REPUBLIC POLYTECHNIC

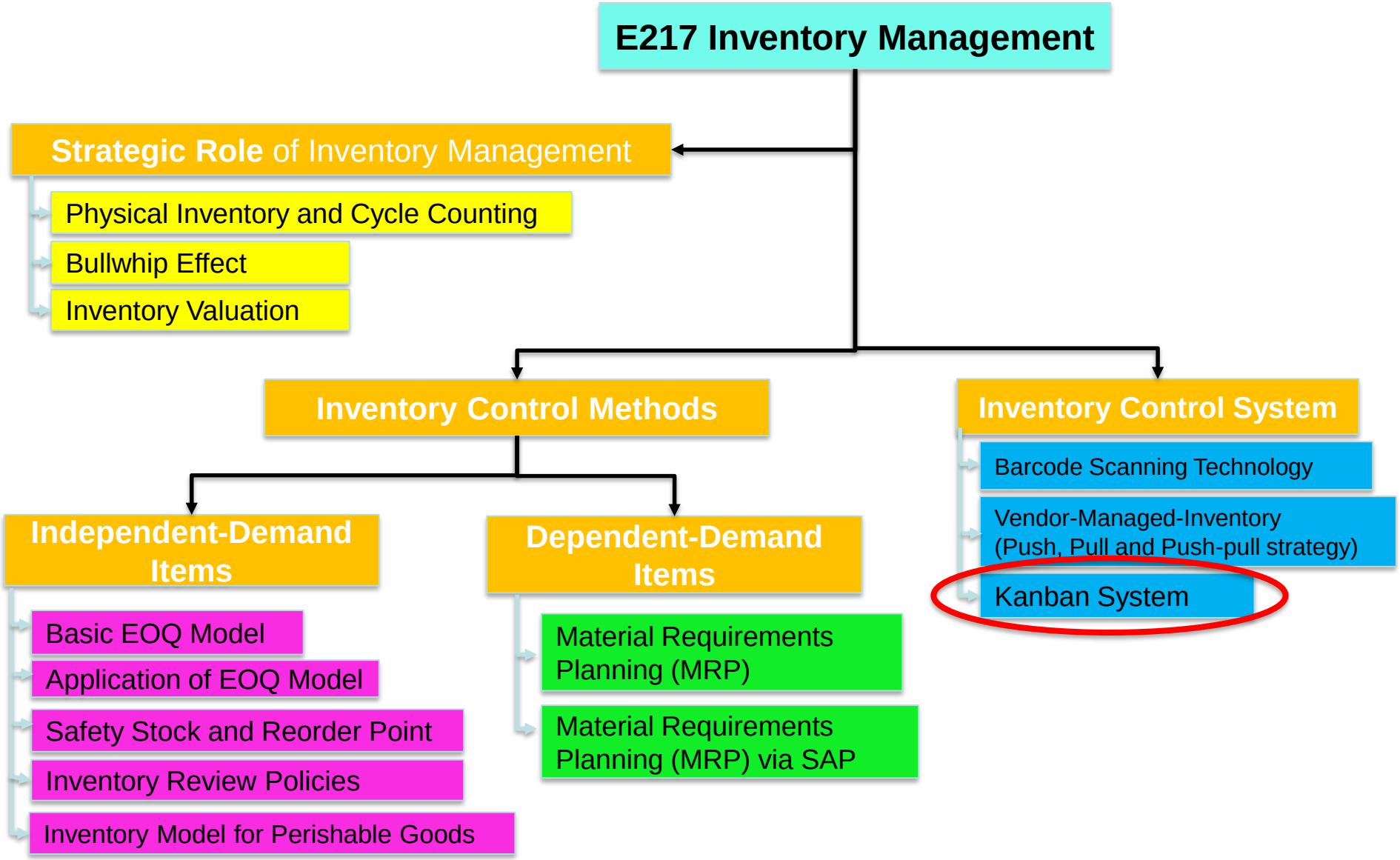
Lesson 12

Streamline by Cards

E217 – Inventory Management

SCHOOL OF ENGINEERING

E217 Inventory Management Topic Tree



Scenario – Production and Distribution of Fans

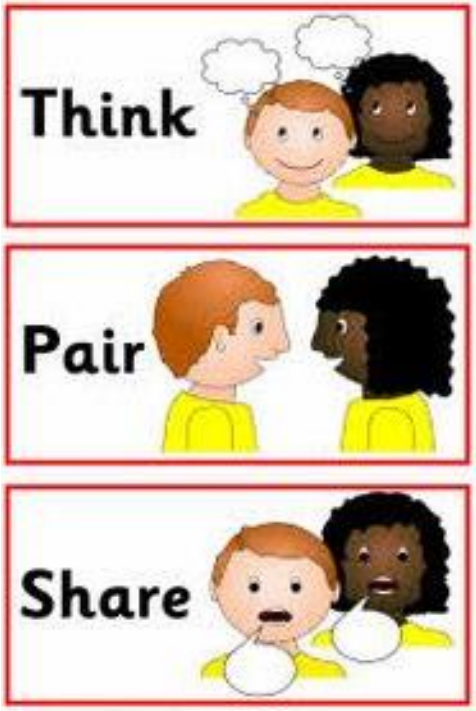
- Fans.com is a distributor and original equipment manufacturer (OEM) of portable fans
- Ricky, the warehouse supervisor manages the inventory of the portable fans.
- Ricky normally places orders based on his experience when the stock level is low.
- The demand from customers is about 50 units a day, and he can get the supplies from factory next day.
- One day, Ricky was on urgent leave and would be away for about one week. His colleague John walked into the warehouse and had no idea on whether he should reorder and how many he should reorder for the products.
- During the week, there are a few stock-out situations for certain SKUs due to demand increase

Scenario – Task of the day

John is frustrated in understanding the numbers recorded in Ricky's spreadsheet, because he has to take actions as fast as possible. He is wondering whether there is a way to achieve better visibility, in order to

- See which SKUs are required to order from factories internally and how many to order?
- Find which SKUs are producing at factories now and will come to the warehouse soon?
- Ensure no overstock and understock situations
- Minimize inventory holding cost

Activity 1: Think-Pair-Share



Based on your prior knowledge, answer the following questions through **think by yourself**, **exchange your thoughts with your neighbour** and **share your ideas within your team**:

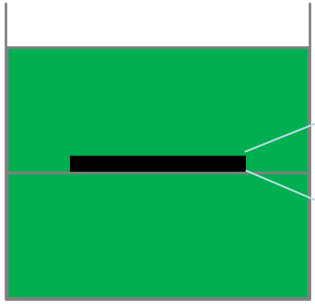
1. What information should John have before he can make decision on what, when and how many to order for certain SKUs?
2. How long do you think John needs to find, understand and make use of the information?
3. Any suggestions for John to speed up the decision making process?

