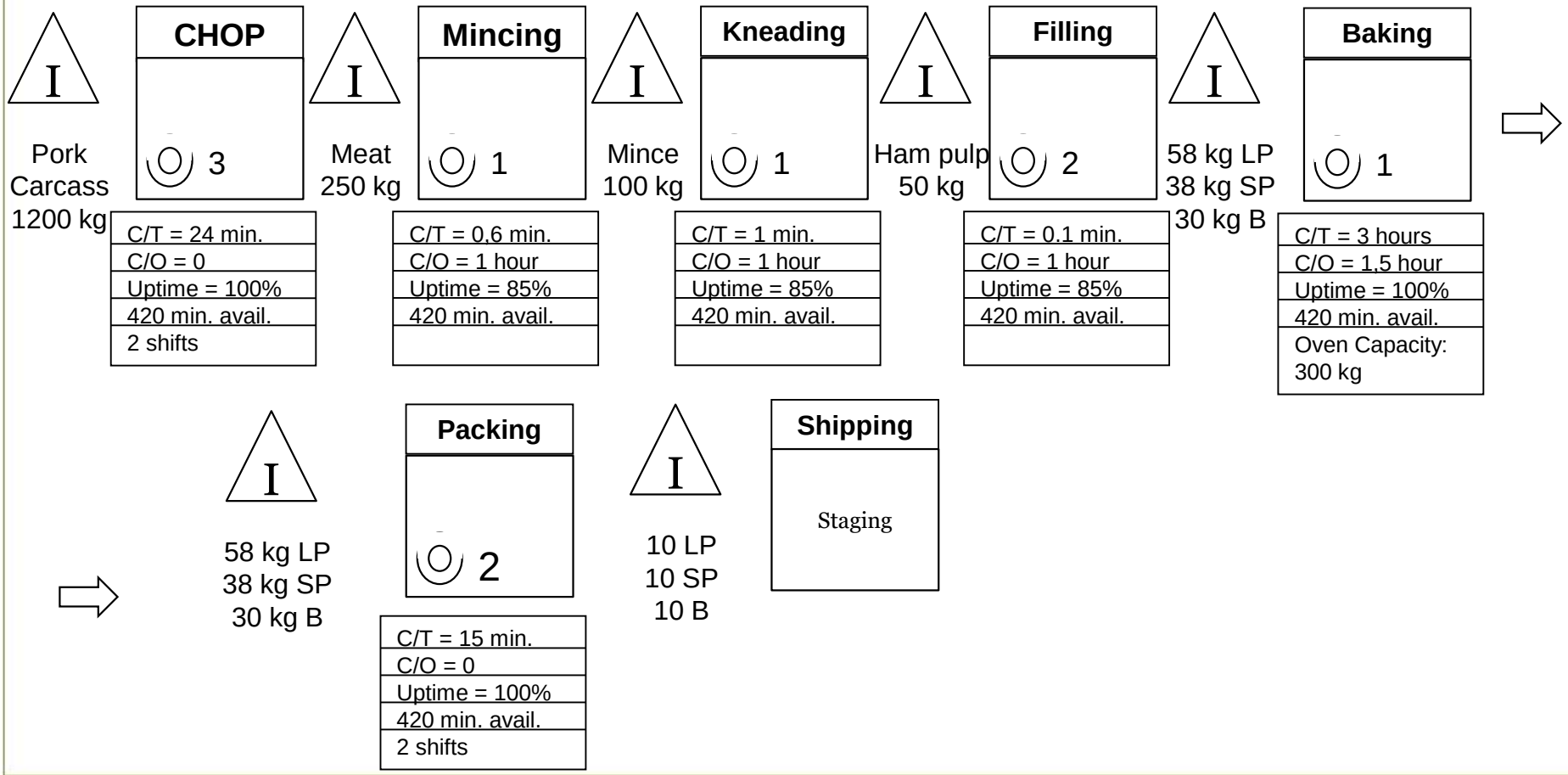
