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Pull Systems

Agenda

1. Pull Systems: What is it ?
2. Pull Systems purpose and benefits
3. Pull Connections:
 - Continuous Flow
 - Sequential Pull
 - Replenishment Pull
4. Kanban Systems
5. The Supermarket
6. Push and Pull Controls
7. Drum, Buffer, Rope
8. Takeaways



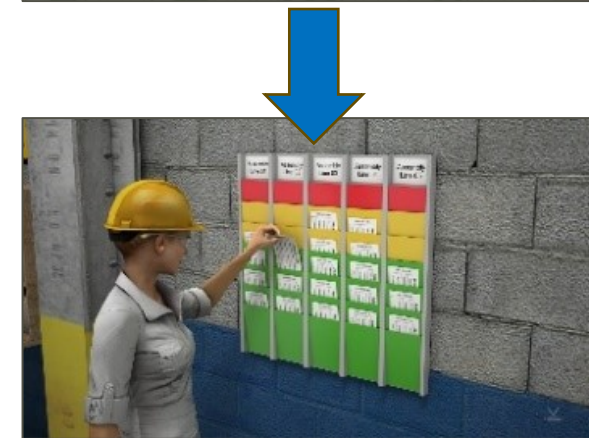
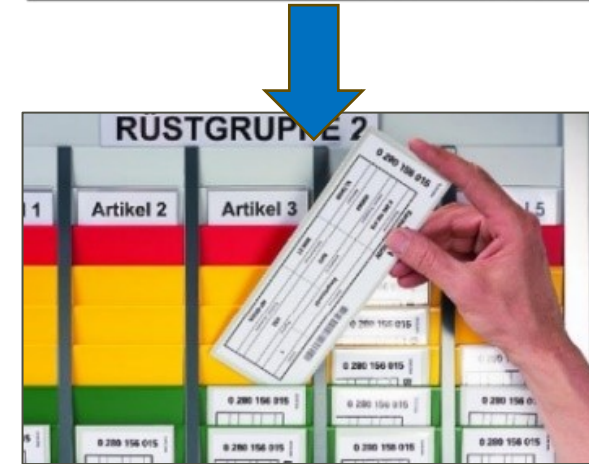
Introduction

What is it ?

A **Pull system** is a process in which a workstation starts to work on his next order **only when there is a free slot** on the output side.

This means the trigger for producing anything on the workstation **comes from the customer side**, which can be internal as well as external.

| Part Description | | | | Part Number | |
|-----------------------------|-------------------------|-------------|----------|-------------|------|
| Smoke-shifter, left handed. | | | | 14613 | |
| Qty | 20 | Lead Time | 1 week | Order Date | 9/3 |
| Supplier | Acme Smoke-Shifter, LLC | | | Due Date | 9/10 |
| Planner | John R. | Card 1 of 2 | | | |
| | | Location | Rack 1B3 | | |



Introduction

Purpose and Benefits

Choosing the right type of pull connection is one of the steps in designing a Future State VSM.

Visualize the workflow

Eliminate interruptions by **limiting** Work in Process

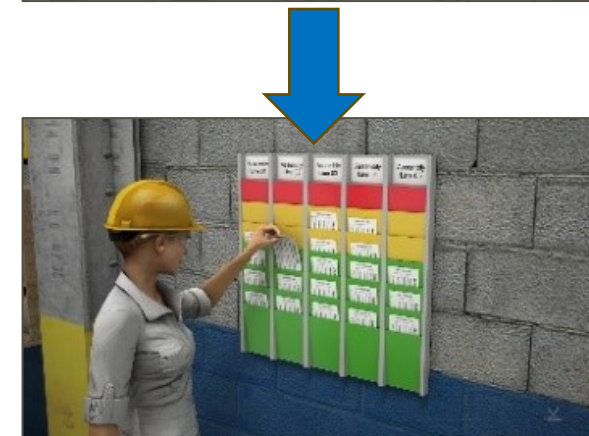
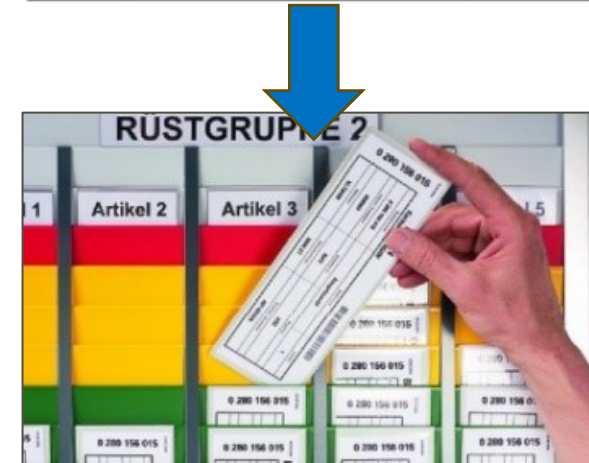
Manage **flow**

Make process **policies** explicit

Maintain open **feedback** loops

Improve **collaboratively**

| Part Description | | | | Part Number | |
|-----------------------------|-------------------------|-------------|----------|-------------|------|
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| | | Location | Rack 183 | | |



Introduction

Purpose and Benefits

Make all we can just in case



✗ Product approximation
✗ Anticipated usage
✗ Large lots
✗ High Inventories
✗ Waste
✗ Management by Firefighting
✗ Poor communication

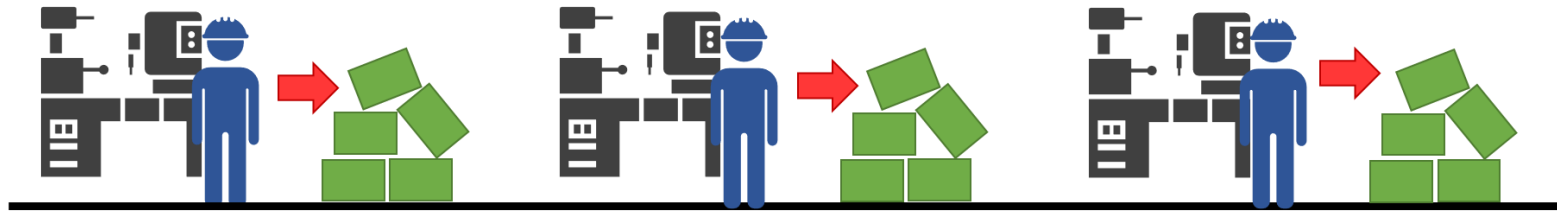
Make what's needed when we need it



✓ Product Precision
✓ Actual Consumption
✓ Small Lots
✓ Low Inventories
✓ Waste Reduction
✓ Management by Sight
✓ Better Communication

Pull Systems

The inventory in Push and Pull systems



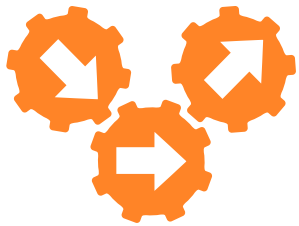
PUSH SYSTEM: Material is moved to the next stages as soon as is processed



PULL SYSTEM: Material is moved only when next stages calls for it

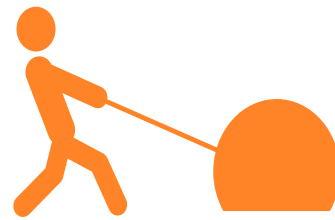
Pull Systems

Pull Connections:



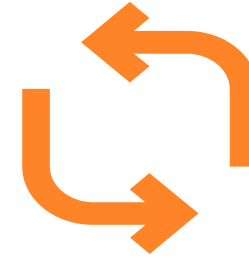
Continuous Flow

Work cell with Continuous Flow.
One by one and with a maximum **inventory of one** between the workstations.