Pulling Inventory using Kanban

- *When does your family replenish the toilet paper?*

Pulling Inventory using Kanban

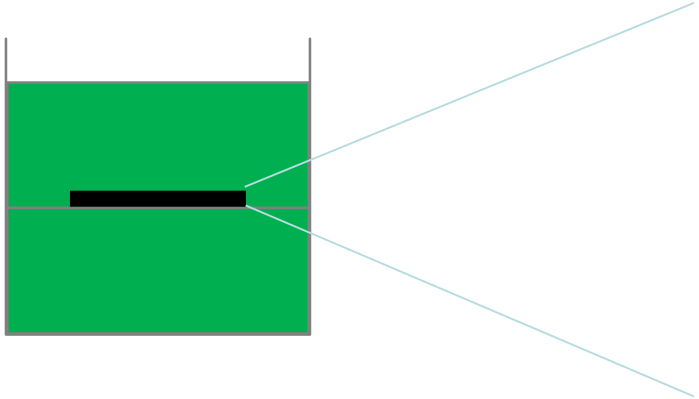
- Kanban
  - Visualize when to reorder, what to reorder, how much to reorder



Reorder Finished Goods	
Part Number	: PPUF228
Part Description	: Metal USB Fan
Reorder Quantity	: 1 Carton
Quantity per Container	: 12 Pieces
Location	: 02-18-01
Lead Time	: 1 Days

Pulling Inventory using Kanban

- Kanban
  - Visualize when to reorder, what to reorder, how much to reorder



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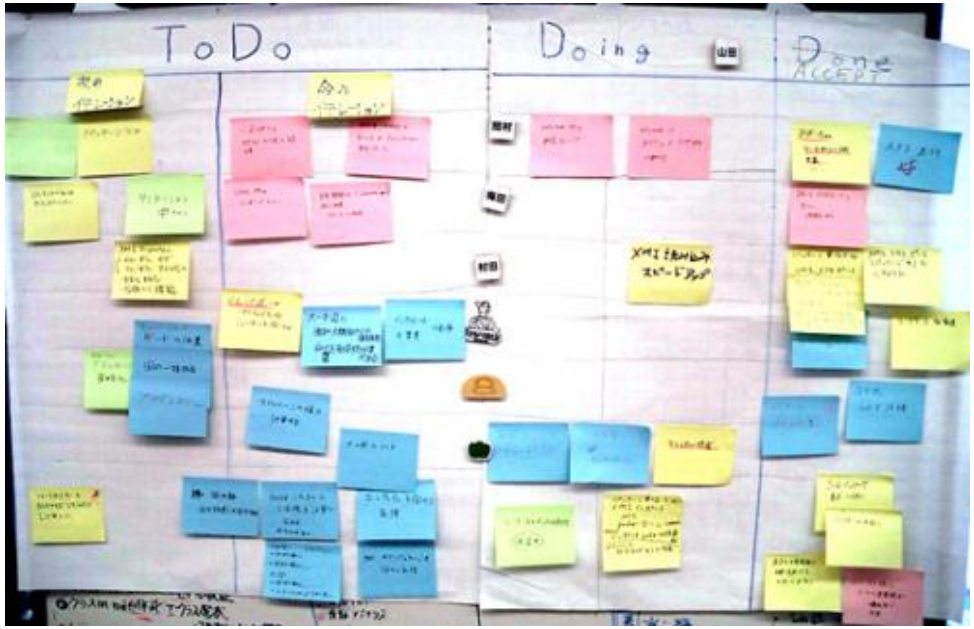
Waiting for Finished Goods Arrival	
Part Number	: PPUF228
Part Description	: Metal USB Fan
Reorder Quantity	: 1 Carton
Quantity per Container	: 12 Pieces
Location	: 02-18-01

Kanban Concept

https://youtu.be/5izyN66PTxs

Examples Incorporating Kanban Concept



Kanban on Products

- Good location and/or packaging labels help to quickly identify the product and make less mistakes
- Facilitates logical, more detailed product search from left to right, or/and up and down
- The use of contrasts, underline, bold and font types are also low costs ways to improve product, packaging and location labels

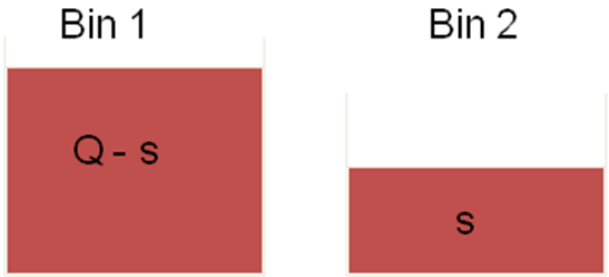
Kanban for Products

H&M uses both colours and number of pieces for their changing rooms

Visual Management of what is a new style vs older style

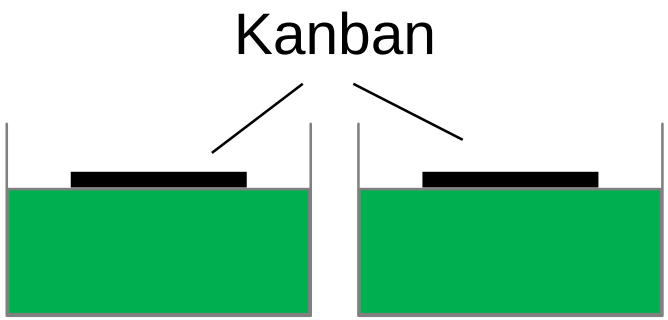
The Origin Of Kanban

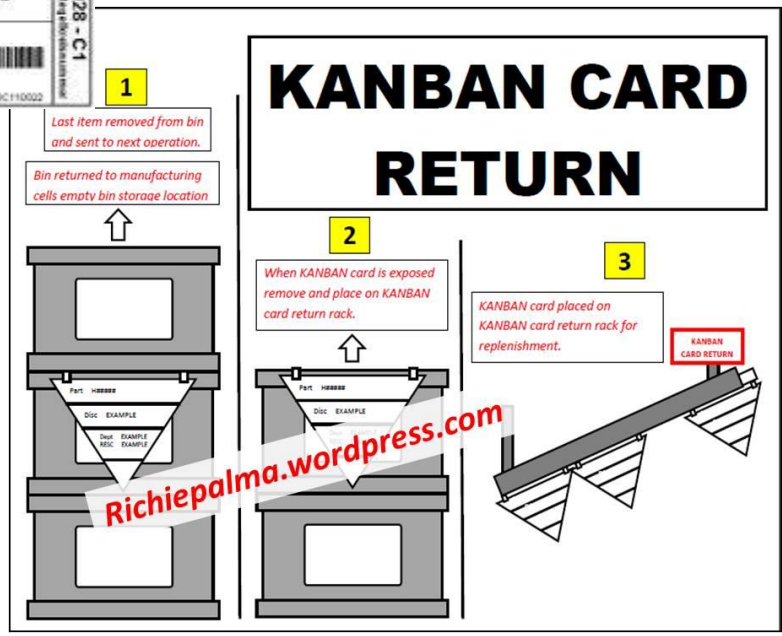
Two-bin inventory system



Q = order quantity
s = reorder point
= demand during lead time

Kanban Inventory System





Kanban Inventory Control

- Kanban (Japanese): Card or Visual Record
- It contains any information necessary to describe what, where, when and how much is needed for the process.
- Kanbans are signals used to replenish the inventory of items used repetitively in a facility
- Consists of an information *Card* and *Container* that holds a standard quantity of items
- Kanban maintains discipline of *pull* production, which is based on actual demand.
- No station is permitted to produce more than what is immediately required by the succeeding station, thereby it reduces waste (inventory)

Essential Rules for Kanban System

- ✓ ***Each container /product must have a card***
- ✓ ***Downstream station always withdraws from a station upstream (pull system)***
- ✓ ***Containers/product cannot be moved without a Kanban***
- ✓ ***Containers should contain the same number of parts***
- ✓ ***Only good parts are passed along***
- ✓ ***Production should not exceed authorized production quantity***

Activity 2: Poll

1. Will the Kanban system will _____ the average inventory level of the product
   - **A. Increase**
   - **B. Reduce**
   - **C. Not Change**

2. The product with _____ demand is suitable for Kanban system
   - **A. Low and intermittent**
   - **B. High and consistent**
   - **C. Moderate and fluctuated**