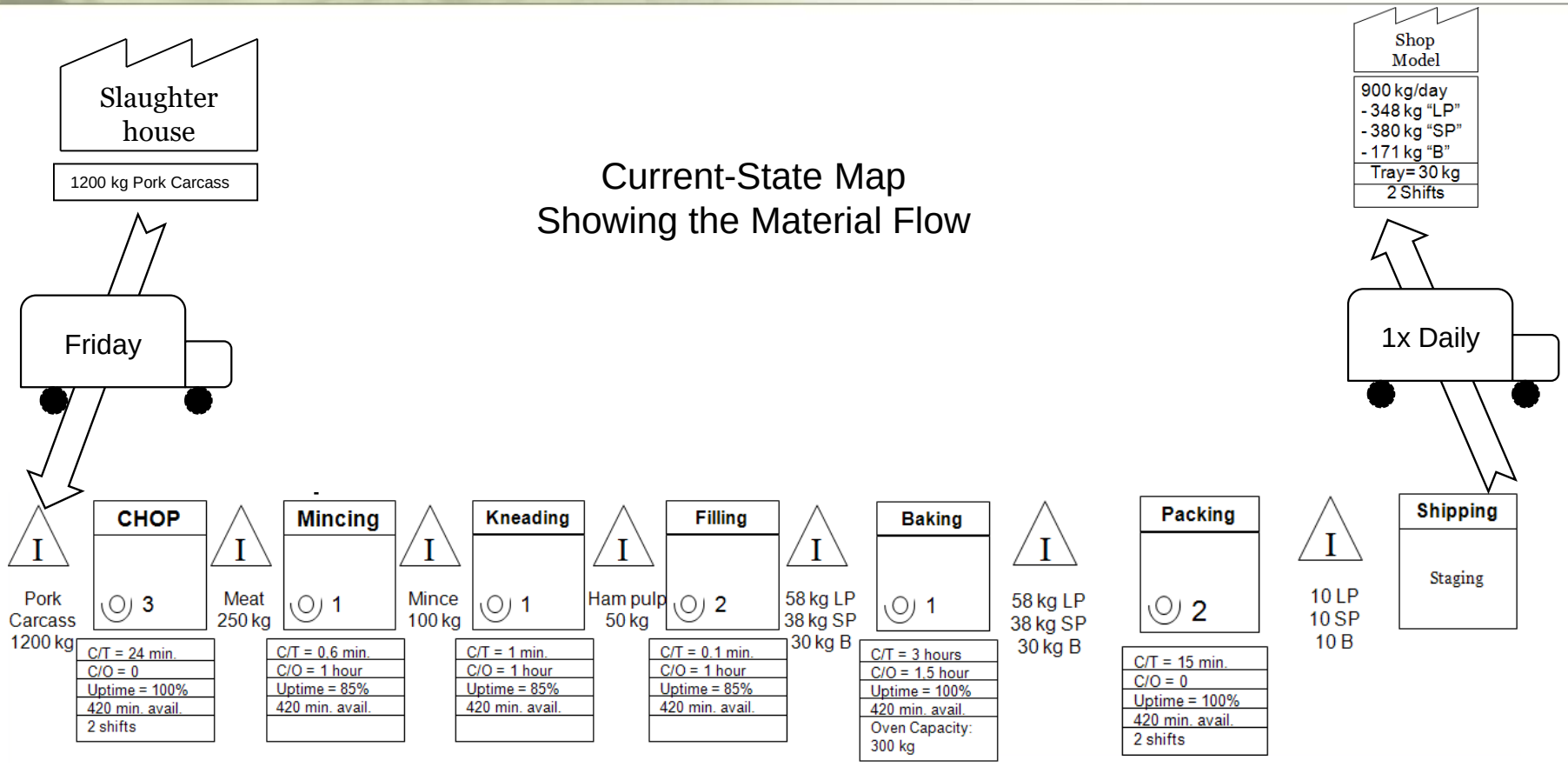
- Process description