Sequential Pull

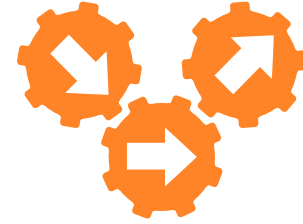
Fixed Quantity.
Defined Sequence.
Buffer designed.



Replenishment Pull

Supermarket.
maximum number of products is waiting to be worked on.
Kanban system.

Pull Systems



1. Continuous Flow

The **Continuous flow** connection has the highest level of Pull, since all three factors are included. Products are worked on **one by one** and with a maximum **inventory of one** between the workstations.

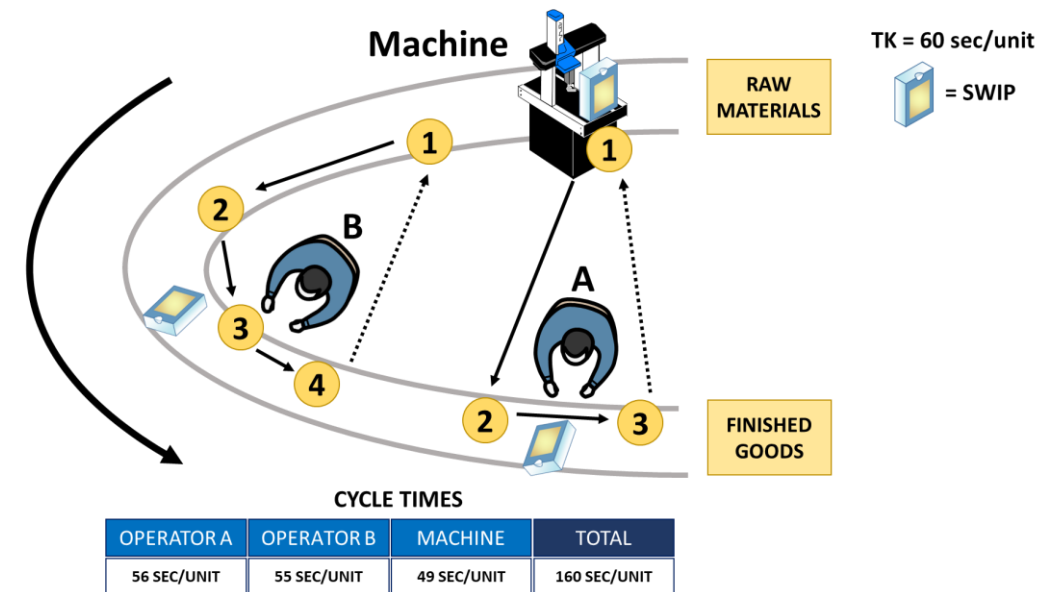
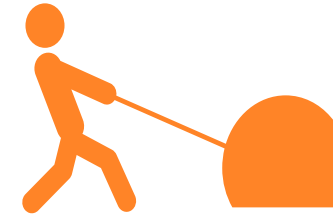


Pull Systems

2. Sequential Pull

The **Sequential Pull** connection is the second-best possible Pull connection, in which the **fixed quantity** is determined, the sequence of product is defined, but a buffer with a defined maximum is allowed between workstations to buffer for variance.

This is usually implemented using **First-In-First-Out** lanes (FIFO).

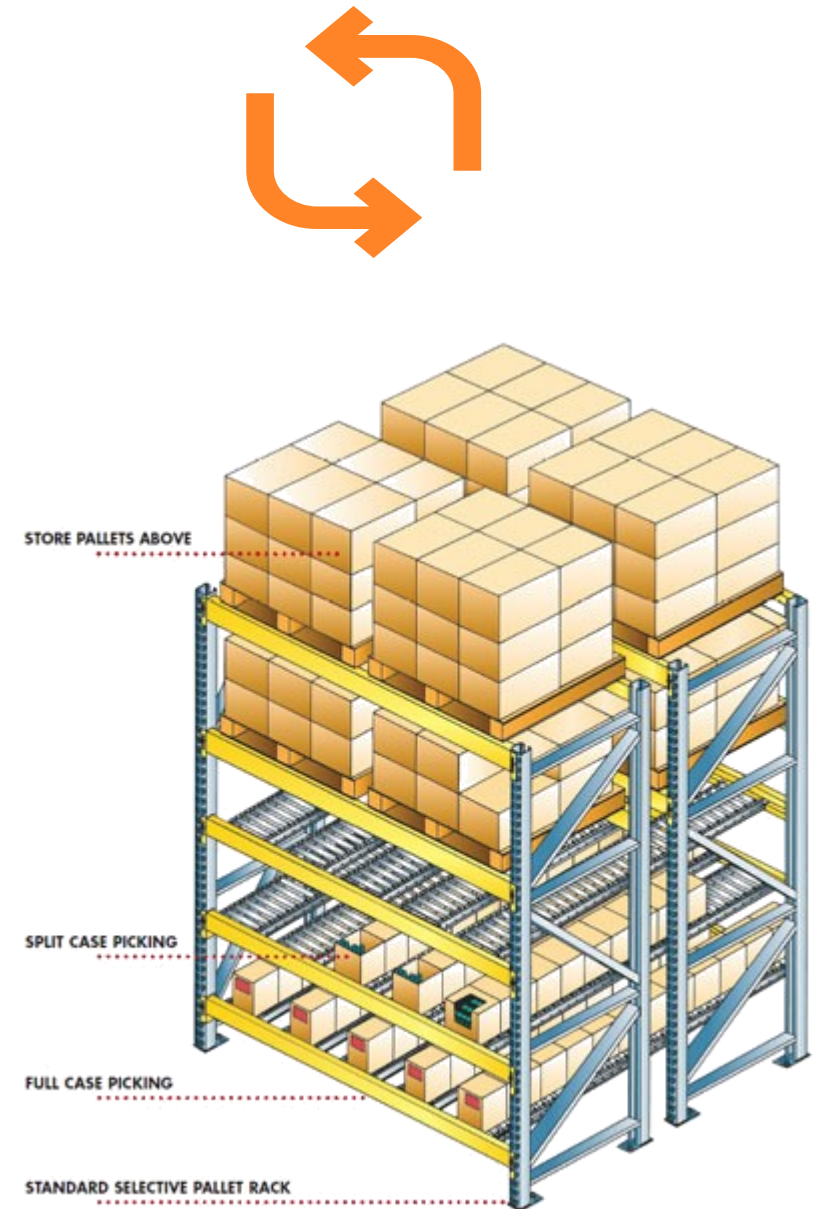


Pull Systems

3. Replenishment Pull

The **Replenishment Pull**, the **supermarket**, is the third and last option, in which a **maximum** number of products is waiting to be worked on, but it is unknown which type of product will be pulled out next.