Activity 2: Poll

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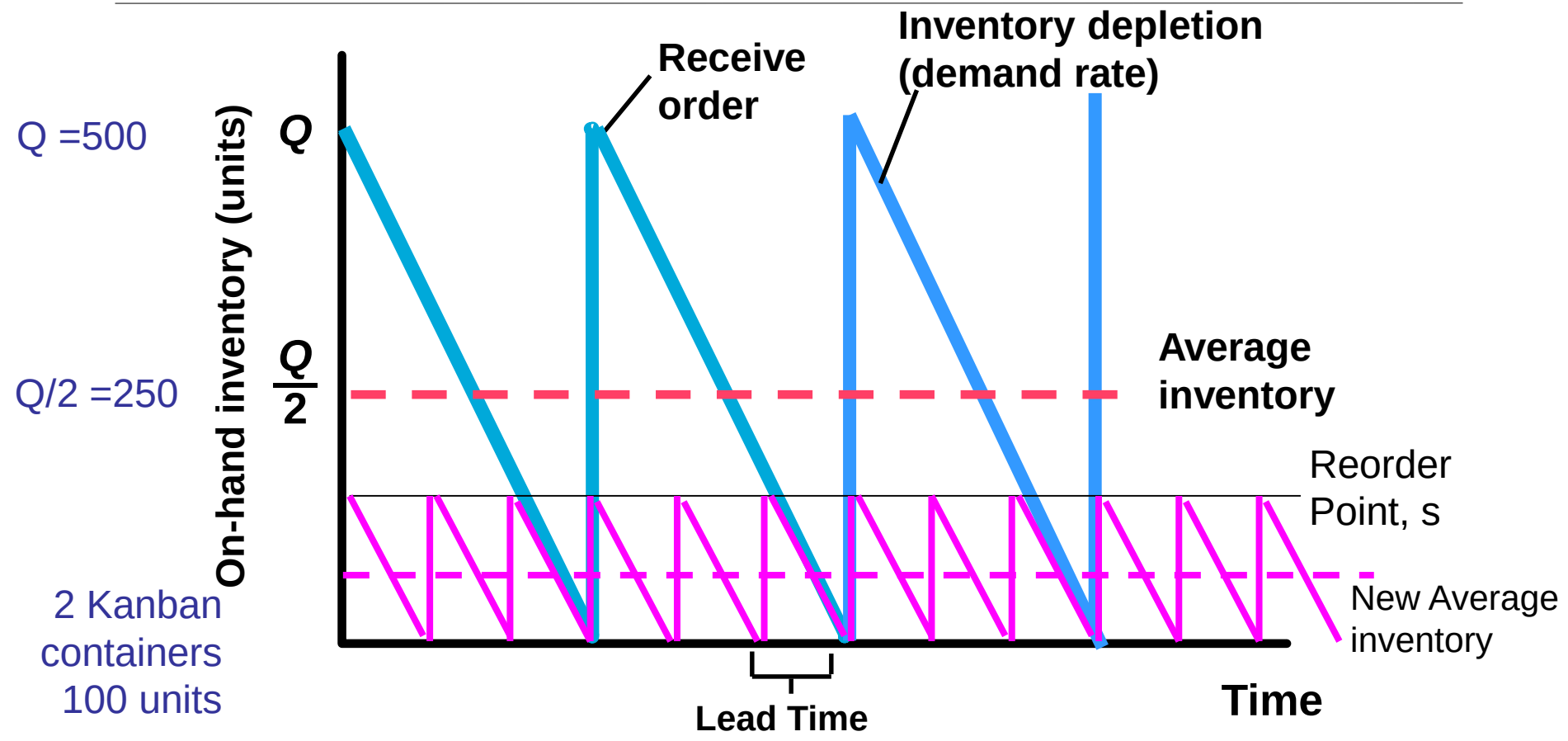
Lower Inventory with Kanban by Example

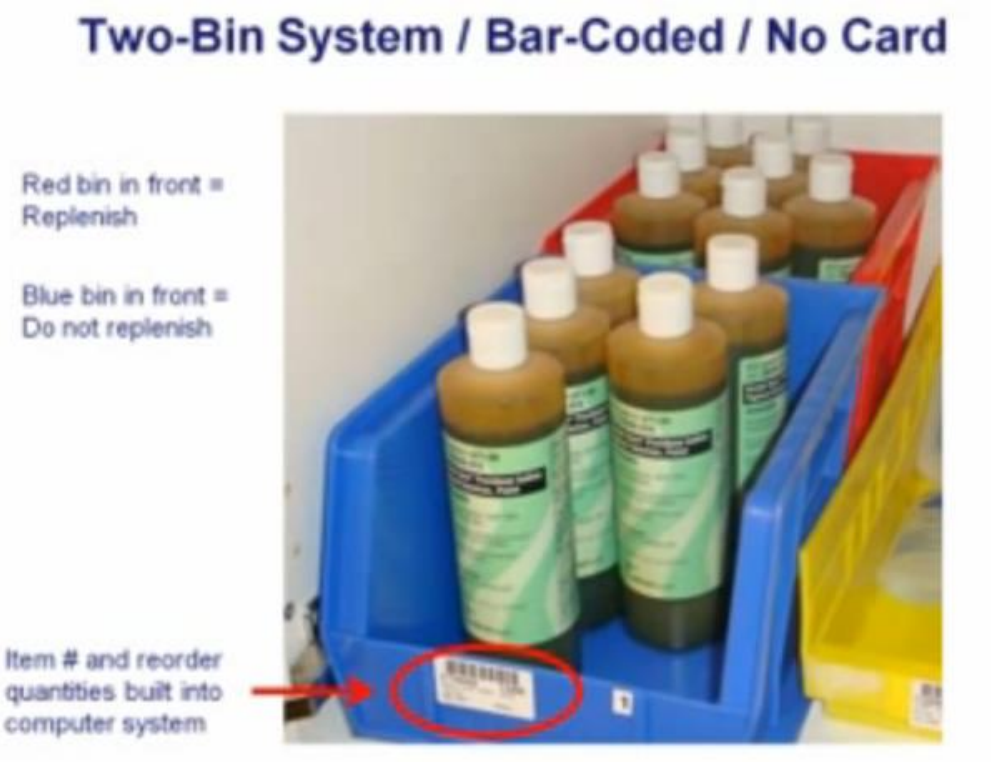


- For example, two-bin system (reorder point system), Q =500, so average inventory is 250 and reorder point is 50.
- If we replace with Kanban system with 2 containers, 50 units in each, the maximum inventory is 50 and average inventory is 25 units, which is much lower than the two-bin system. This saves **space**, and **capital locked in inventory**
- Same demand rate