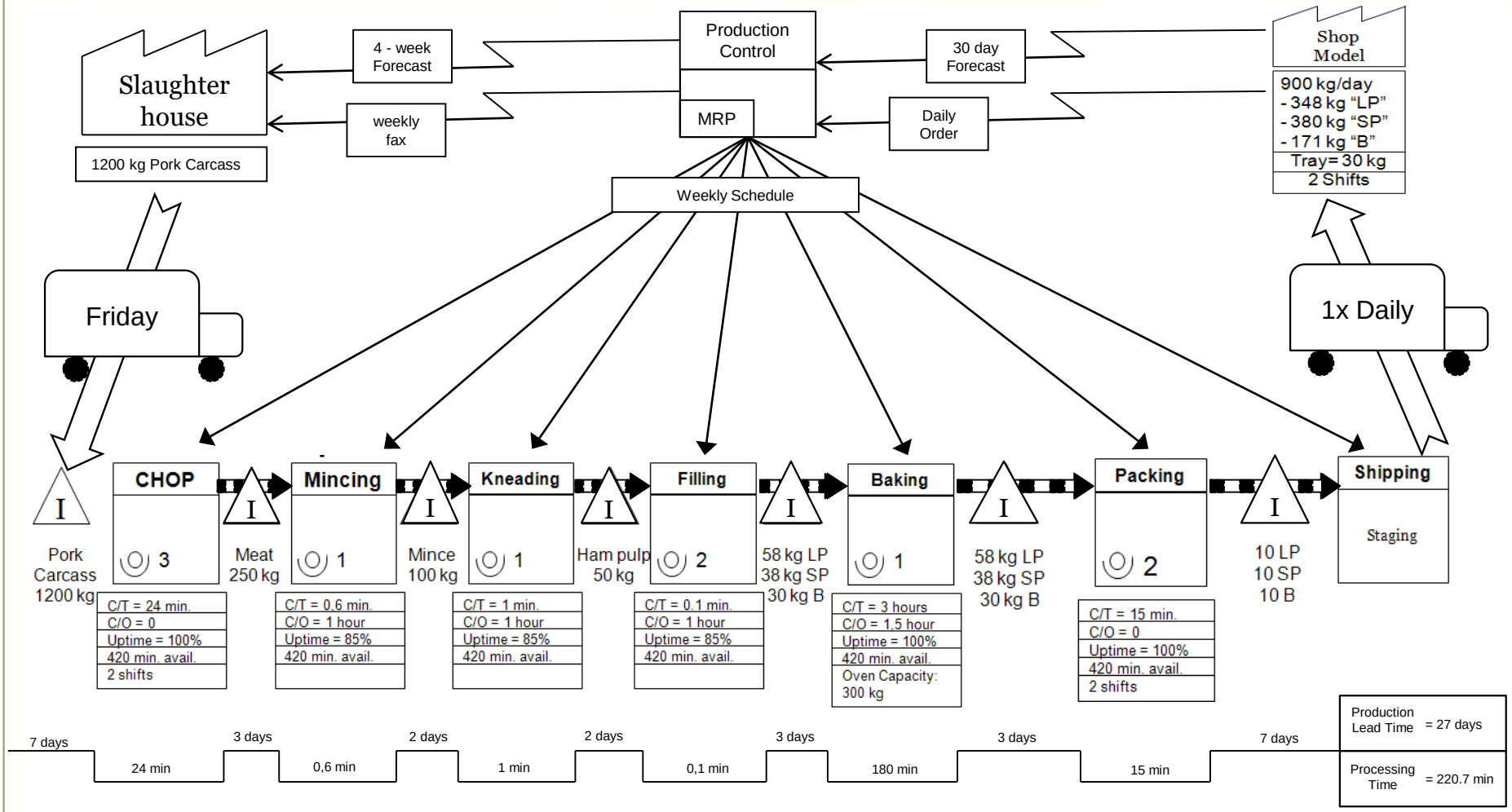


7. Application Case

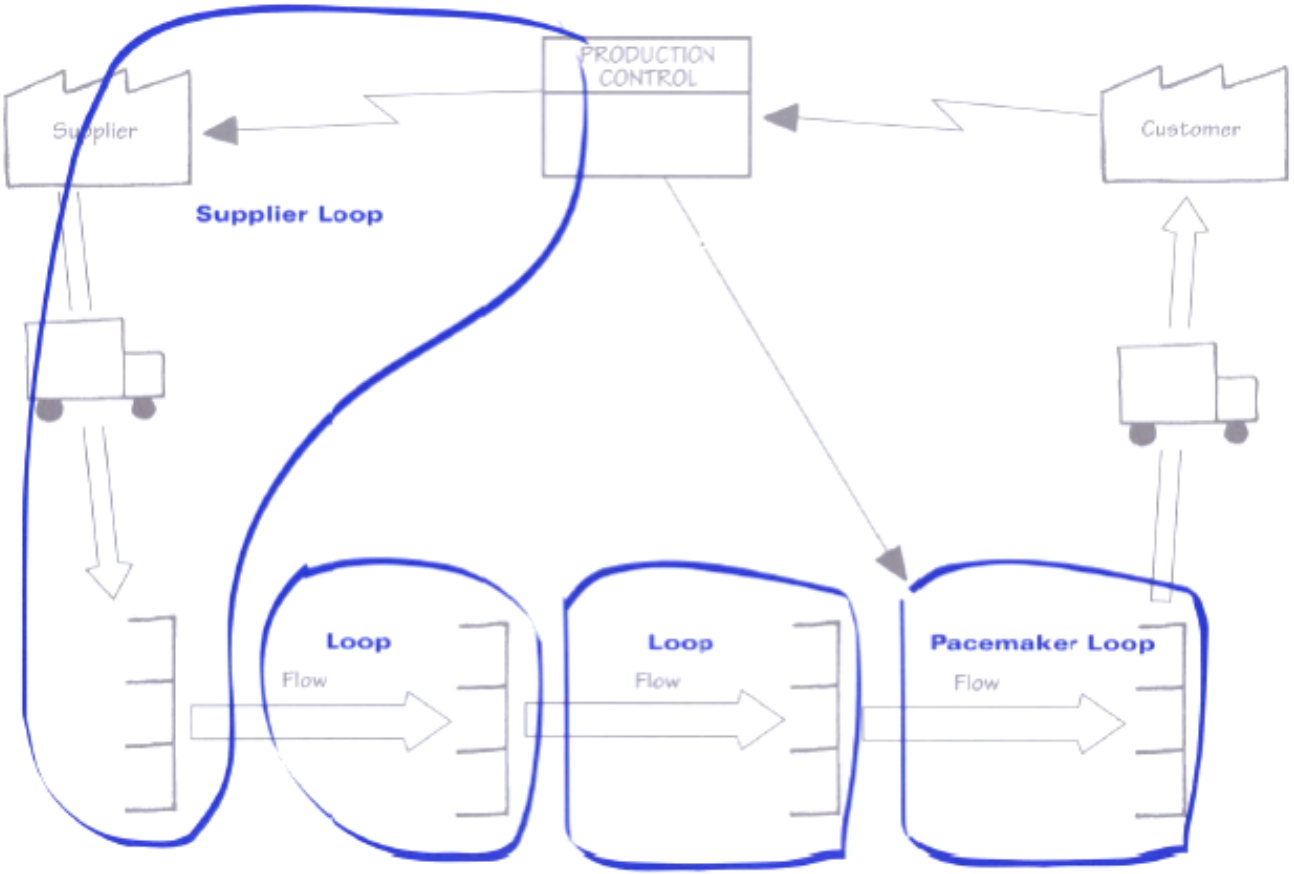


7. Application Case

Current-State Map
With Information Flow and Push Arrows



Breaking implementation into steps



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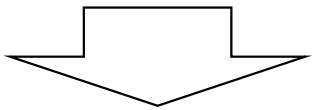
Definition of the Pacemaker