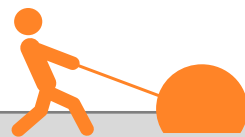

This type of inventory is also known as a supermarket and can be controlled using **Kanban**.



Pull Systems

Choosing the right type of pull connection is one of the steps in designing a **Future State VSM**. This decision depends on a few processes and product variables.

Pull Connections


| |  Continuous Flow |  Sequenced Pull |  Replenishment Pull |
|---------------------------------|---|---|---|
| Max 1 part inventory | X | | |
| Fixed Sequence | X | X | |
| Maximum number of parts waiting | X | X | X |

Pull Systems

When to use what type of connection

Pull Connections

| | | Process Reliability (Good and on time) | | Changeover times | | Lead times | | Demand Variation & Part usage | | Part cost | |
|---|------------------------|---|------|------------------|------|------------|------|----------------------------------|------|-----------|------|
| | | LOW | HIGH | LOW | HIGH | LOW | HIGH | LOW | HIGH | LOW | HIGH |
| 1 | Continuous Flow | | X | X | | X | | X | X | X | X |
| 2 | FIFO | | X | X | | X | X | X | X | X | X |
| 3 | Supermarket/ Kanban | X | X | Choose FIFO | X | X | X | X | | X | |
| 4 | Push | | | X | | | | | X | | X |

 Problem

Pull Systems

Kanban Systems

Kanban is a Japanese term that can be translated into '**Visual signal**' and is used to visualize production and transport signals in a process.



Pull Systems

Kanban Systems

Kanban is used when a pull-connection between two process steps is chosen to be a supermarket.

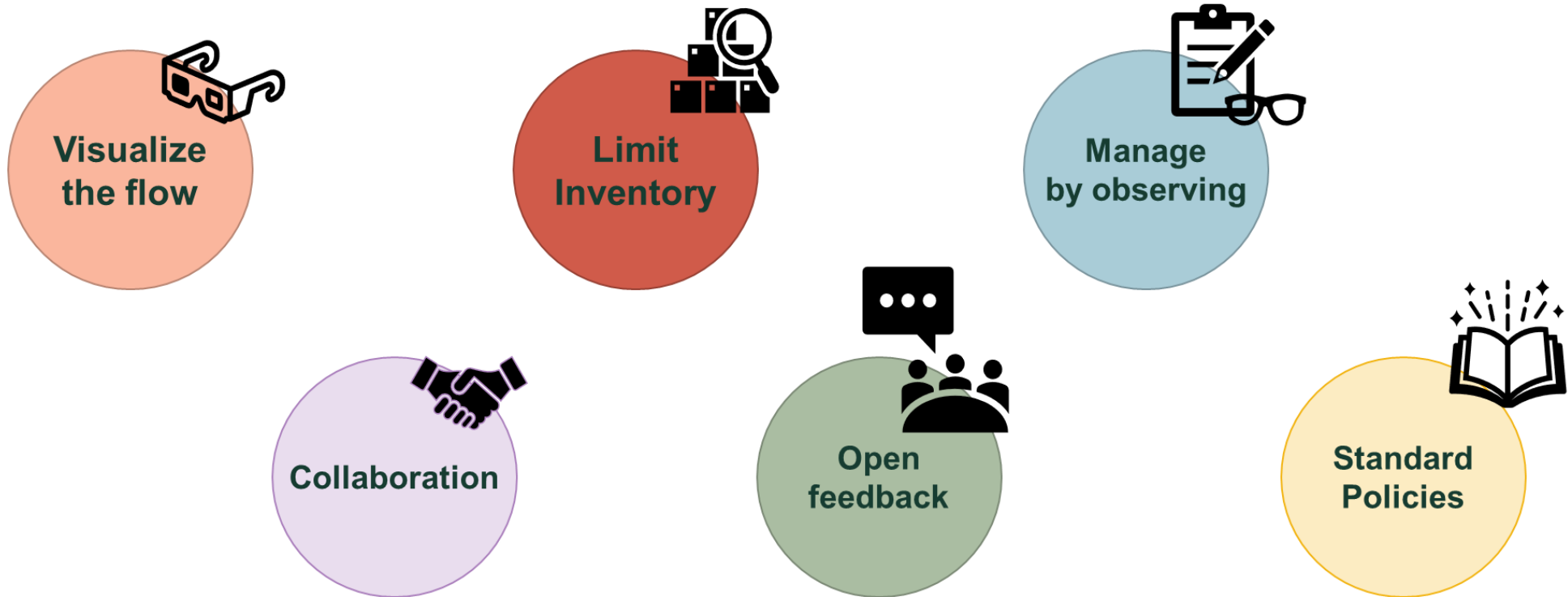
The upstream processes which replenish the supermarket must know what product need to be produced.

The Kanban signal provides this information.



Pull Systems

Kanban Systems



Pull Systems

Kanban Systems

As a pull connection, both **One-piece flow** as well as **First-In-First-out (FIFO)** are more desirable than the supermarket because they do not need a separate signal to know what to replenish.

A Kanban system is a pull system, and therefore a lean system, but **the goal of the Kanban** is to eliminate the Kanban which means the supermarket is transformed into a FIFO lane or a One-Piece Flow line.



Pull Systems

Kanban Systems

The Kanban Card system can be explained best using the 6 golden rules:

1. The **downstream** process only takes products out of the supermarket which are used immediately. In a two-card-system, material can only be collected with a Kanban card.
2. The **upstream** process produces the exact number of products listed on the Kanban card. Nothing is produced without a card.



Pull Systems

Kanban Systems

The Kanban Card system can be explained best using the 6 golden rules:

3. The Kanban signal **always stays** with the product. As soon as there is material without a Kanban, or a Kanban without material, a problem has occurred.
4. Defects won't be transported downstream, which means all workstations have their **own quality** check.