Preconditions for Kanban system

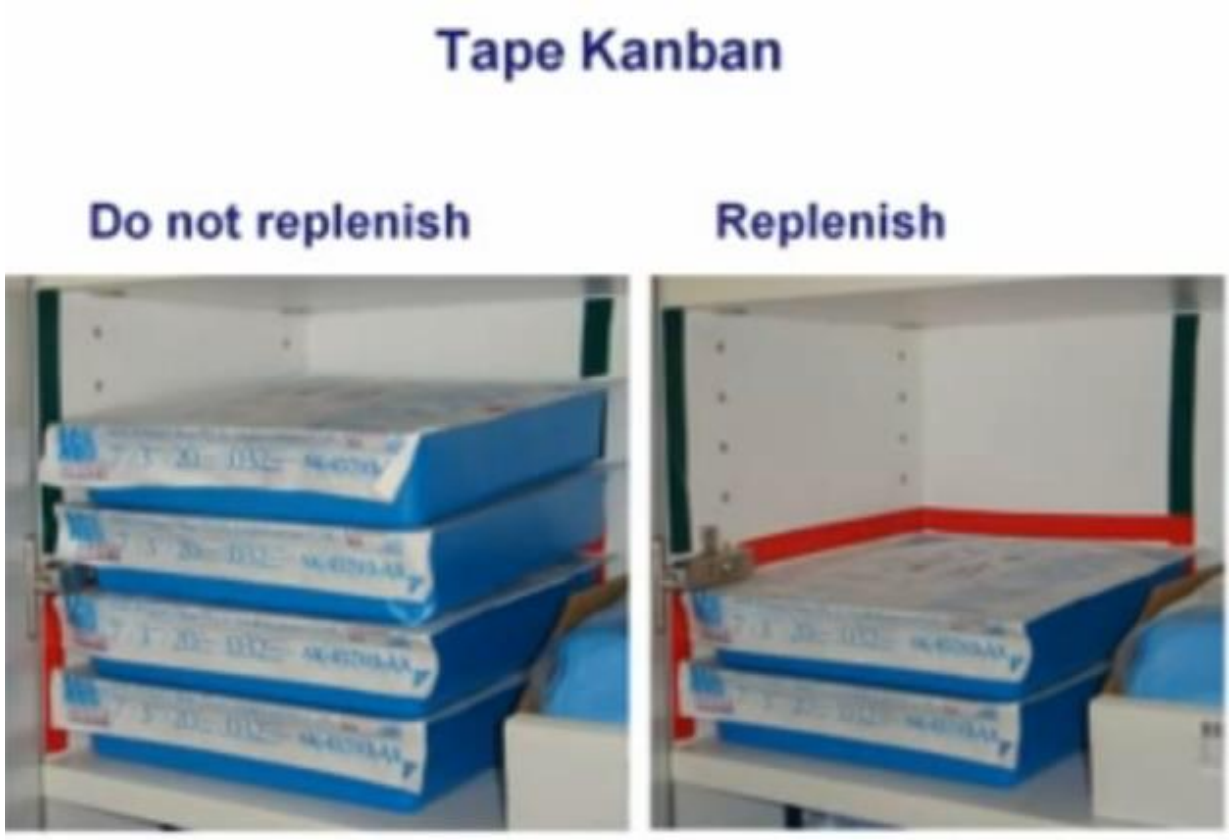
- Quick changeovers
- Repetitive production in small lots
- Balanced manufacturing line and stable process with minimal setup
- Close proximity of different parts of the system
- Scrap/ defects are not present
- Consistent demand (no large fluctuations)

Kanban System Without Cards



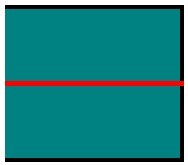
- Add color to visually detect when to order
- When red bin is in front, use the barcode scanner/smart phone with apps to read item to be ordered
- Order information is sent wirelessly to the inventory system
  - **Wireless Kanban**

Kanban System Without Cards



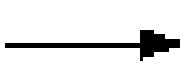
- When the stock gets down to the red tape, it is time to order

Simple Single-Card Kanban System



1. Start with a full container

Kanban



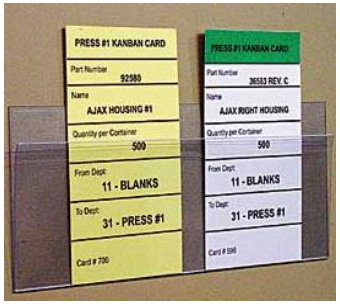
2. A new container is requested

3. The new container is delivered

4. The first container is completely emptied

Generalized Single-Card Kanban System

- In a Single Card Kanban system, the operator of a downstream operation requires a Production/Move Card and the necessary Material to be authorized to begin processing.
- The operator simply removes the Card and sends it back to the upstream process, signaling production to replenish the materials used by the station prior to processing the job.
- Information on a Kanban card:
  - Product name
  - Part code or item number
  - Preceding stage and succeeding stage
  - Card number
  - Item quantity / container size
  - Barcodes, etc.

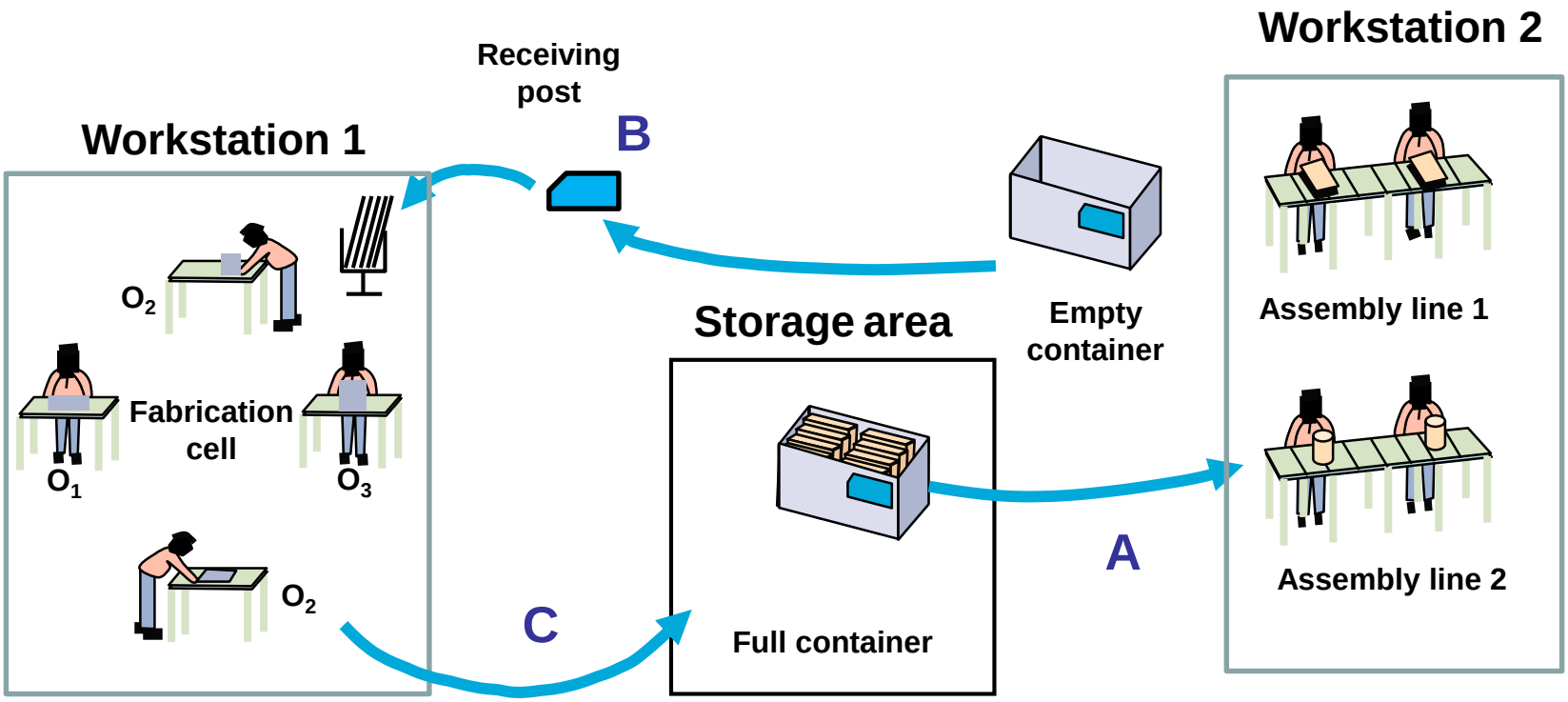


One Example of Single-Card Kanban System

https://youtu.be/tum1lLwy6gE

Single-Card Kanban System

- To “pull” inventory and production processes



After one container is used by Workstation 2

A: Workstation 2 gets the materials from the full container at the storage area.

B: The empty container with Kanban attached is sent to Workstation 1.

