What Makes a Value Stream “Lean”?

Guidelines to a Lean Value Stream

What Makes a Value Stream "Lean"?

- You will require a number of future-state maps, each a little leaner and closer to that ideal.
- You can begin with established principles and practices and work to adapt them to future states for your own value streams.

- Each future state map, will have another future state to achieve continues improvement

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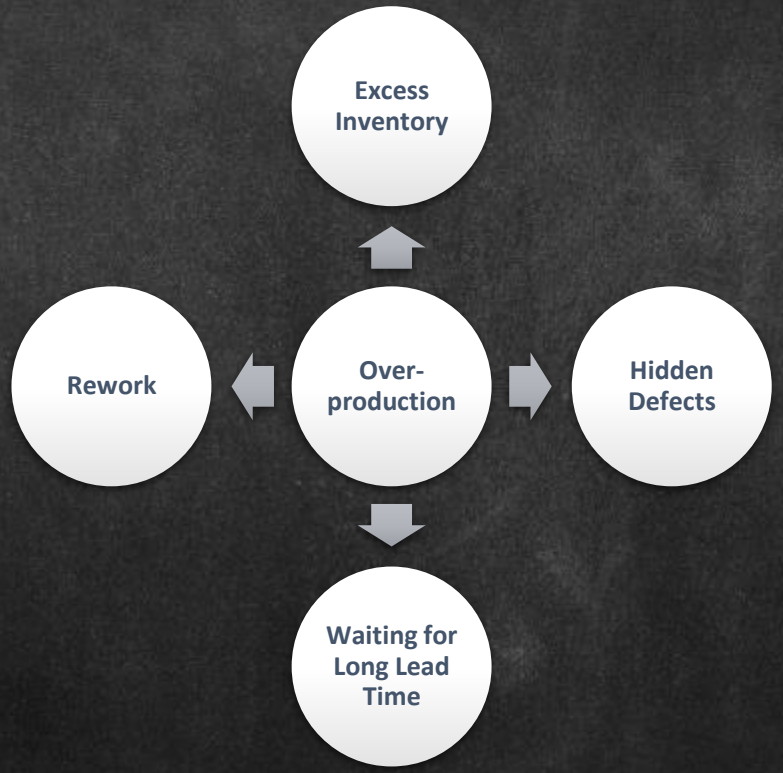
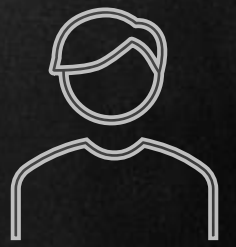
What Makes a Value Stream "Lean"?

Overproduction Waste

- We can see the fundamental problems with mass (or "batch-and-push") production in the Acme Stamping current state:
  - Each process in the value stream operates as **an isolated island**, producing and pushing product forward **according to schedules** it receives from Production Control **instead of the actual needs** of the downstream "customer" process.
  - Since this material output is not yet needed, it **must be handled**, **counted**, stored, and so on -- **pure muda**.
  - **Defects remain hidden** in the inventory queues until the downstream process finally uses the parts and discovers the problem (which is by then extensive and hard to trace).
  - As a result, while the **value-added time for producing one product is very short**, the **total time that product spends getting through the plant is very long**.



- Overproduction can be defined as producing more, sooner or faster than is required by the next process.



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What Makes a Value Stream "Lean"?

Overproduction Waste

- All we are really trying to do in lean manufacturing is to get one process to make only what the next process needs when it needs it.
- We are trying to link all processes -- from the final consumer back to raw material -- in a smooth flow without detours that generates the shortest lead time, highest quality, and lowest cost.

- Overproduction can be defined as producing more, sooner or faster than is required by the next process.

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Guidelines to a Lean Value Stream

- Produce to Takt
- Continuous Flow
- Use Supermarkets
- Schedule ONE Process
- Level the production mix
- Level the production volume
- Every Part Every (EPE)

Producing to takt sounds simple, but it requires concentrate effort to:

- provide fast response (within takt) to problems
- eliminate causes of unplanned downtime
- eliminate changeover time in downstream, assembly-type processes

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Guidelines to a Lean Value Stream

Guideline #1: Produce to your takt time.

- "Takt time" is **how often** you should produce one part or product, 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 your **available working time** per shift (in seconds).
- Takt time used to **synchronize** the pace of **production** with the pace of **sales**, particularly at the "pacemaker/bottleneck process"
- It is a **reference number** that gives you a sense for the rate at which a **process should be producing**.
- It helps to see how you are doing and **what you need to improve.**
- On the future-state map, **takt times** are noted in the **data boxes**.

