Storage - The 10 Levels of Pallet Storage Technology

Track 5 Session 7
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Abstract

The alternatives available to store pallets today are many and span from conventional manual handling to lights-out deep lane ASRS. This session will expose you to a broad array of technologies and compare them in terms of investment, ROI, physical capabilities, pros, cons, best fit applications and operational implications. This is a great overview for the poor soul who thinks that technology implies mile-high rack systems that require an oil well and PhD to own and operate. New hybrid solutions will pleasantly surprise you!
# Acronyms Used

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>HBW</td>
<td>High Bay Warehouse</td>
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<tr>
<td>ASRS</td>
<td>Automated Storage and Retrieval System</td>
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<tr>
<td>SRM</td>
<td>Storage and Retrieval Machine also known as a crane</td>
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<tr>
<td>LHD</td>
<td>Load Handling Device</td>
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<tr>
<td>AGV</td>
<td>Automated Guided Vehicle or Laser Guided Vehicle</td>
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<tr>
<td>WCS</td>
<td>Warehouse Control System</td>
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<tr>
<td>FPM</td>
<td>Feet Per Minute</td>
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<td>P&amp;D</td>
<td>Pickup and Drop Stations - refers to the stations where cranes pickup and drop off pallets</td>
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<td>PPH</td>
<td>Pallets per Hour</td>
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## Agenda & Scenario Definitions

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<th>Scenario</th>
<th>Conventional Vs. Automated</th>
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Scenario 1: Manual Forklift

- Narrow Aisle Forklift
  Lifting 3500 LB pallets up to 422” (35.2’) in a Conventional Single Deep Warehouse
  - E.g. Hyster N45ZR Narrow-Aisle Single Reach Truck
  - Selective Single Deep Racking System
  - Works in a 10’-6” (126”) operating aisle (i.e. narrow aisle operation)
  - Standard conventional forklift truck
Scenario 2A – 2F: Manual Forklift

- Narrow Aisle Forklift lifting 3200 LB pallets up to 505” (42’’) in a Conventional 1-Deep through 6-Deep Pushback Racking System
  - E.g. Crown RM 6000 S Class Narrow-Aisle Reach truck launched in 2011
  - “Monolift” is a Pantograph mast originally designed for Turrett trucks and differs from the traditional dual mast
  - Forks capable of rising 153 FPM unloaded
  - Works with Single/Double Deep static racks and 2 to 6-deep pushback racks
  - Works in a 10’-6” (126”) operating aisle
  - Most suitable where space is expensive and height is required
Scenario 3: VNA Swing-Reach Truck

- Very Narrow Aisle Swing-Reach Forklifts are capable of lifting 3000 LB pallets up to 514” (42.8’) in a Conventional Single Deep Warehouse
  - E.g. Raymond 9700-CSR30T Swing-Reach Truck
  - Works with Single Deep Racks
  - Works in 72” Very Narrow aisles without wire guidance
  - Most suitable where space is expensive and velocity is slow - or receiving and shipping are on separate shifts

Click Here for Movie
Scenario 4: VNA AGV w/Turrett Forks

- Automated Laser-Guided Vehicle lifts 2,200 LB pallets up to 420” (35’)
  - E.g. Dematic FlexVNA AGV
  - Counterbalance AGV works in 80” Very Narrow Aisles with laser-guidance system
  - Works with Single or Multi-Deep Racks
  - Forks capable of rising 65 FPM
  - Suitable where space is expensive and throughput requirement is high

Click Here for Movie
Scenario 5: Narrow Aisle AGV w/Forks

- **Automated Laser-Guided AGV** lifts 2,000 LB pallets up to 258” (21.5’) in a Single Deep Environment
  - E.g. Dematic Flex Truck AGV
  - Counterbalance AGV works in 12’ (144”) Aisles with laser-guidance system
  - Forks capable of rising 42.5 FPM
  - Works with Single or Multi-Deep Deep Racks
  - Most suitable where flexibility is needed for multiple vehicles to work in the same aisle

Click Here for Movie
Scenario 6A – 6C: ASRS Rotating Forks

- **ASRS with Rotating Fork lifts 3,000 LB pallets up to 648” (54’)**
  - E.g. Dematic RapidStore UL 1400
  - Works in a single-deep, captive aisle environment as well as 2-deep and 3-deep push-back
  - Horizontal Speed: 350 FPM
  - Vertical Speed Empty/Loaded: 58/35 FPM
  - Works in Freezers & Coolers
  - Low bottom beam required at 8” up to 40’ and 12” for 40’ – 60’
  - Suited for case picking applications

[Click Here for Movie]
Stop & Shop Installation Freetown, MA
78 Rotating Fork Single Deep RapidStore UL 1400 SRMs
Scenario 7A-7C: ASRS Captive-Aisle SRM