C: Full container to replenished to Storage area

Dual-Card Kanban System

- This Kanban system is more commonly referred to as the Toyota Kanban system as Toyota was the first to employ this system in full scale use.
- It is a more useful Kanban technique in large-scale, high variety manufacturing facilities.
- A Two Card Kanban is used when WIP can't be effectively handed from one process to the next, thus necessitating an Inbound Stock Point and an Outbound Stock Point for processing stations.
- Two Cards are used:
  - Move card (Withdrawal card/ Transport card) :
    - Delivers order for parts from a preceding process
    - Specifies quantity and type of parts to deliver from Location A to Location B
  - Production Card:
    - Provides production instructions for the work center
    - Tells the workers exactly the quantity and the type of part to produce

Move Card & Production Card

Move Card

Part number : 33311-3501

Container capacity : 50

No. of kanban released : 7 of 12

Downstream work center: K123

Stock location no.: A-12

Stock location no.: A-07

Upstream work center: Y321

Production Card

Work Center no.: Y321
Part number to be produced: 33311-3501
Container capacity: 50 units
Stock capacity at which to store: A-07

Materials Required:

Material no. 33311-3504
Stock location: A-05

Part no. 33825-2474
Stock location: B-03

Move Card

Types of Kanban

Can stop at supplier Kanban around 5 min plus https://youtu.be/NWCPBMDZ7SU

Activity 3: Ten-minute Assignment

Design a Kanban system to help fans.com know clearly when the inventory needs to be produced.

- Write down the necessary information on your Kanban Cards
- Demonstrate how the cards are moved and used

Note: show clearly how the production knows which SKU to produce, how many units to produce at one time, when the finished goods reaches or goes below the Kanban level?

Activity 3: Ten-minute Assignment

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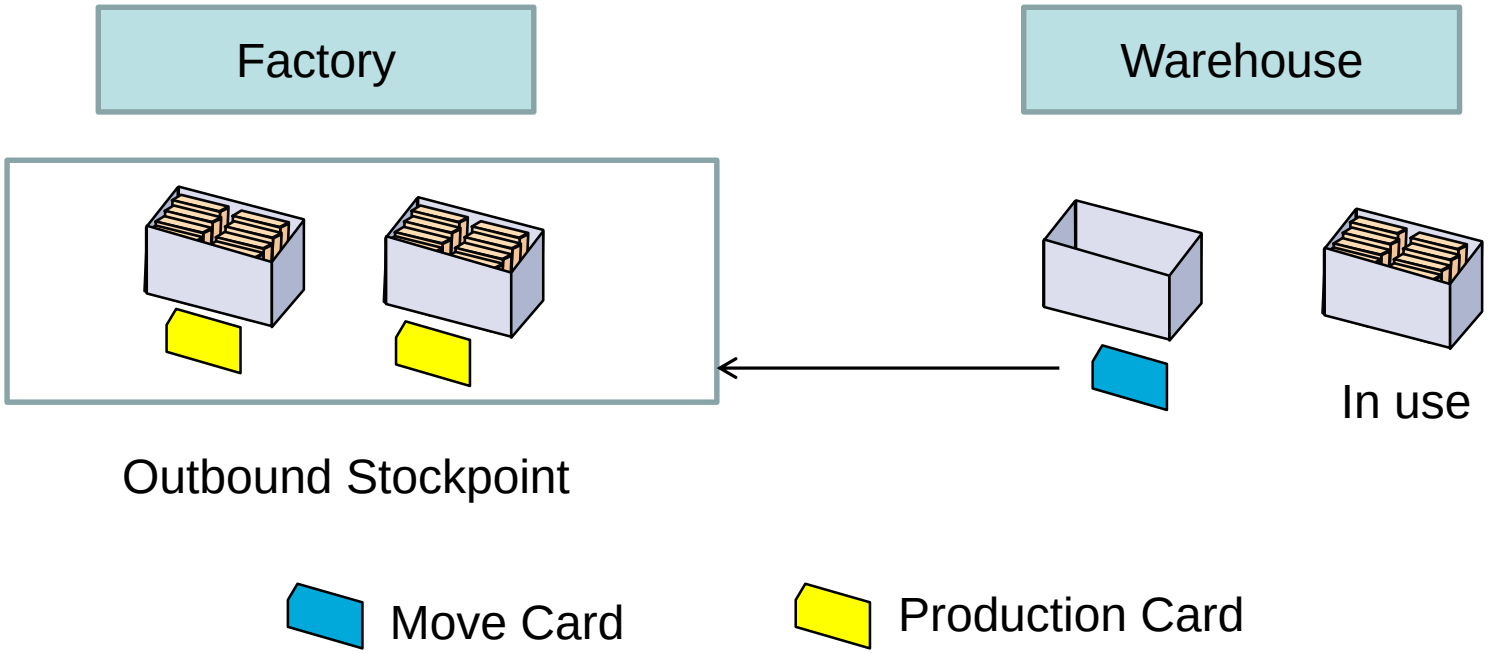
Note: show clearly how the production knows which SKU to produce, how many units to produce at one time, when the finished goods reaches or goes below the Kanban level?

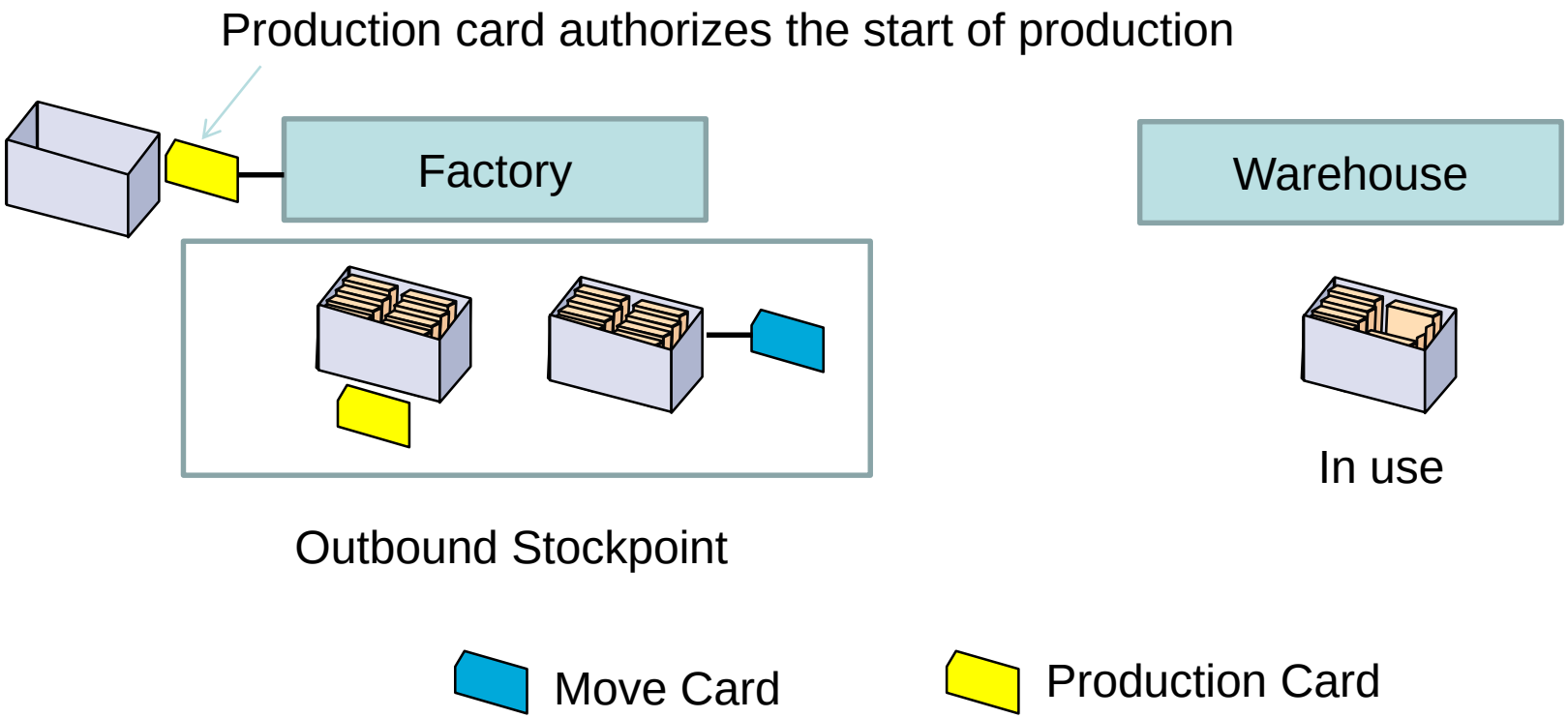
(Allow students have enough time to think, give them the blank cards to simulate the process)
One proposed system is explained in the following slides

Proposed Dual-Card Kanban System (1)



1) When Warehouse consumes the contents of a full container, the move card is sent to Factory.