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Guidelines to a Lean Value Stream

Guideline #1: Produce to your takt time.

$$Takt\ Time = \frac{Available\ Time\ Per\ Shift}{Customer\ Demand\ Per\ Shift}$$

$$Example: \frac{27000}{455} = 59\ Seconds$$

Producing to takt sounds simple, but it requires concentrate effort to:

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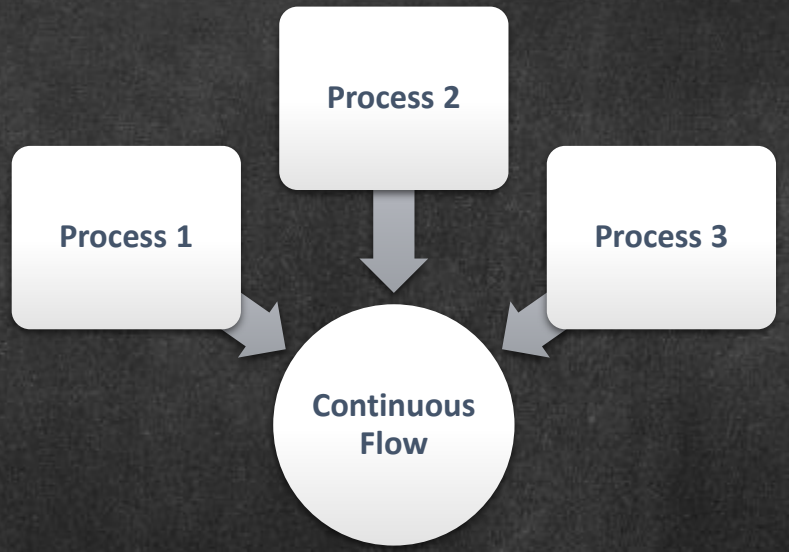
Guidelines to a Lean Value Stream

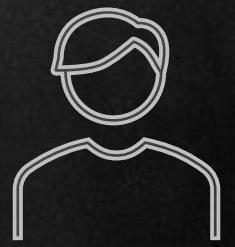
Guideline #2: Develop continuous flow wherever possible.

- Continuous flow refers to producing one piece at a time, with each item passed immediately from one process step to the next without stagnation (and many other wastes) in between.
- The mapping icon we use to indicate continuous flow is simply the process box. In your future state drawing, each process box should describe an area of flow.
- A good approach can be to begin with a combination of continuous flow and some pull/FIFO. **Then** extend the range of continuous flow as process reliability is improved, changeover times are reduced to near zero, and smaller, in-line equipment is developed.



If you introduce more continuous flow in your future state, then two or more current-state process boxes would combine into one box on the future state map.

- Continuous flow is the most efficient way to produce, and you should use a lot of creativity in trying to achieve it.



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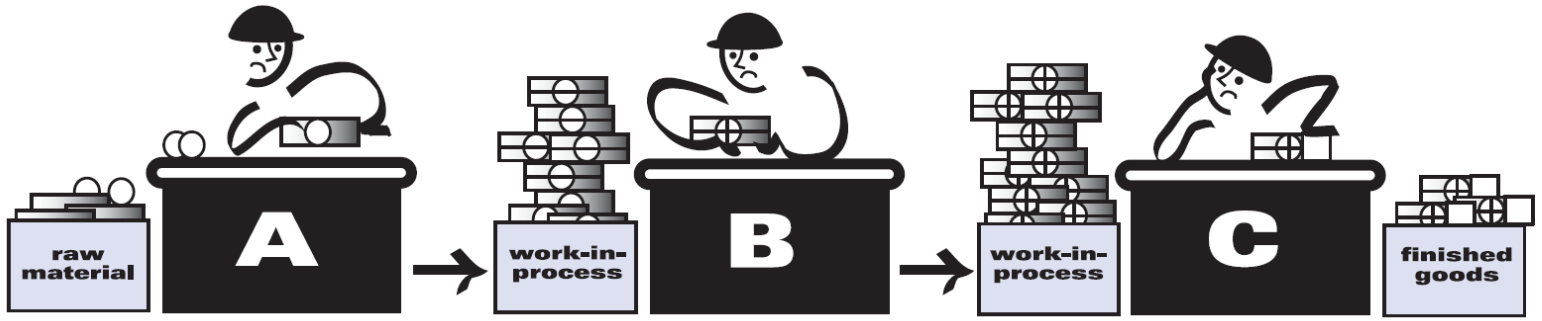
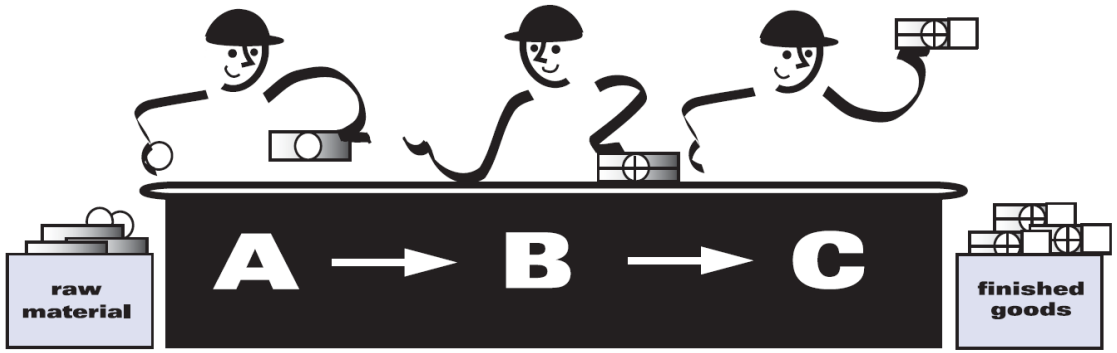