Pull Systems

Kanban Systems

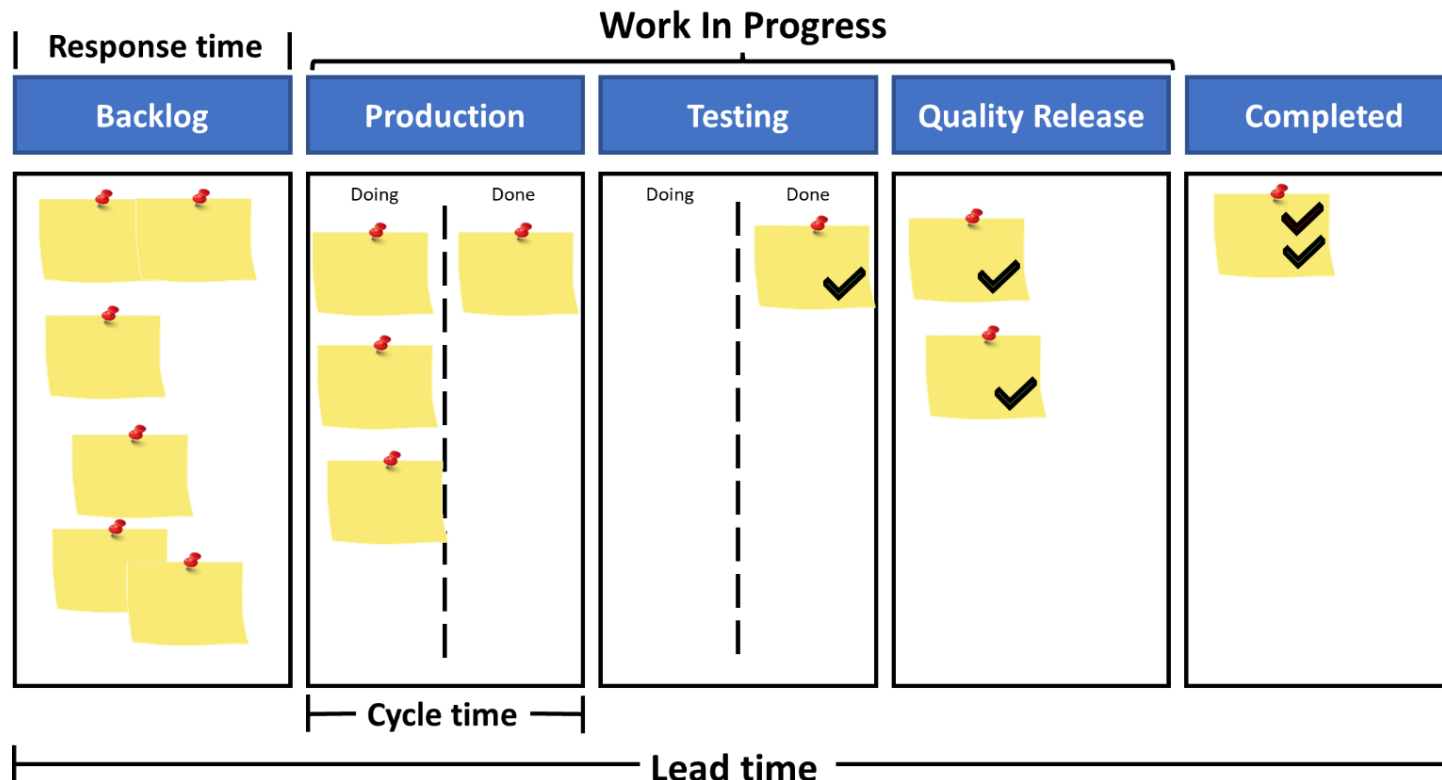
The Kanban Card system can be explained best using the 6 golden rules:

5. Kanban can be used when volumes **vary about 10% maximum**.
6. The number of Kanban cards represents the amount of **inventory**, hence waste (muda), in a process. The number of cards should therefore continuously be reduced.



Pull Systems

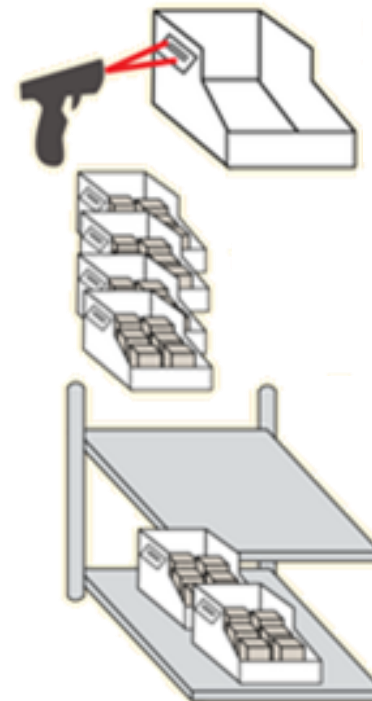
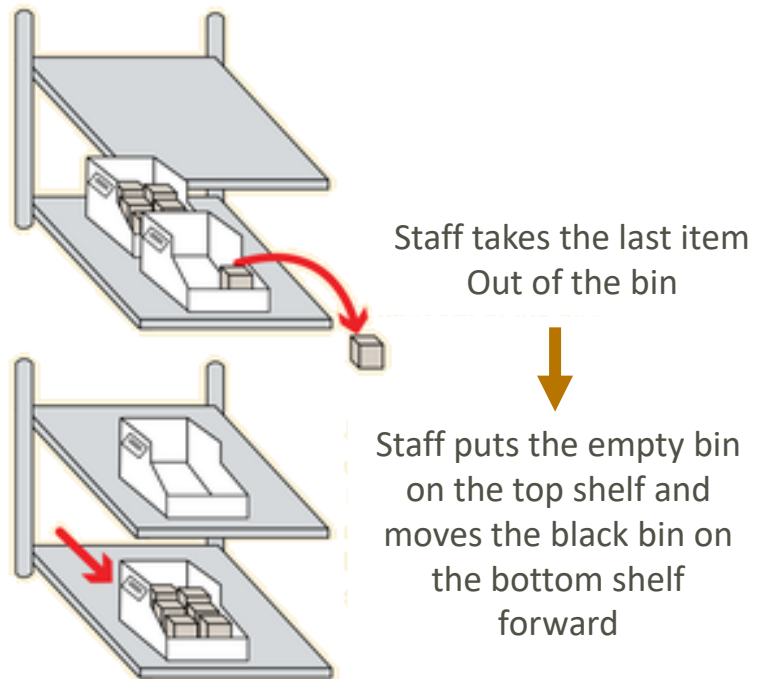
Kanban Systems



Pull Systems

The 2-bin system principle

Kanban Systems



Staff scans the empty bin,
and a message goes into
the inventory management
system to order more
supply