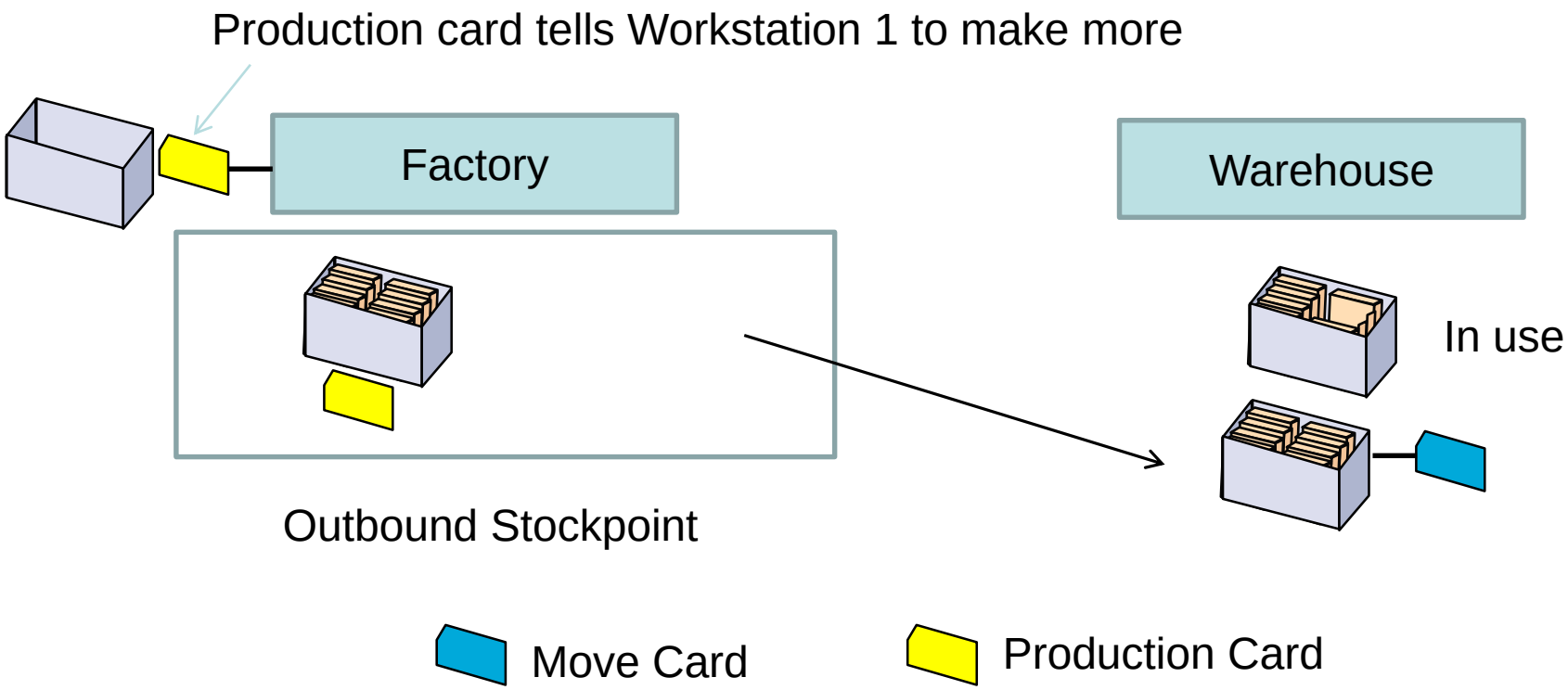
Proposed Dual-Card Kanban System (2)



2) Attach the move card to a full container at the outbound stock point of Factory, this authorizes movement of this container to Warehouse.

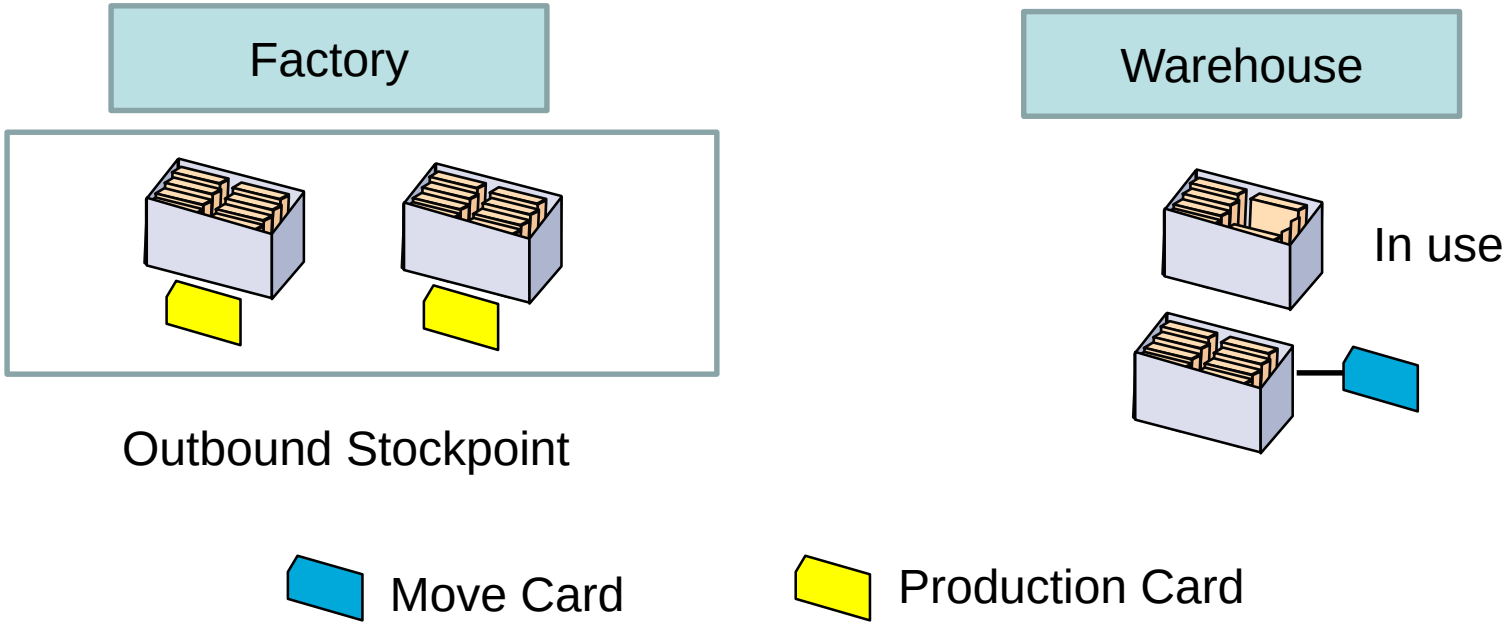
- Production card from the container in factory is detached.
- Factory should now begin to produce parts to fill in an empty container to replace the one that was taken.

Proposed Dual-Card Kanban System (3)



3) Move the full container to Warehouse.

Proposed Dual-Card Kanban System (4)



4) Factory completes its work and fills up the empty container.
Nothing more happens until Warehouse exhausts the “in use” container.