Batch-and-queue production.



Continuous flow processing.

- Sometimes you'll want to limit the extent of a pure continuous flow, because connecting processes in a continuous flow also merges all their lead times and down times.

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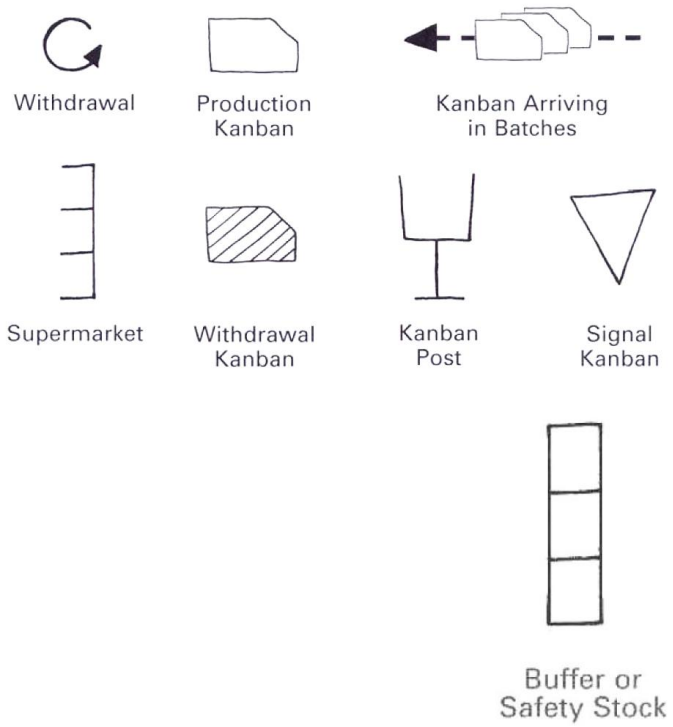
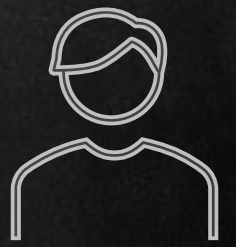
Guidelines to a Lean Value Stream

Guidelines #3. Use supermarkets to control production where continuous flow does n

- There are often spots in the value stream where continuous flow is not possible and batching is necessary. There can be several reasons for this including:
  - Some processes are designed to operate at very fast or slow cycle times and need to change over to service multiple product families (e.g. stamping or injection molding.)
  - Some processes, such as those at suppliers, are far away and shipping one piece at a time is not realistic.
  - Some processes have too much lead time or are too unreliable to couple directly to other processes in a continuous flow.
- You usually need to install a pull system where continuous flow is interrupted and the upstream process must still operate in a batch mode.



- Resist the temptation to independently schedule these processes via an independent scheduling function, because a schedule is only an estimate of what the next process will actually need.
- Instead, control their production by linking them to their downstream customers, most often via supermarket-based pull systems.