- ASRS lifts 4,000 LB pallets up to 1263” (105.3’) in a 1-Deep, 2-Deep or 3-Deep Static Rack Environment
  - E.g. Dematic RapidStore UL 1800
  - Horizontal Speed: 900 FPM
  - Vertical Speed Empty: 210 FPM
  - Vertical Speed Loaded: 155 FPM
  - Z-Axis Speed: 200 FPM
  - Single/double/triple telescopic forks
  - Works in Freezers & Coolers
  - Workhorse for high-lift / high-density / high throughput requirements
  - Good for Pick to Pallet and Pick to Belt Applications

Click Here for Movie
Scenario 7A-7C: 1,2,3-Deep Storage
Scenario 8: ASRS with Aisle-Changing SRM

- ASRS lifts 3,300 LB pallets up to 1248” (104’) in a Single Deep or 2-deep Environment
  - E.g. Dematic RapidStore UL 1500
  - Horizontal Speed: 790 FPM
  - Vertical Speed Loaded: 295 FPM
  - SRM can service multiple aisles to reduce capital investment
  - Suitable for slower throughput applications

Click Here for Movie
Scenario 8: ASRS with Aisle-Changing SRM
Scenario 9A-9B: ASRS Single Mast with Dual Load Handling Device

- ASRS lifts 2,200 LB x 2 (pallet pairs) up to 1248” (104’) in a Single or Double Deep Environment
  - E.g. Dematic RapidStore UL 1500 Single Mast Dual Load Handling
  - Horizontal Speed: 780 FPM
  - Vertical Speed Loaded: 295 FPM
  - Z-Axis Speed: 200 FPM
  - Transports pallets in pairs with regenerative braking
  - Suitable for high velocity environments where variety of SKUs requires greater selectivity
Scenario 10: ASRS 6-Deep Storage System With Mole

- ASRS lifts 4,400 LB pallets up to 150’ in a Multi-Pallet Deep Environment
  - E.g. Dematic RapidStore UL 1500
  - Horizontal Speed: 790 FPM
  - Vertical Speed Loaded: 295 FPM
  - Z-Axis Speed: 180 FPM
  - 6-Deep Storage System
  - Suitable for Low Variety, High inventory, high throughput environments

Click Here for Movie
Scenario 10: ASRS 6-Deep With Mole
DC Designer Tool

- **MWPVL International has developed a Distribution Center Designer Tool**
  - Tool compares the economics of conventional versus automated distribution centers for multiple scenarios
    - Full pallet in/out operations
    - User-configurable inputs include:
      - Pallet storage requirements & throughput volumes
      - Pallet attributes
      - Wage & inflation rates
      - Energy Rates
      - Cost of Capital / Discount Factor
      - Operating Hours, etc.
Greenfield DC Designer Tool

- **Example of User Inputs:**

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<th>Configurable Assumptions</th>
<th>Unit of Measure</th>
<th>Value</th>
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<tr>
<td>Storage Requirements</td>
<td>Pallets</td>
<td>30,000</td>
</tr>
<tr>
<td>Average Hourly Throughput (In+Out)</td>
<td>Pallets</td>
<td>250</td>
</tr>
<tr>
<td>Peak Hourly Throughput (In+Out)</td>
<td>Pallets</td>
<td>500</td>
</tr>
<tr>
<td>Operating Hours/Day</td>
<td>Hours</td>
<td>22</td>
</tr>
<tr>
<td>Fully Loaded Forklift Wage Rate/Hour</td>
<td>$/Hr</td>
<td>$23.00</td>
</tr>
<tr>
<td>Cost/Hour Utility Rate</td>
<td>$/kWh</td>
<td>$0.09</td>
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<tr>
<td>Pallet Dimensions (WxLxH)</td>
<td>Inches</td>
<td>40x48x54</td>
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Note that the tool allows users to configure many more variables than shown above.
## ScenariosEvaluated

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The Model Determines Warehouse Sizing Requirements

This chart shows the square feet of warehouse space required for each scenario.
The Model Determines Operating Expenses

This chart shows the 10-Year total operating expenses for Forklift Labor, Maintenance, Supervision, Utilities, & other expenses (we only included expenses that change by scenario).
The Model Determines Capital Investment

This chart shows the capital investment requirements for building, fixed equipment, mobile equipment, Engineering Services, WCS Integration, Hardware, & Spare Parts.
The Model Determines 10-Year NPV of TCO

This chart shows the 10-Year net present value of the total cost of ownership for before-tax cash flows of each scenario.
The Model Determines 10-Year Cash Flow

The crossover point shows when Automation Systems start to make money
This chart shows green where the solution is economically strong based on a range of wage rates being tested on the Y-Axis.
Key Takeaways

- We have reviewed 10 different full pallet storage and handling systems
- Each system has a fit depending on the operation profile
- No single pallet storage system is the “best system” because there are many operational dynamics involved
  - For more help in understanding which solutions work best for you please see us about our DC designer tool
Questions?