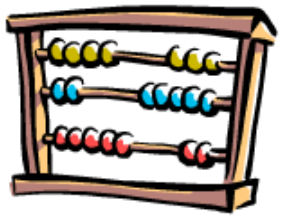
Determining the Number of Kanbans

$$\text{No. of kanbans} = \frac{\text{average demand during lead time} + \text{safety stock}}{\text{container size}}$$

$$N = \frac{dL + S}{C}$$

where

- N = number of Kanbans or containers
- d = average demand over some time period
- L = lead time
- S = safety stock/ buffer stock, set by policy,
  e.g. 10% of dL
- C = container size



Kanban Calculation Example

Given the following information, determine the number of Kanban Cards required:

d = 50 units per day

L = 1 day

dL = (50)(1) = 50

S = 10% dL = 10% x 50 = 5

C = 20 units

Solution:

$$N = \frac{dL + S}{C} = \frac{(50 \times 1) + 10\% * 50}{20}$$
$$= 2.75 \text{ kanbans or containers}$$

- Round up to 3 (allow some slack)
- Or round down to 2 (force improvement, but risky)

Activity 4: Test Yourself

To implement a Kanban System, all the necessary information are gathered as follows, calculate the number of Kanban cards required.

Average Monthly Demand	600 units
Standard Deviation of Weekly Demand	40 units
Lead Time	1 month
Target Service level	95%
Container Size	100

Assume 4 weeks per month

Activity 4: Test Yourself - (Answer)

To implement a Kanban System, all the necessary information are gathered as follows, calculate the number of Kanban cards required.

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Standard Deviation of Weekly Demand	40 units
Lead Time	1 month
Target Service level	95%
Container Size	100

Assume 4 weeks per month

SS= k*std(L)* sqrt(L) = Normsinv(0.95)* weekly std * sqrt(L)

=1.65*40*sqrt(4)

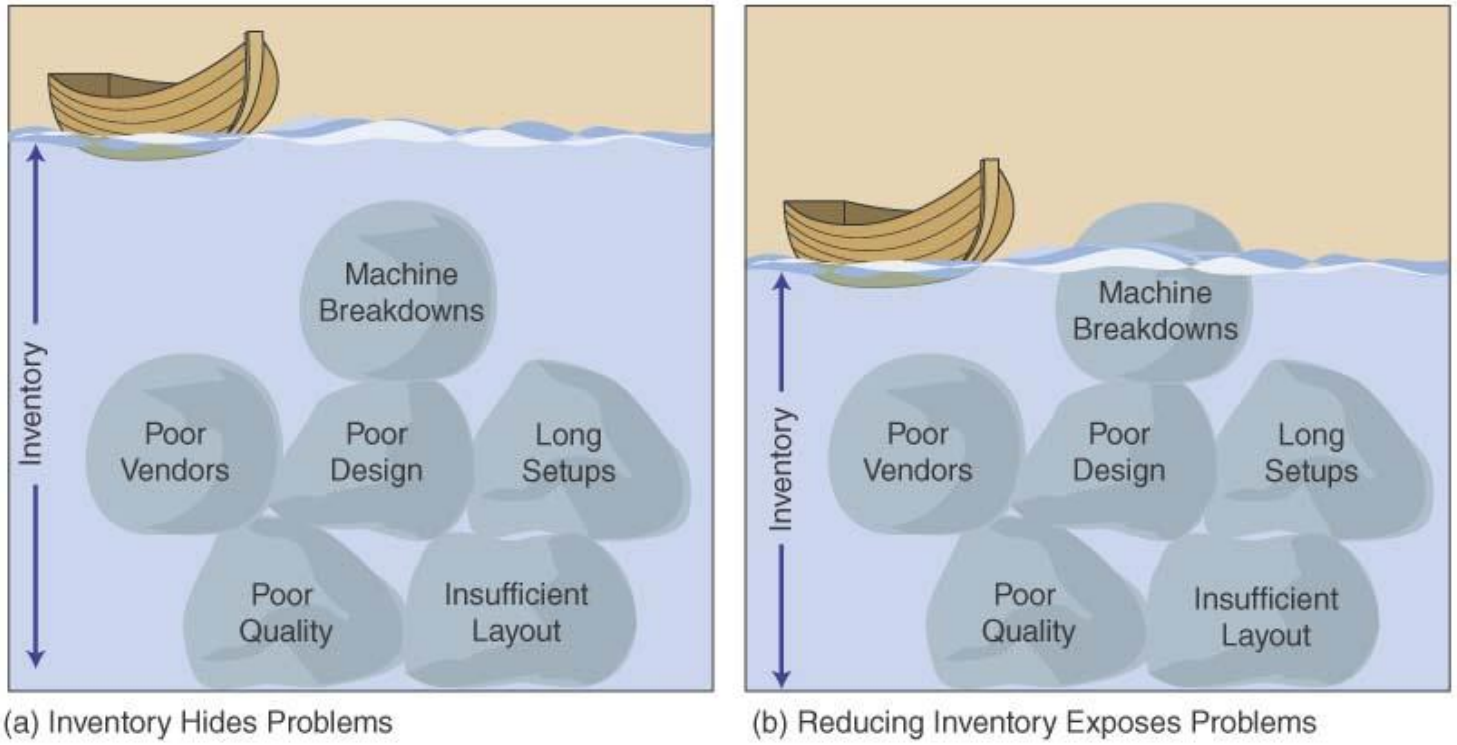
≈132

No. of Kanbans = (DL+SS)/Container Size

= (600*1+ 132)/100

= 732/100 ≈ 8 (round up)

Problems Exposed by Inventory Reduction



(a) Inventory Hides Problems

(b) Reducing Inventory Exposes Problems

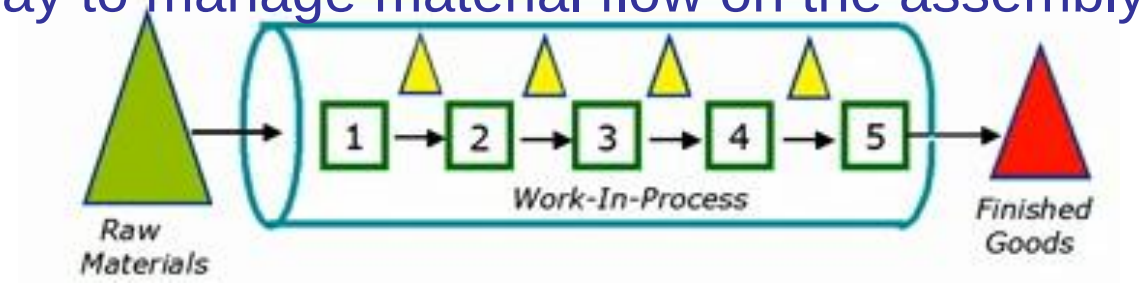
Kanban system helps to reduce inventory level and expose problems and solve it, thus it helps eliminate waste:

- Example 1: Poor vendor, by identifying defective items from a vendor early in the production process, the downstream work is saved
- Example 2: Poor quality, by identifying defective items by employees upstream, the downstream work is saved

Operational Benefits: Kanban System

- ✓ Reduces inventory holding
- ✓ Minimises risk of inventory obsolescence
- ✓ Improves the material flow process
- ✓ Prevents overproduction
- ✓ Low implementation cost
- ✓ Improves responsiveness to changes in demand

Kanban was originally developed at Toyota in the 1950's as a way to manage material flow on the assembly line.