Available Working Time: 420 minutes per shift

Available Working Time/ Customer Demand = 420 min / 180 kg per shift

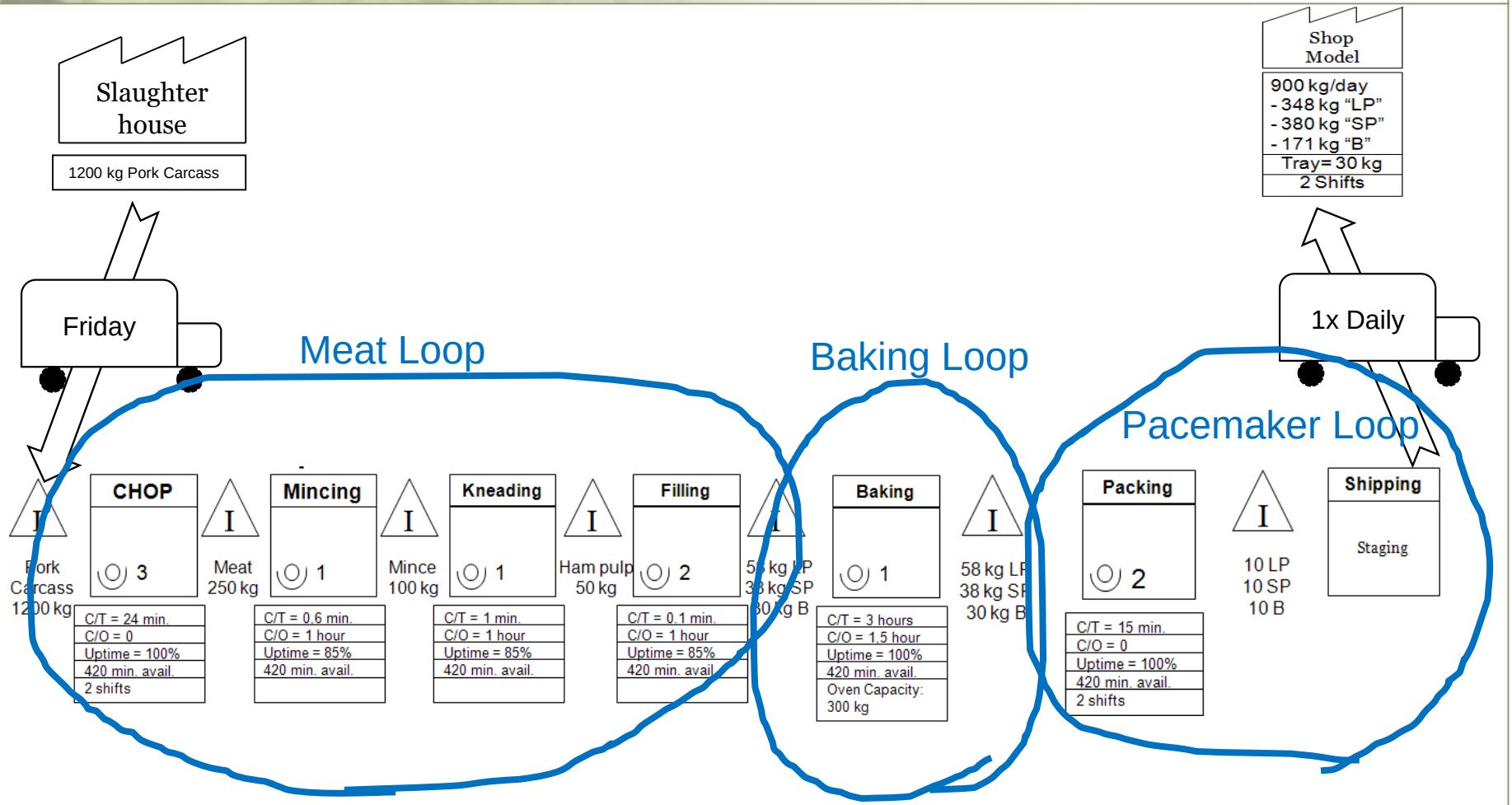
Farmland Ham packing Takt Time = 2.33 min (140 sec.)



Since Baking Process is too long to tackle the Takt Time is necessary to:

Acquire three smaller units instead of one unique oven.

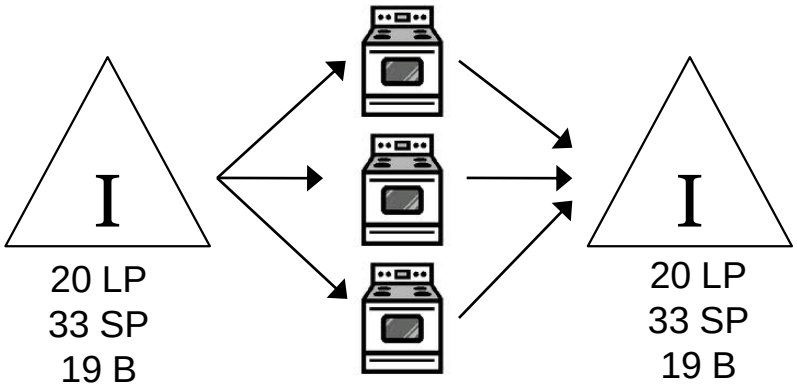
7. Application Case



Baking Schedule

Solution proposed with 3 Ovens

Periods (1.5 h)	1	2	3	4	5	6	7	8	9	10	11
Oven 1	Setup	20 LP		Setup	20 LP		Setup	20 LP			
Oven 2		Setup	33 SP		Setup	33 SP		Setup	33 SP		
Oven 3			Setup	19 B		Setup	19 B		Setup	19 B	