The empty bins are
restocked

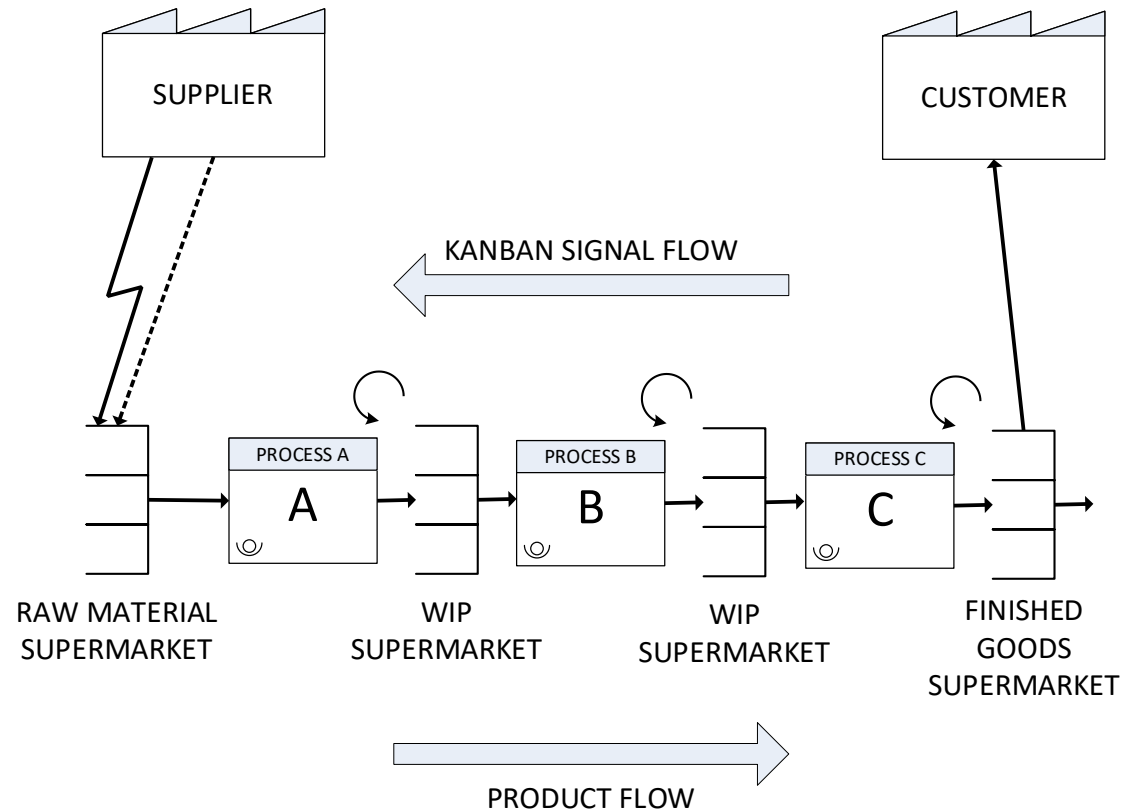


The new bins are put
on the back of the
shelves

Pull Systems

Kanban signal flow and the supermarket (in the VSM).

Kanban Systems



Pull Systems

Kanban signal flow and the supermarket (in the VSM).

Kanban Systems

To calculate the number of Kanban, the replenishment time and the number of items per batch are leading:

Kanban Cards

$$= \frac{\text{Daily demand} \times \text{Safety buffer} \times \text{Lead time}}{\text{Kanban containers}}$$

or

$$K = \frac{D \times (1 + SB) \times KCT}{C}$$

Where:

D = Average daily demand of the product

SB = Safety buffer (typically 10%)

KCT = Kanban Cycle time

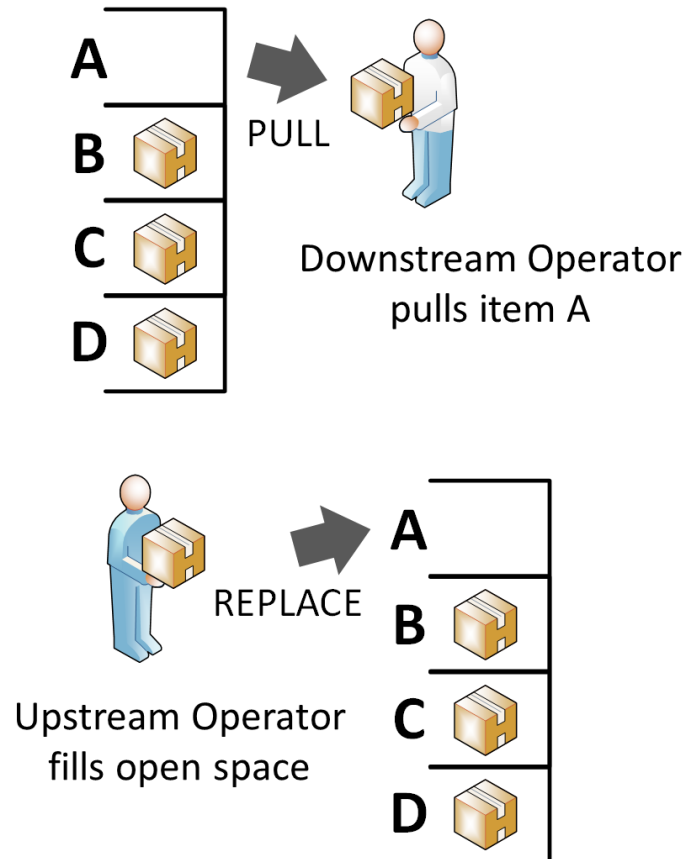
(Replenishment time once the signal has been received expressed in days)

C = Number of Kanban containers

Pull Systems

The Kanban principle.

Kanban Systems



Pull Systems

The Supermarket

The supermarket will **only be considered** when One Piece flow and First In First Out (FIFO) are no longer an option.

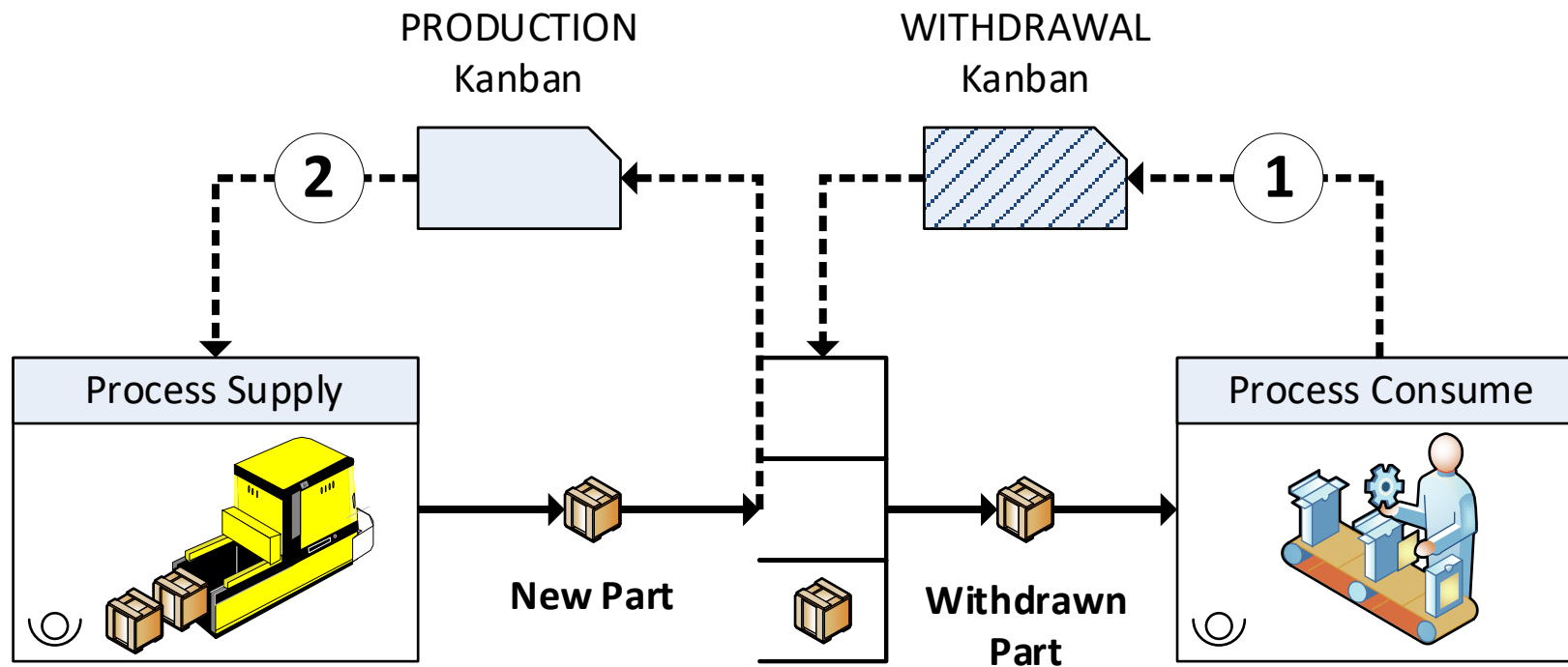
A supermarket is a method of managing inventory in which a **variation of parts** can be kept without knowing in what order the parts will be taken from the inventory.