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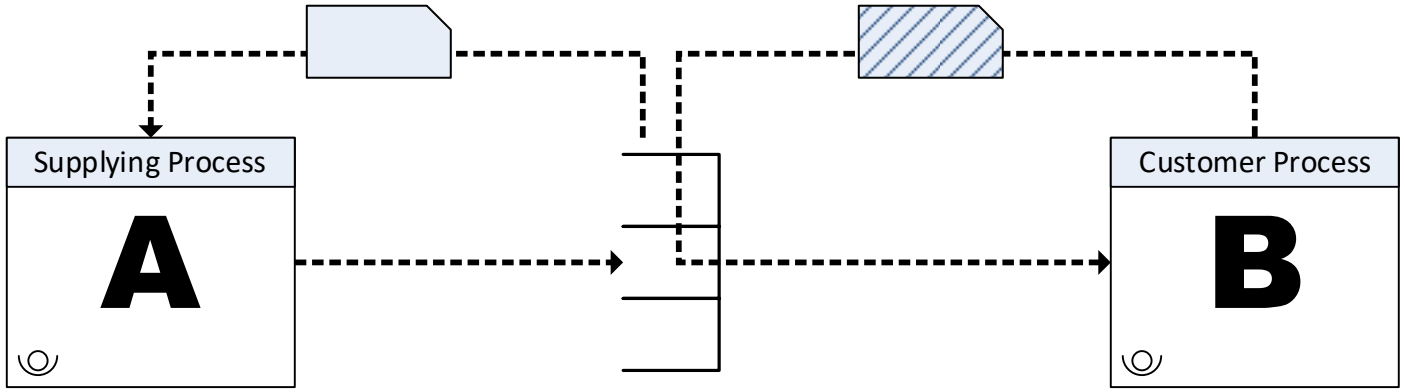
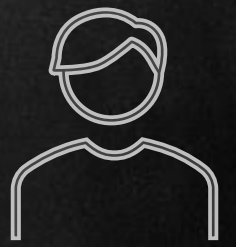
Guidelines to a Lean Value Stream

Guidelines #3. Use supermarkets to control production where continuous flow does not extend upstream



- A "**production**" kanban triggers production of parts,
- while a "**withdrawal**" kanban is a shopping list that instructs the material handler to get and transfer parts.



PURPOSE: Controls production at supplying process without trying to schedule. Controls production between flows.

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Guidelines to a Lean Value Stream

Guidelines #3. Use supermarkets to control production where continuous flow does not extend upstream.

- The supermarket icon is open on the left side, which faces the supplying process.
- This is because this supermarket belongs to the supplying process and is used to schedule that process.
- On the factory floor, supermarkets should ordinarily be located near the supplying process to help that process maintain a visual sense of customer usage and requirements.
- The "customer" process material handler comes to the supplier's supermarket and withdraws what is needed.
- These withdrawals trigger the movement of pre-printed Kanban (typically cards) from the supermarket to the supplier process, where they are used as the only production instruction for that process.

Supermarket

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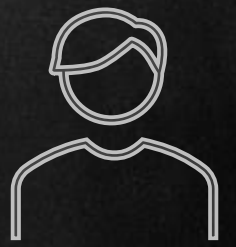

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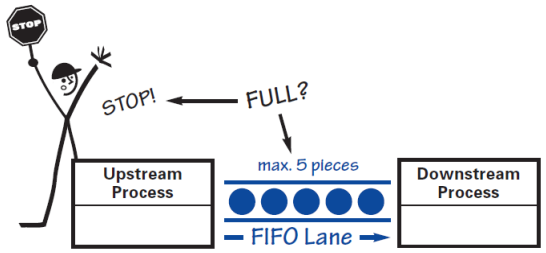
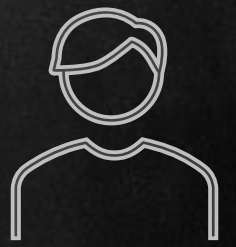
Guidelines to a Lean Value Stream

Guidelines #3. Use supermarkets to control production where continuous flow does not extend upstream.

- In some cases you can use a FIFO ("first in, first out") lane between two decoupled processes to substitute for a supermarket and maintain a flow between them.
  - Think of a FIFO lane like an area that can hold only a certain amount of inventory, with the supplying process at the area entrance and the customer process at the exit.
  - If the FIFO lane gets full, the supplying process must stop producing until the customer has used up some of the inventory.
- **For example**, you ship to an outside plating process one time per day. The platter can only handle 50 pieces per day, so you set up a FIFO lane sized to hold at most 50 pieces of plating work.
  - Whenever the lane is full the upstream process stops producing parts to be plated.
  - In this manner, the FIFO lane prevents the supplying process from overproducing, even though the supplying process is not linked to the platter via continuous flow or a supermarket.



- Some people refer to the FIFO approach as "CONWIP"



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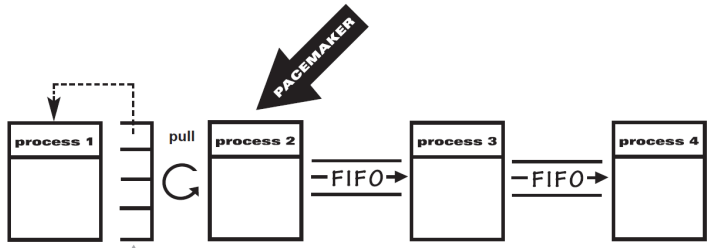
Guidelines to a Lean Value Stream

Guideline #4. Try to send the customer schedule to only one production process.