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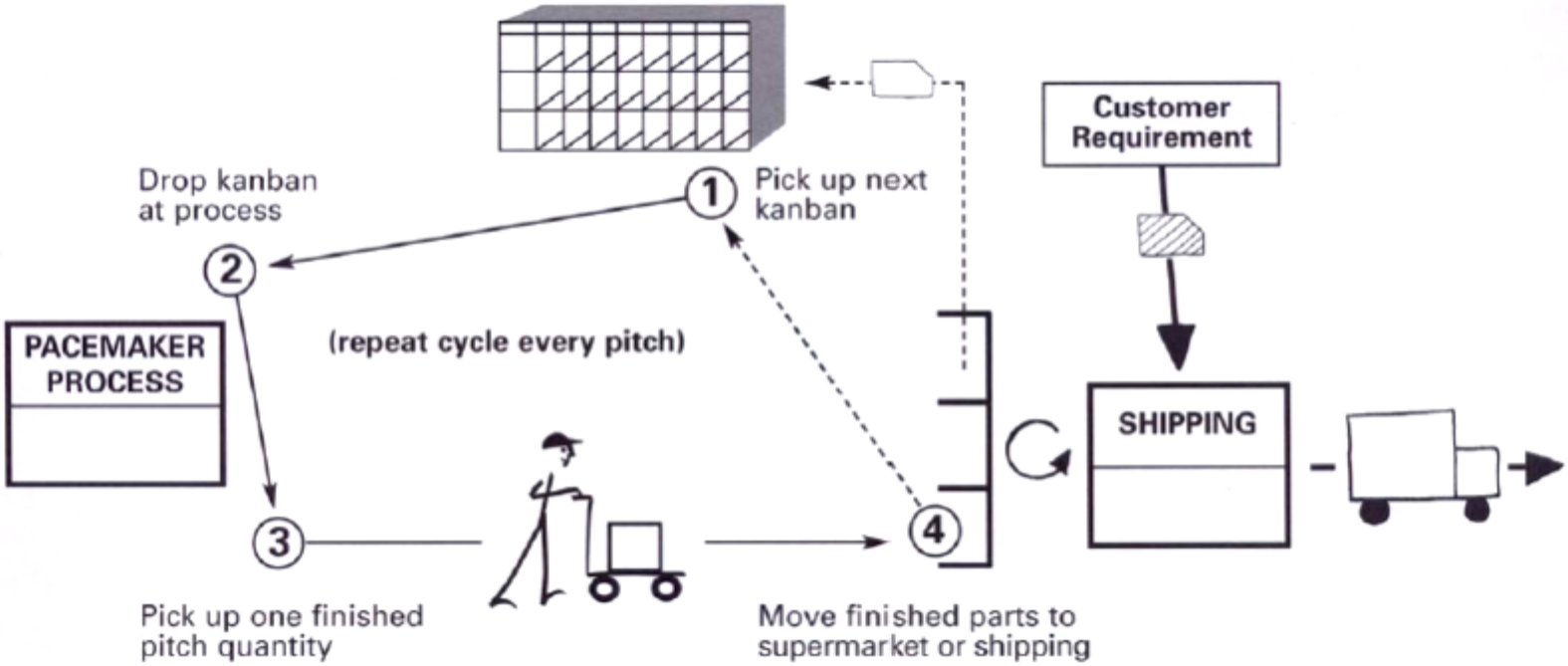