Pull Systems

The Supermarket

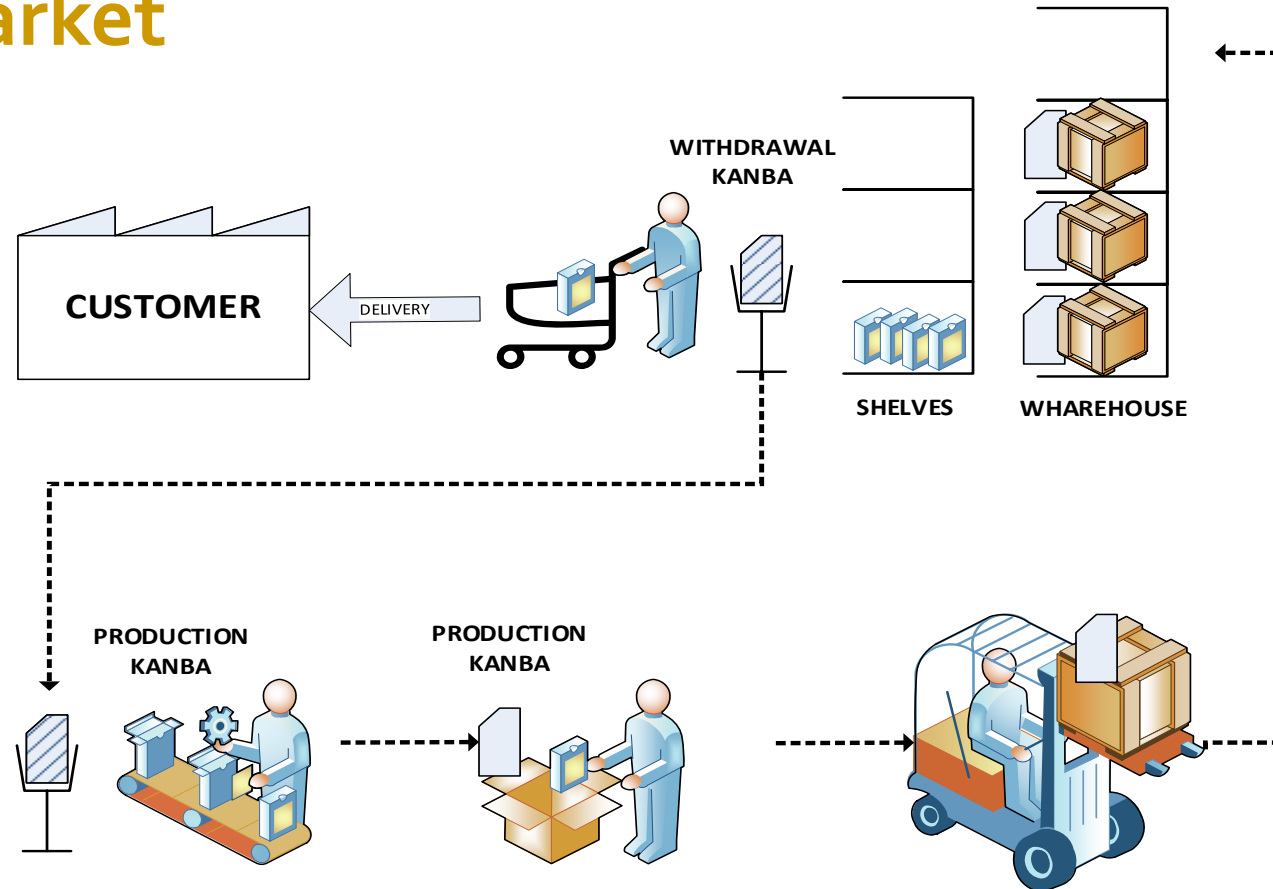
The Supermarket



Pull Systems

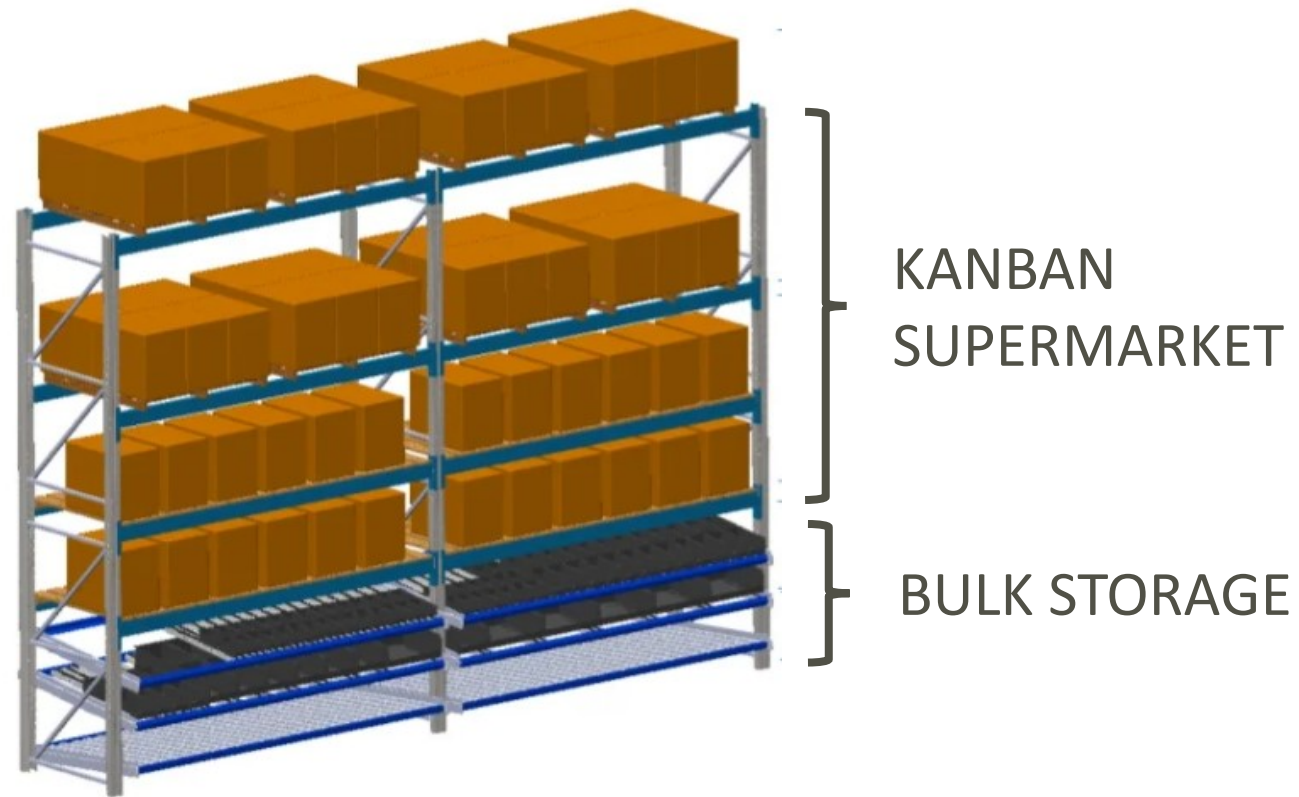
Production Kanban and Withdrawal Kanban

The Supermarket



Pull Systems

The Supermarket



Pull Systems

Kanban Card

The Supermarket

Every position in the **supermarket with Kanban** is represented by a card,

The Kanban card is the **authorization to produce**.

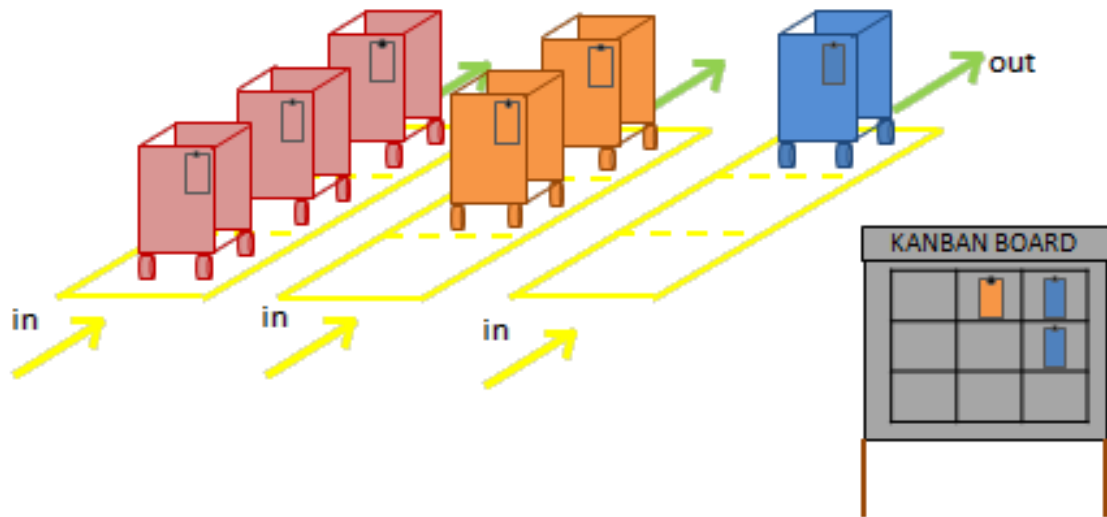
The Kanban cards are usually visualized on a Kanban



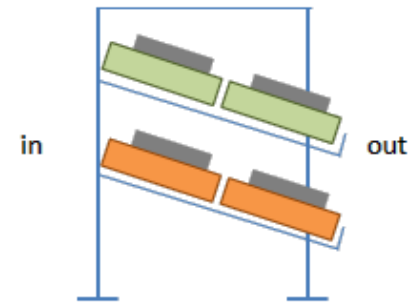
Pull Systems

Supermarket with Kanban Card

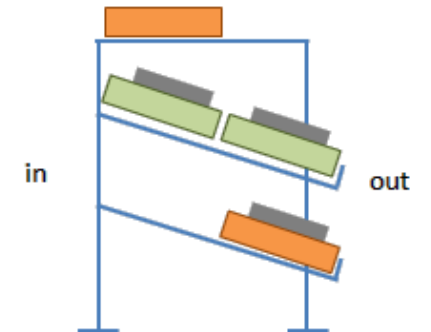
The Supermarket



1



2



Pull Systems

Supermarket with
Kanban Card

Push and Pull Controls

In a System Control:

Push activities are scheduled by means of a central system and completed in line with **central instructions**, such as an **MRP system**.

In a pull system of control, the pace and specification of what is done are set by the 'customer' workstation, which 'pulls' work from the **preceding (supplier) workstation**. The customer acts as the only '**trigger**' for movement.



Pull Systems

Drum, Buffer, Rope

The drum, buffer, rope concept comes from the **Theory of Constraints (TOC)**

The **bottleneck** in the process should be the control point of the whole process. It is called **the drum** because it sets the '**beat**' for the rest of the process to follow.

All they would do is produce work which would accumulate further along in the process up to the point where the bottleneck is constraining the flow (**Buffer**).



"One, people are good. Two, every conflict can be removed. Three, every situation no matter how complex it initially looks, is exceedingly simple."

Eli Goldratt

Pull Systems

Drum, Buffer, Rope

Because it constrains the output of the whole process, any time lost at the bottleneck will affect the output from the whole process.

Some form of communication between the bottleneck and the input to the process is needed to make sure that activities before the bottleneck do not overproduce. This is called the **rope**.