- By using supermarket pull systems, you will typically **need to schedule only one point** in your door-to-door value stream.
- This point is called the **pacemaker process**, because how you control production at this process sets the pace for all the upstream processes.
- For example, fluctuations in production volume at the pacemaker process affect capacity requirements in upstream processes.
- Note that material transfers from the pacemaker process downstream to finished goods **need to occur as a flow** (no supermarkets or pulls downstream of the pacemaker process).
- Because of this, the pacemaker process is frequently the most downstream continuous-flow process in the door-to-door value stream.
- On the future-state map the pacemaker is the **production process that is controlled by the outside customer's** orders.



- The bottleneck process (process with longest cycle time) is usually considered as the pacemaker process

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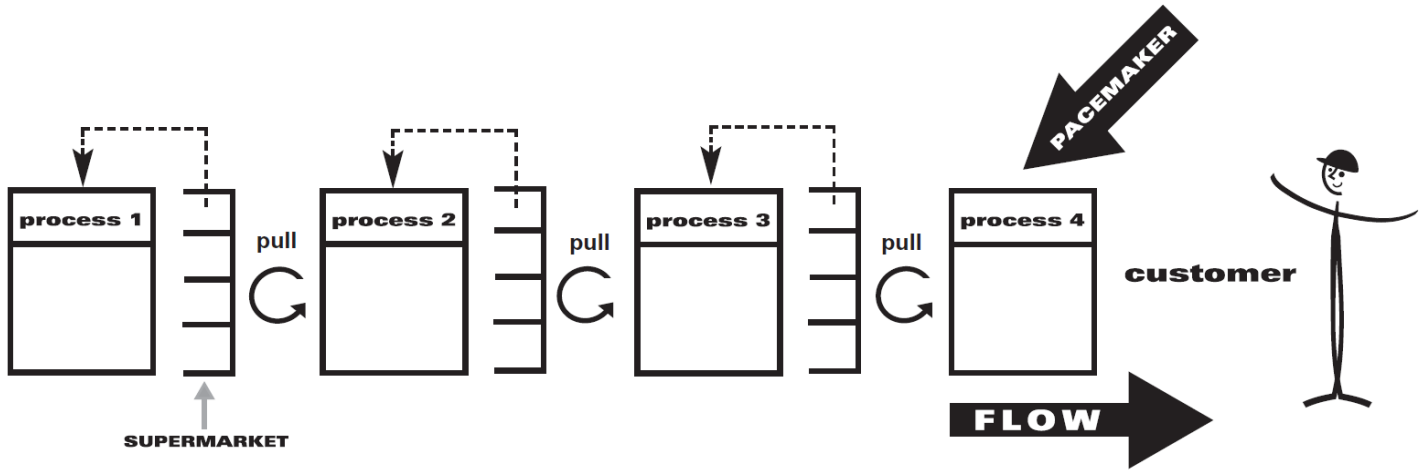