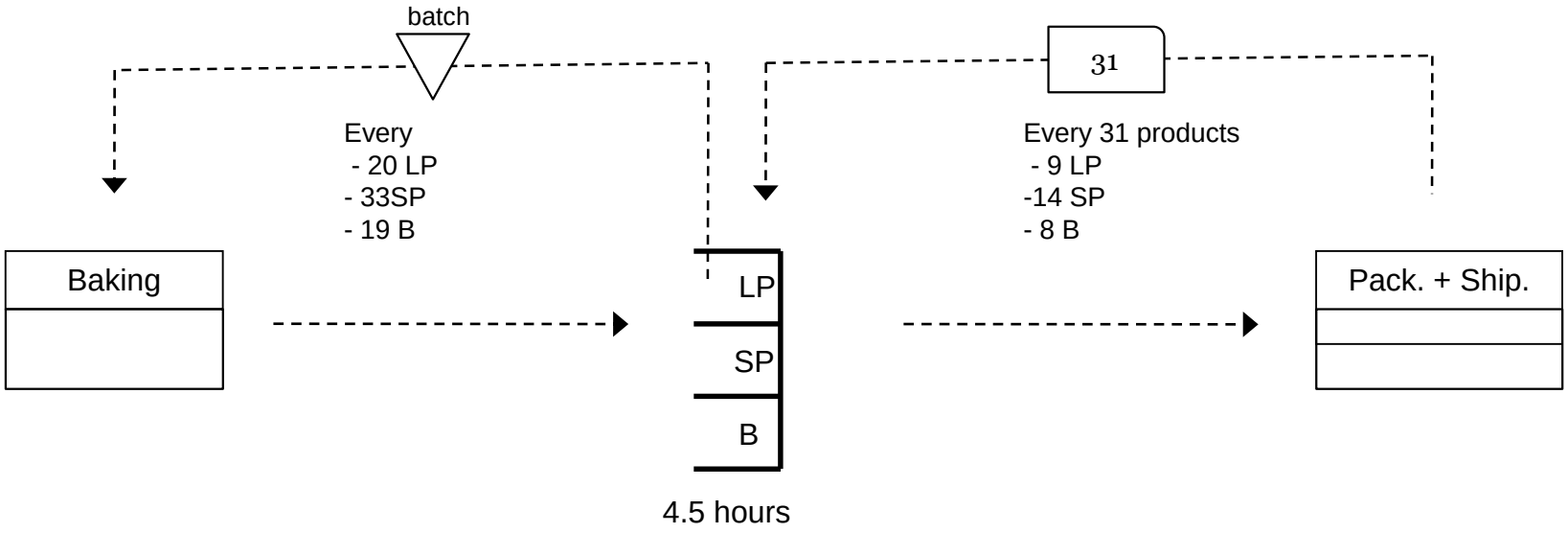
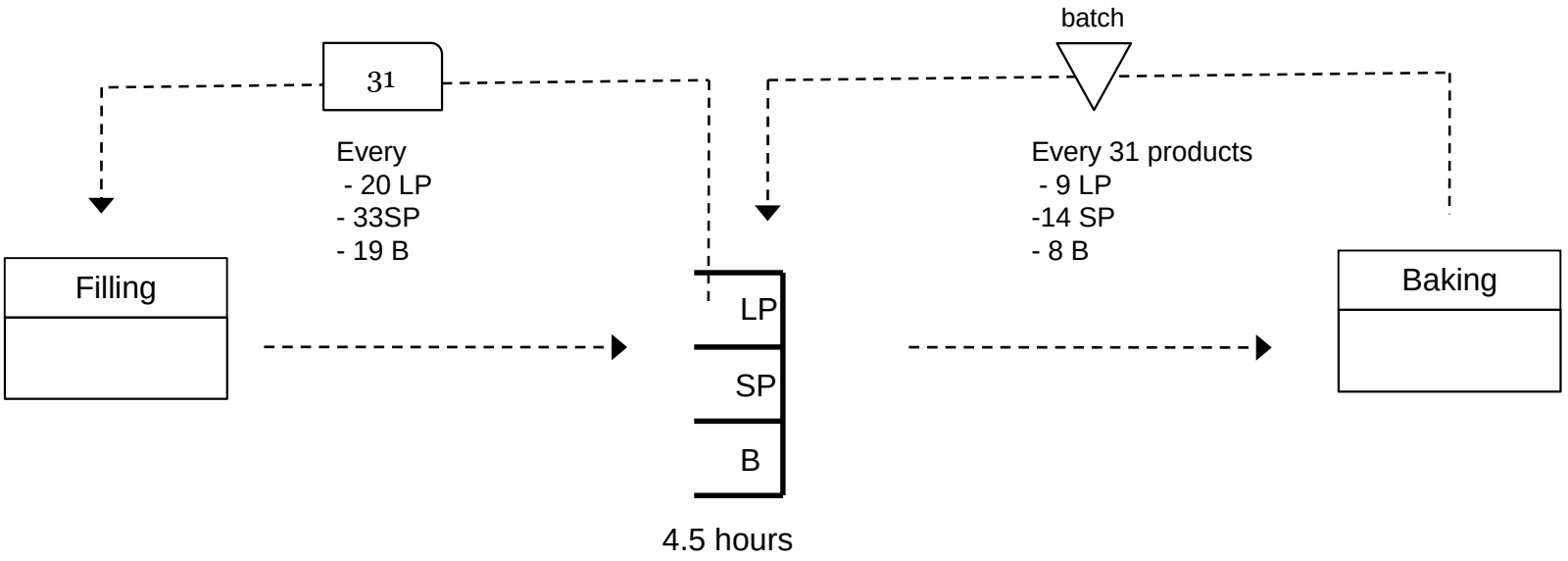
Implementation of Pacemaker Withdrawal