Kanban Implementation Framework

Pre-Implementation Phase

- Data collection & analysis – current state of operations
- Calculate the Kanban size
- Design the Kanban – Signaling mechanism, rules for operating the Kanban system
- Train the people involved in the system – Develop an Operating handbook for ease of reference and for personnel training purposes

Implementation Phase

- Implement the Kanban system

Post Implementation Phase

- Audit and maintain the Kanban – Review and identify shortfalls of the system on a periodic basis (e.g. quarterly)
- Improve the Kanban – Following-up on the shortfalls or issues uncovered

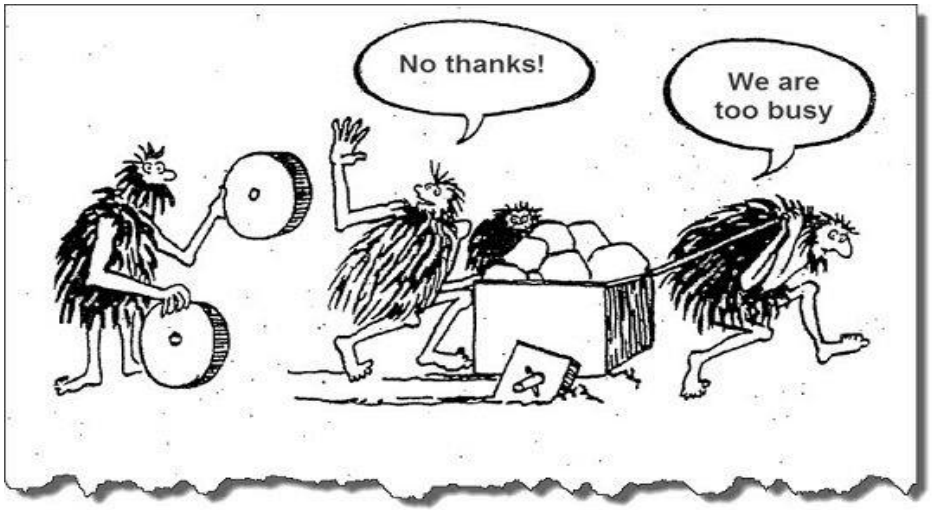
Recommendations to Fans.com

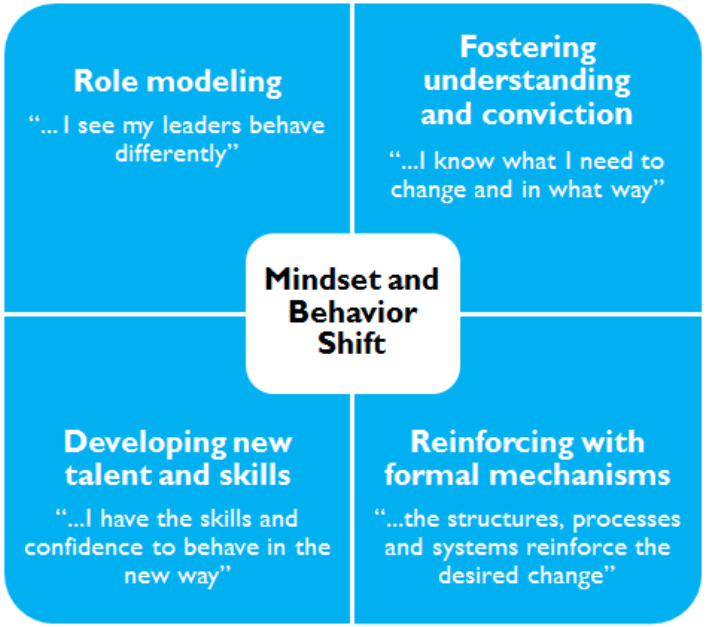
- Telling the supervisor to implement Kanban does not mean he will do it
- He needs to be convinced by how Kanban will help him in his work, and not just the company
  - Mindset Change for Staff
- The company's management also needs to measure the supervisor differently for him to be motivated to better manage inventory
  - Management Change

Recommendations to Fans.com

Mindset Change for Staff

- Rather than just valuing him for his experience and loyalty, management should measure the supervisor by the average inventory he keeps, and out of stock situations, etc.





Recommendations to Fans.com

Management Change

- Acknowledge supervisor's experience
- Kanban will help the supervisor in:
  - Tracking when an item needs to be reordered, what is being reordered, and how much to order
  - Handling what needs to be ordered for more different products
  - Tracking what products have already been ordered
  - Training new and temporary staff in reordering finished goods

Recommendations to Fans.com

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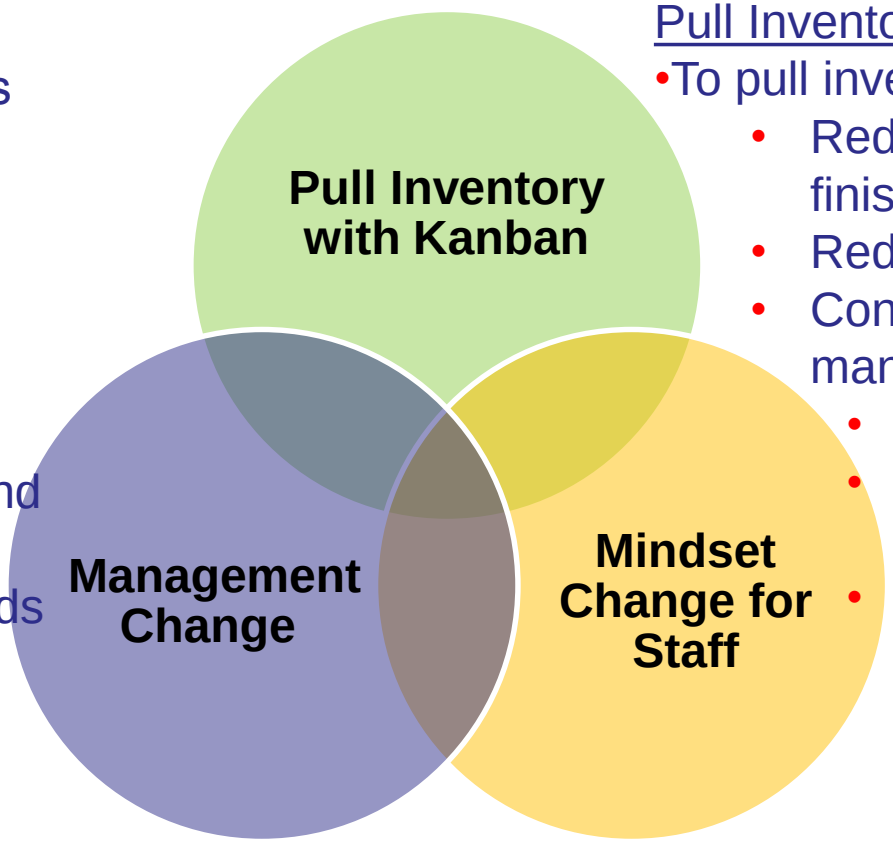

Pull Inventory with Kanban

- To pull inventory
  - Reduce overstocking of finished goods
  - Reduce understocking
  - Control using Visual management
    - Anyone can do it
    - What to replenish, when to replenish
    - How much to replenish

Mindset Change for Staff

- Rather than just valuing him for his experience and loyalty, management should measure the supervisor by the average inventory he keeps, and out of stock situations

MRP V.S. JIT

- MRP is the classic *push* system. The MRP system computes production schedules for all levels based on forecasts of sales of end items. Once produced, subassemblies are *pushed* to next level whether needed or not.
- JIT is the classic *pull* system. The basic mechanism is that production at one level only happens when initiated by a request at the higher level. That is, units are *pulled* through the system by request.
- These methods offer two completely different approaches to basic production planning in a manufacturing environment:
  - ✓ Main Advantage of MRP over JIT: MRP takes forecasts for end product demand into account. In an environment in which substantial variation of sales are anticipated (and can be forecasted accurately), MRP has a substantial advantage.
  - ✓ Main Advantage of JIT over MRP: JIT reduces inventories to a minimum. In addition to saving direct inventory carrying costs, there are substantial side benefits, such as improvement in quality and plant efficiency.

Learning Objectives

- Discuss the role of Kanban cards
- Explain how single-card & dual-card Kanban systems work
- Calculate the Kanban size
- Understand the concept of Just In Time (JIT)
- Support mindset change and how management should change how they measure staff performance

E217 Inventory Management Topic Flow