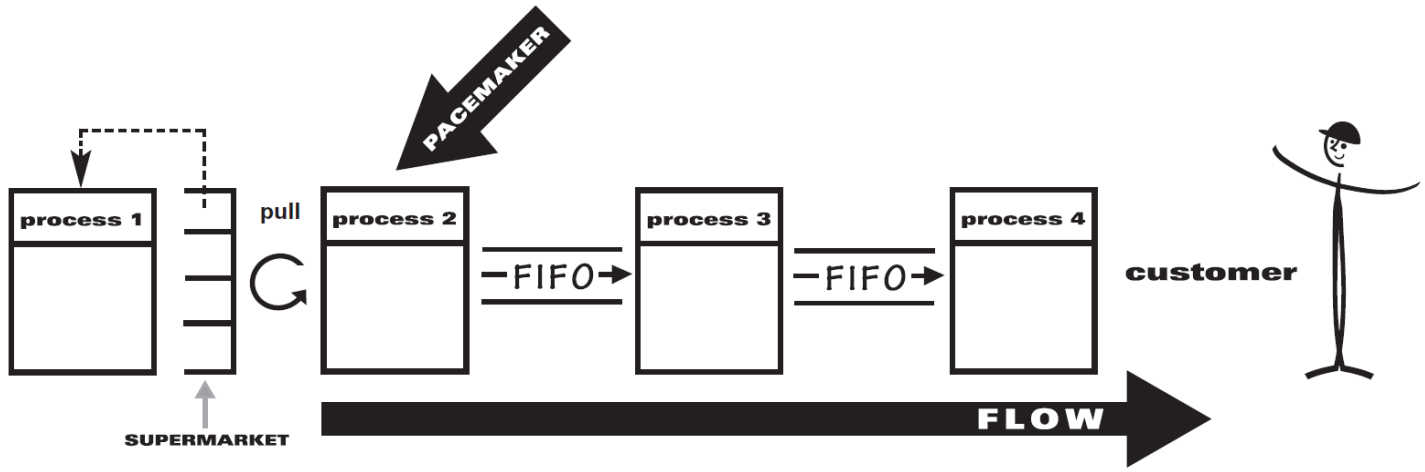

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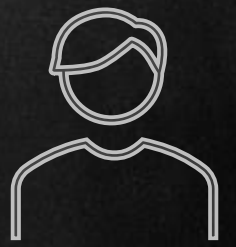

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Guidelines to a Lean Value Stream

Guideline #5. Level the production mix

- Some manufacturers probably find it easier to schedule long runs of one product type and avoid changeovers, but this creates serious problems for the rest of the value stream.
  - **Grouping** the same products and producing them all at once makes it **difficult to serve** customers who want **something different** from the batch being produced **now**.
  - This requires you to have **more finished goods inventory** -- in the hope that you will **have on hand what a customer wants** -- or more lead time to fulfill an order.
  - Batching in assembly also means that **the components** will be consumed in batches, which creates the same effect, or worse, upstream.
- Leveling the product mix means distributing the production of different products evenly over a time period.
  - For example, instead of assembling all the "Type A" products in the morning and all the "Type B" in the afternoon, leveling means alternating repeatedly between smaller batches of "A" and "B".
- The **more you level** the product mix at the pacemaker process, the more able you will be to **respond to different customer requirements** with a short lead time while holding little finished goods inventory.

OXOX

The icon for leveling is the above symbol, which is inserted into an information flow arrow.

- A "**production**" kanban triggers production of parts,
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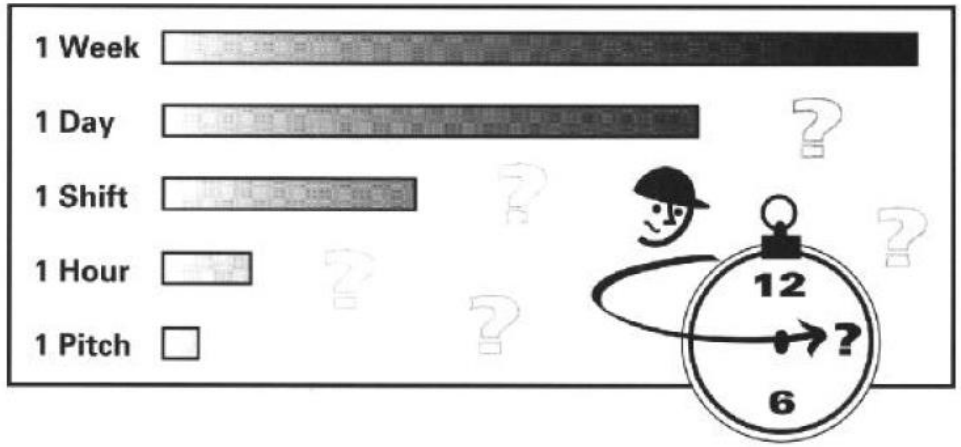
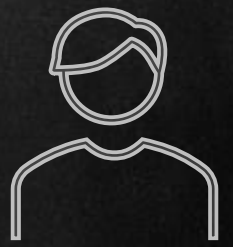
Guidelines to a Lean Value Stream

Guidelines #6. Level the production volume

- Too many companies **release large batches** of work to their shop floor processes (Daily / Weekly / Monthly Schedule), which causes several problems:
  - With a large amount of work released to the shop floor, each process in the value stream **can shuffle orders**. This increases **lead time and the need to expedite.**
  - **Responding** to changes in customer requirements **becomes very complicated**, which can often be seen in very complex information flows in current-state drawings.
- Establishing a consistent, or level production pace creates a predictable production flow, which by its nature advises you of problems and enables you to take quick corrective action.



- The icon for leveling the production pace is the same symbol as for leveling the mix, because a pre-requisite for lean manufacturing is that both the mix and volume of production be leveled.



