THE GOAL: Directly link all processes - from the customer back to raw material suppliers - to improve responsiveness, shorten lead time, and reduce costs
Why Use Pull Systems to Manage Inventory Buffers?

1. Start with invariably inaccurate forecasts

2. Add in the variability of real world operations

3. And you create large inventories of what you don’t need and stock-outs of what you do need
What is a Pull System?

Min Stock To Cover Demand Until Refilled

Point of Use
Storage for Customer, Empty Space Indicates Consumption

Refill Only What Customer Has Removed
Mfg. Example of a Pull System

Min # of Bins To Cover Demand Until Empty Bin is [Seen + Removed + Refilled + Replaced]

Point of Use Storage for Customer

Empty Bin is Signal to Replenish a Specific Part

Part #9031.A5
Bin Qty: 25
Address: Q22-671
Process for Implementing a Pull System

1. Map the Current State
2. Address Barriers to Pull
3. Determine Customer Scheduling Strategy
4. Design a Communication System
5. Train People to Use the Pull System
6. Define Inventory Locations
7. Start at Customer and implement upstream
1. Map the Current State
2. Address Barriers

WASTE REDUCTION

LEAD TIME

MATERIAL
- Lean Value Stream
- Pull System
- One-Piece Flow
- Quick Setup

PEOPLE
- Continuous Improvement
- Problem Solving Skills
- Production Teams
- Multi-Process Skills
- Problem Solving Skills

PROCESSES
- Standardized Work
- Total Prod. Maintenance
- Visual Control
- Quality Practices
- 5S

ORGANIZATIONAL COMMITMENT
3. Determine Customer Scheduling Strategy
Communicating Customer Orders to the Plant Floor

- Send Customer Schedule to Only One Point in your Manufacturing Process
- Select point furthest upstream that flows continuously to customer
- Avoid including or correct processes that corrupt the customer order sequence
- Order-to-Delivery lead time will determine the customer’s inventory requirements
- Level the schedule to the Production Floor
- Consider using a Sequence Pull versus a Conventional Pull System to reduce buffer requirement
Leveling Production

**Determine Demand for Each Product**
- Model A = 160/month
- Model B = 80/month
- Model C = 40/month

**Level the Daily Volume**
- Total Volume = 160+80+40 = 280
- Daily Volume = 280 / 20 day/month = 14

**Level the Sequence**
- Ratio (A:B:C) = 160:80:40 = 4:2:1
- Batch Size = 4 Parts
- Sequence = 4A-4A-4B-4A-4A-4B-4C
4. Design a Communication System

Kanban: Any signal used to directly communicate production or delivery information between those people performing the work.
Types of Kanban

• Production Kanban
  – **Signal (or Triangle):** Processes with long setup times
  – **Call:** Where use of a physical card is not practical
  – **Regular:** All other Production Kanbans

• Withdrawal Kanban
  – **Stock:** Material is pulled from in-house storage location
  – **Supplier:** Material is ordered from external supplier
### Production Kanban

- Contains all information needed to communicate a production order or a delivery order
- One Kanban per bin of parts
- Different forms:
  - Cards
  - Empty Bins
  - Floor Location
  - Call Light
  - Electronic

<table>
<thead>
<tr>
<th>Market Address or Preceding Process</th>
<th>Kanban Number</th>
<th>Line-Side Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPT-37-125</td>
<td>6281</td>
<td>EBB-289W-5</td>
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<table>
<thead>
<tr>
<th>Pick-up Times</th>
<th>Part Number</th>
<th>Route</th>
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<tbody>
<tr>
<td>0930</td>
<td>W8005673-S56</td>
<td>S5</td>
</tr>
<tr>
<td>1730</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Part Description
  - **BOLT – M8x1.25x1.8, HEX FLANGE**

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Quantity</th>
<th>Dock Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACME BOLT COMPANY</td>
<td>80</td>
<td>SOUTH - 3</td>
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</tbody>
</table>
How a Kanban Works

1. Starts new bin, removes Kanban, places in mailbox.

2. Retrieve Withdrawal Kanbans at scheduled intervals.


4. TL Removes Prod. Kanbans from mailbox, places on board to communicate leveled schedule, line produces parts to replace those consumed by customer.

5. Transports needed parts (with Kanbans) to Line-side Address.
Kanban Calculations

Number of Kanban = \[\text{Daily Output} \times \text{Lead Time [Mfg + Kanban + Safety]}\] / Parts per Bin

- Daily Output = Monthly Output / Workdays per Month
- Lead Time = Time to Manufacture Part + Time to Process Kanban + Safety Factor
### Signal Kanbans

<table>
<thead>
<tr>
<th>Preceding Process</th>
<th>Subsequent Process</th>
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<tbody>
<tr>
<td>LPT 125B</td>
<td>TSA 11-4</td>
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<table>
<thead>
<tr>
<th>Kanban #</th>
<th>Part Name</th>
<th>Upper Liner Blank</th>
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<tbody>
<tr>
<td>DB 02</td>
<td></td>
<td></td>
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<table>
<thead>
<tr>
<th>Material Size</th>
<th>Container Capacity</th>
<th>25</th>
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</thead>
<tbody>
<tr>
<td>24” x 8” x 8”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>Number of Containers</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>2</td>
</tr>
</tbody>
</table>

**Advance Notice for Next Production Lot**
- Prepare Raw Mat’l
- Perform External Set Up

**Signal to Run Next Production Lot**
- Complete Internal Setup
- Run Lot to Kanban Requirements
How Signal Kanban Works

1. Starts bin with Rectangle Kanban, removes Kanban and places in mailbox. Repeats when reaches bin with Triangle Kanban.

2. Retrieves Kanbans at set intervals. Places on Kanban Board.

3. Rectangle Kanban.
   - Prepare for next job
   - Blank coil length
   - Perform external setup

4. Receive Triangle Kanban.
   - Perform internal setup
   - Run lot
   - Attach Kanban

5. TL “sees” status of stamping area by viewing Scheduling Board.

6. Transports parts w/Kanbans to customer.
Signal Kanban Calculations

\[ \text{Reorder Point} = \frac{\text{Daily Output} \times \text{Lead Time} [\text{Mfg} + \text{Prep} + \text{Kanban} + \text{Safety}]}{\text{Parts per Bin}} \]

\[ \text{Reorder Point} = \frac{\text{Daily Output} \times \text{Lead Time} [\text{Mfg} + \text{Kanban} + \text{Safety}]}{\text{Parts per Bin}} \]

• Prep is the critical-path time needed to prepare for the production run to include external setup and cutting of raw material
5. Train People to Use the Pull System

1. **Never** send defective products downstream.
2. Downstream process draws from upstream processes **only** what is required by the Kanban.
3. Upstream process produces items in **exact** quantity and sequence indicated by the Kanban.
4. **Never** produce or convey parts without a Kanban.
5. Attach Kanban to the actual container of parts.
6. Use Kanban to fine tune the production system.
6. Define Inventory Locations

If you had only 30 seconds to find the unit...
...which storage system would you choose?
7. Start at the Customer and Implement Upstream

- Initial buffers may be large to account for long lead times or unstable processes
- Reduce buffer sizes over time as implement improvements upstream and gain confidence in the system
- Avoid using your ERP system to communicate customer pull signal to the plant floor
  - Streamline the communication/scheduling process connecting your customer to your plant floor
  - Use ERP for capacity planning and long-lead suppliers
- Implement Material-Information Loops starting at shipping dock and working upstream