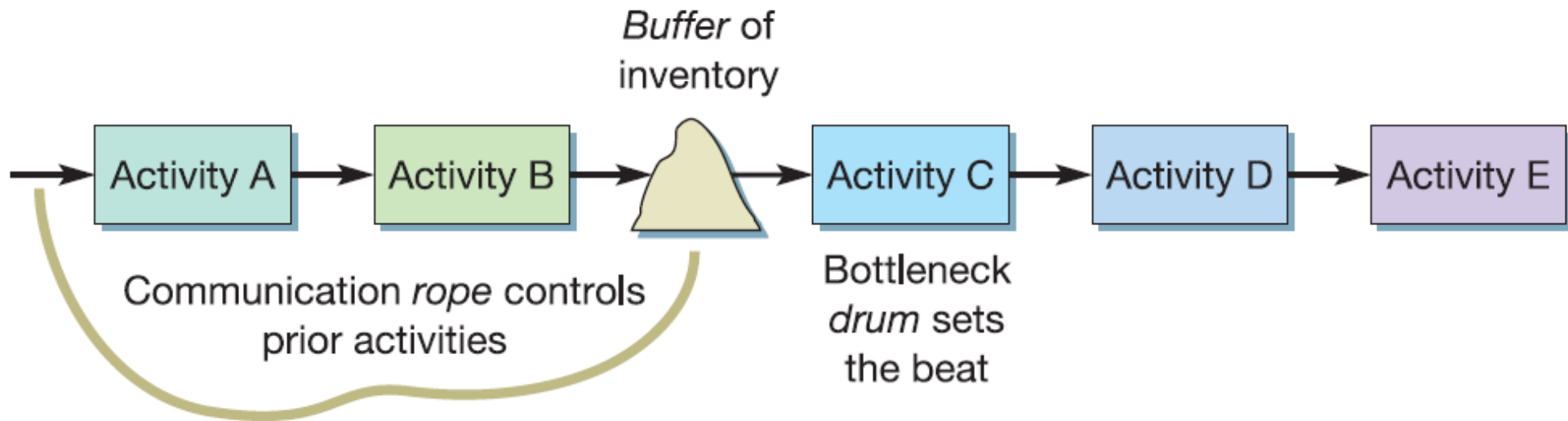
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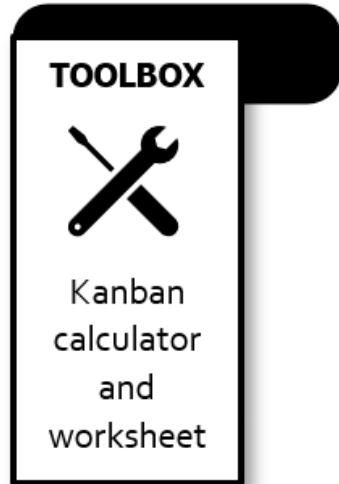
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The Rope and Buffer concepts.

Drum, Buffer, Rope




Kanban Calculator and Worksheet



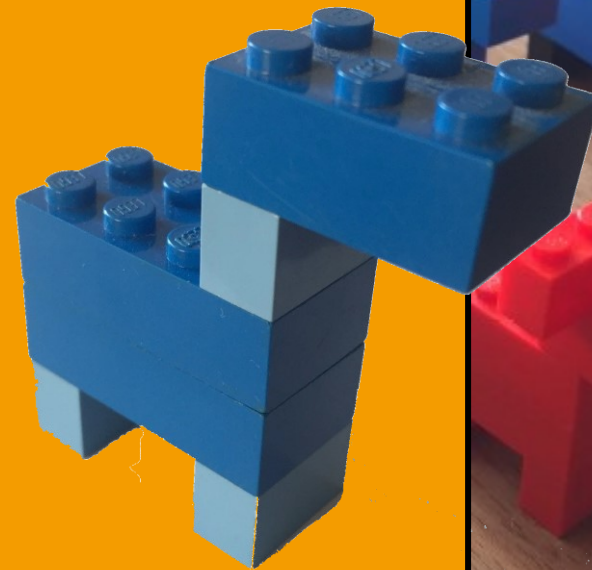
| <u>Number of Kanban – Calculator</u> | | | |
|--------------------------------------|----|---|----------------|
| Input [weekly based] | | | Output |
| Weekly Demand [pcs] | 45 | ➔ | N° of Kanban 6 |
| Lead Time [weeks] | 1 | | |
| Safety Stock [%] | 15 | | |
| Kanban/Container Quantity [pcs] | 10 | | |
| Input [daily based] | | | Output |
| Daily Demand [pcs] | 5 | ➔ | N° of Kanban 1 |
| Lead Time [days] | 2 | | |
| Safety Stock [%] | 20 | | |
| Kanban/Container Quantity [pcs] | 20 | | |
| Input [hourly based] | | | Output |
| Hourly Demand [pcs] | 5 | ➔ | N° of Kanban 1 |
| Lead Time [hours] | 2 | | |
| Safety Stock [%] | 20 | | |
| Kanban/Container Quantity [pcs] | 20 | | |

Animal Farm

**LEARNING
HUB**



Lego
Kanban



Takeaways

- A lean pull system has the purpose of creating a workflow where work is pulled only if there is a demand for it.
- The purpose of implementing a pull system is to build products based on actual demand and not on forecasts. By doing so, a company can focus on eliminating waste activities in the production process.
- As a result, management may be able to optimize the resources and reduce the possibility of overstocking.
- In the context of workflow management, a pull system allows workers to pull their next task if they have the capacity to start working on it.
- This may help to prioritize tasks better and prevent teams from overloading. By doing so, a team can stay focused on executing the most important work just in time.



Thank You



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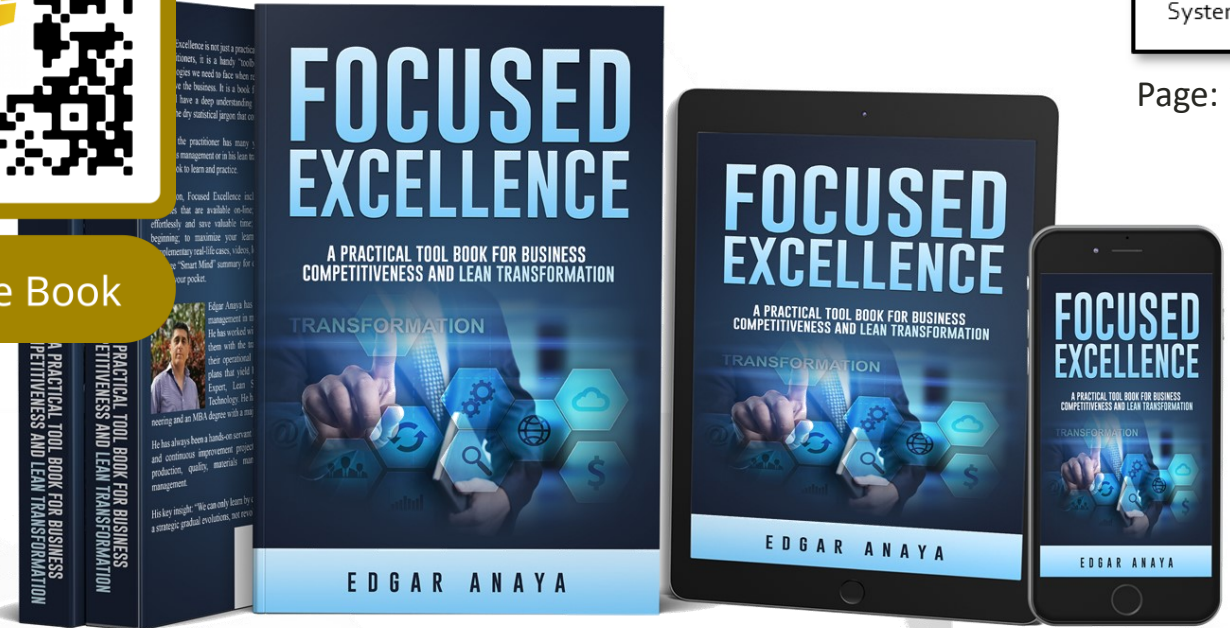
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A Practical Tool Book for
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Lean Transformation**