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Guidelines to a Lean Value Stream

Guidelines #6. Level the production volume

- A good place to start is to regularly **release only a small**, consistent **amount of production instruction** (usually between 5-60 minutes worth) at the **pacemaker process**, and simultaneously take away an equal amount of finished goods. We call this practice a "**paced withdrawal**".
- We call the consistent increment of work the pitch, and often calculate the pitch increment based on packout container quantity (the number of parts one finished-goods container holds), or a multiple or fraction of that quantity.
- **For example**: If your takt time = 30 seconds, and your pack size = 20 pieces, then your pitch = 10 minutes (30 sec x 20 pcs = 10 minutes).
- In other words every 10 minutes:
    a) give the pacemaker process instruction to produce one pack quantity;
    b) take away one finished pack quantity.
- So in this case pitch means multiplying your takt time upward to a finished-goods transfer quantity at the pacemaker process. This then becomes the basic unit of your production schedule for a product family.
- One way to think about **pitch** is as your "**management time frame**".
- If you release a **week of work** to the floor at one time, then your current pitch is probably "once a week".
- Just as we don't want to transfer **material in large batches**, we don't want to transfer production instruction (**information**) **in big batches either**.

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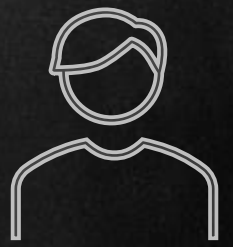

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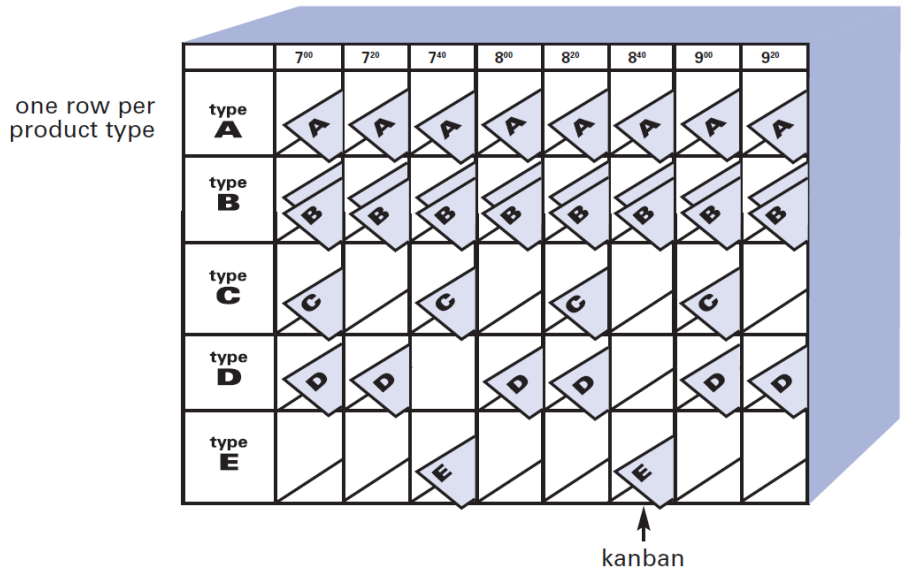
Guidelines to a Lean Value Stream

Guidelines #6. Level the production volume

- There are **many ways** to practice **paced withdrawal** of small, consistent quantities of work.
- A tool used at some companies to help level both the mix and volume of production is a load-leveling (or **heijunka**) box.
- Kanban are placed (loaded) into the leveling box in the desired mix sequence by product type (see levelling box illustration). The material handler the withdraws those kanban and brings them to the pacemaker process, one at a time, at the pitch increment.



Example of a heijunka box.