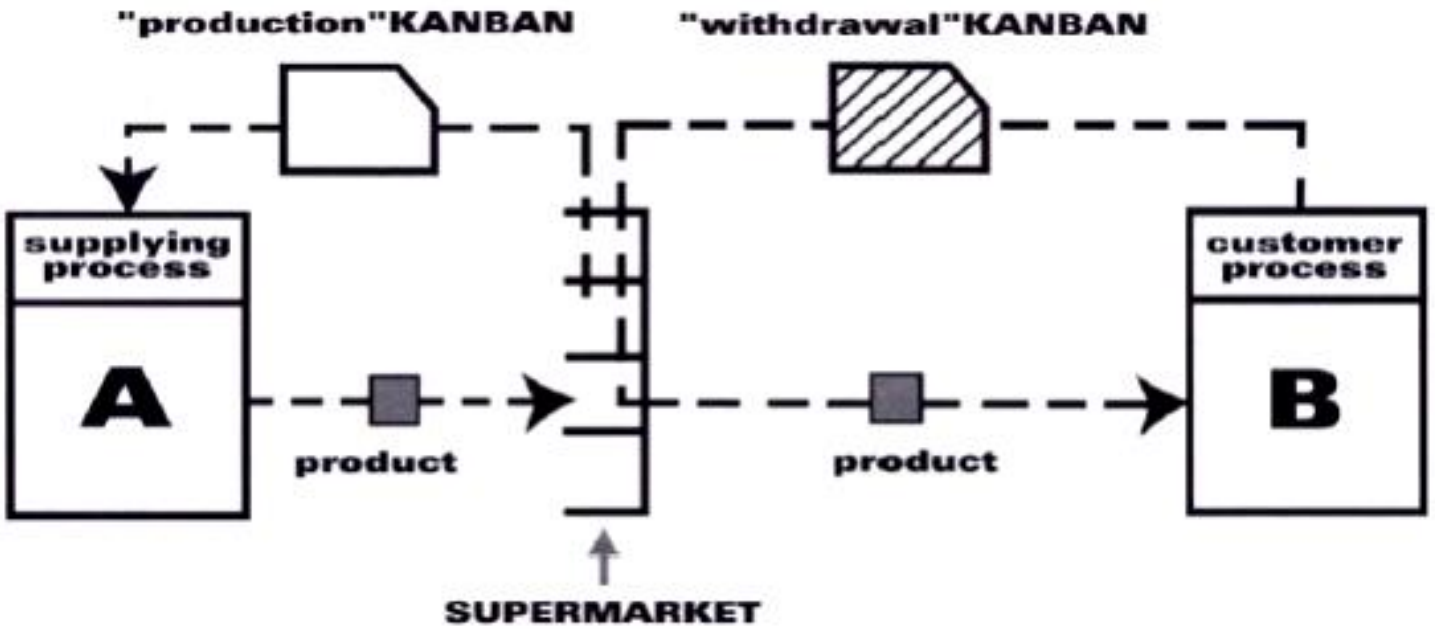
Implementation of Baking downstream interface



Implementation of Baking upstream interface



Implementation of upstream interface



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