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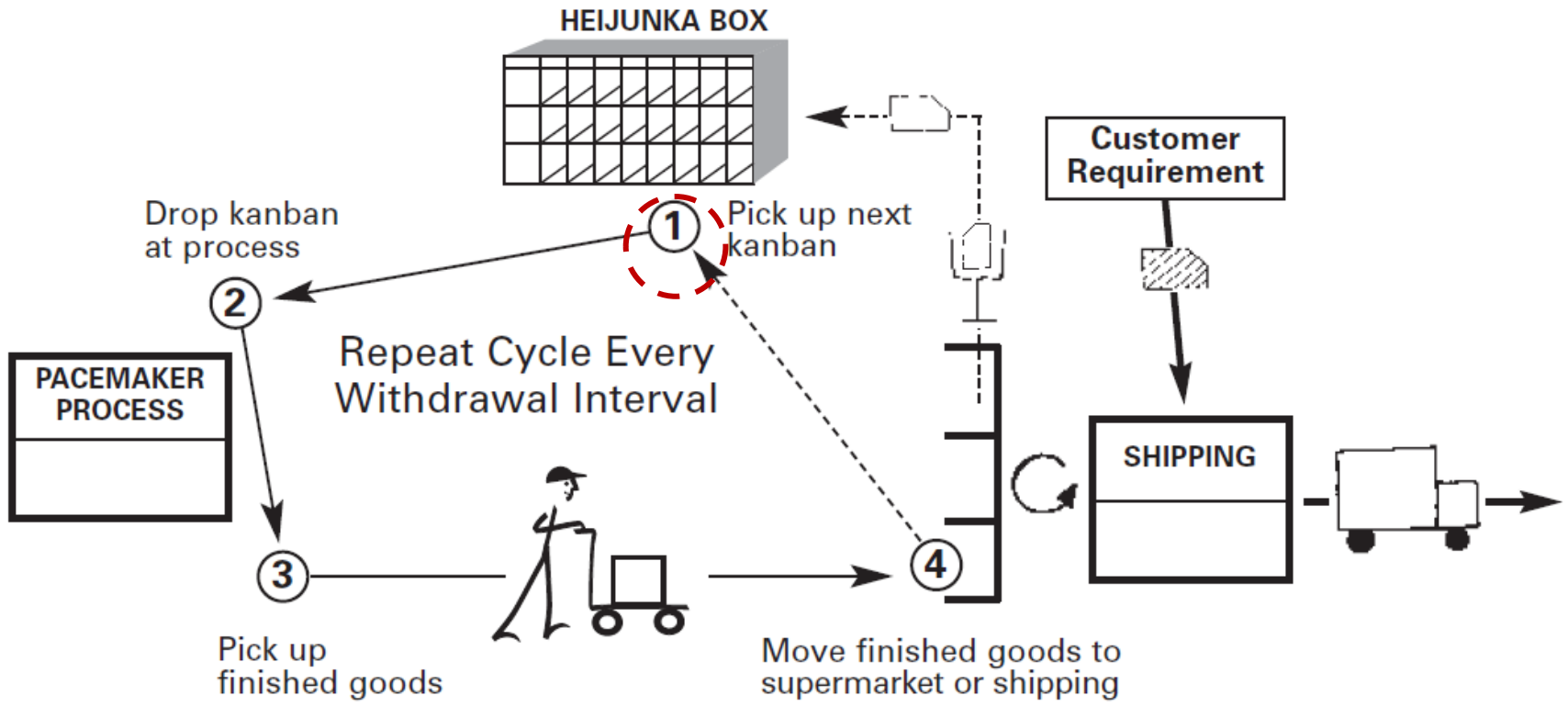

Typical paced withdrawal in a plant environment.

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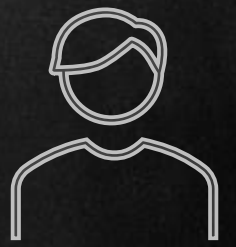

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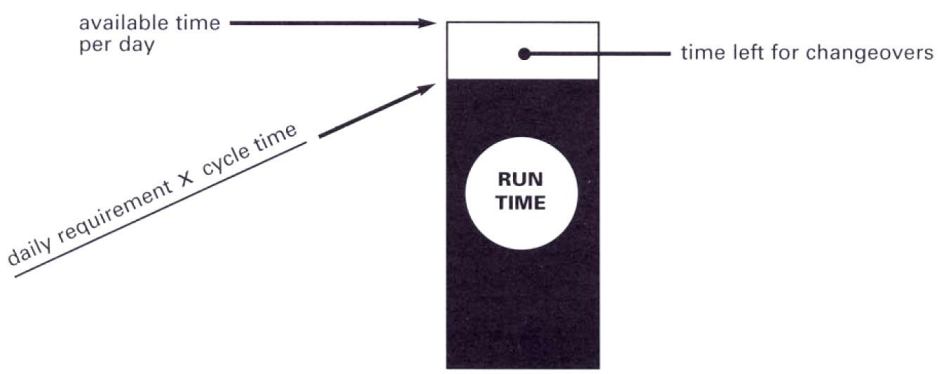
Guideline #7. Every Part Every (EPE)

- In general, we note either the batch sizes or "**EPE**" in the data boxes. EPE stands for "every pat every…" after which you write a time such as week, day, shift, hour, pitch, or takt.
- This describes **how frequently** a **process changes over** to produce all part variations. An initial goal at many plants is to make **at least "every part every day" for high-running part numbers.**
- One method for determining **initial batch sizes** at fabrication processes is to base them on **how much time** you have left in the day to make **changeovers**.
    - For example, if you have 16 hours available per day and it takes 14.5 hours to run the daily requirement, then there are 1.5 hours available for changeovers. (A typical target is approximately 10% of available time to be used for changeovers.) In this case if the current changeover time is 15 minutes, then you can make 6 changeovers per day.
    - To run smaller batches more frequently you will need to reduce the changeover time and/or improve uptime.



- SMED is a Well Established technique to Substantially Reduce Changeover Time

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Summary

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