Warehouse Execution Systems and the “Smart” Distribution Center

Presented by:
Dinesh Dongre
Dan Gilmore
Presenters

Dinesh Dongre
VP Product Strategy
Softeon, Inc.

Dan Gilmore
CMO
Softeon, Inc.
What is a Warehouse Execution System?
“The WMS should have all the information it needs to make all the decisions. The WCS should just take that decision about where a carton goes, deliver it, and then tell us that it's there.”

Mark Fralick, GetUsROI
Some Implementations

Why?

- Lack of WMS Capabilities
- MHA Vendor in Control of Customer
- Agreements between WMS and WCS Vendor
New Dynamic in Some Scenarios

<table>
<thead>
<tr>
<th>WMS</th>
<th>WES</th>
<th>WCS</th>
</tr>
</thead>
</table>

Why?
- WES only Developed Due to Perceived Shortcomings in WMS
- Attributes
  - Visibility to Process/Work Area/MHA Status
  - Flow of Work Based on Capacities and Work Load
  - “Waveless” Processing/Leveling of Activity
## Gartner’s View

<table>
<thead>
<tr>
<th>System</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehouse control system (WCS)</td>
<td>Middleware that sits between the WMS and the PLCs that control material handling automation devices. The WCS translates business-transactional information coming out of a WMS into real-time instructions for the automation. WCSs also help orchestrate product movements within automated warehouses.</td>
</tr>
<tr>
<td>Warehouse execution system (WES)</td>
<td>An emerging hybrid that blends capabilities from both a traditional WMS and a WCS. A WES builds on the WCS’s near-real-time insight into what’s happening in the automated warehouse, but it adds business process logic to this layer.</td>
</tr>
<tr>
<td>Warehouse management system (WMS)</td>
<td>The traditional business applications that handle business transactions, such as receiving goods, putting them away, and picking, packing and shipping orders. The focus of a WMS is on inventory and transactional integrity for people-managed processes. On top of process integrity, WMSs have been enhanced to support more and more capabilities that are intended to proactively drive process and productivity improvements.</td>
</tr>
</tbody>
</table>
## Gartner’s View

<table>
<thead>
<tr>
<th>System</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehouse control system (WCS)</td>
<td>Middleware that sits between the WMS and the PLCs that control material handling automation devices. The WCS translates business-transactional information coming out of a WMS into real-time instructions for the automation. WCSs also help orchestrate product movements within automated warehouses.</td>
</tr>
<tr>
<td>Warehouse execution system (WES)</td>
<td>An emerging and a key combination of both a traditional WMS and a WCS. It offers real-time insight into what’s happening and provides business process logic to this layer.</td>
</tr>
<tr>
<td>Warehouse management system (WMS)</td>
<td>The traditional business applications that handle business transactions, such as receiving goods, putting them away, and picking, packing and shipping orders. The focus of a WMS is on inventory and transactional integrity for people-managed processes. On top of process integrity, WMSs have been enhanced to support more and more capabilities that are intended to proactively drive process and productivity improvements.</td>
</tr>
</tbody>
</table>

*This is pretty good – except WES Is Not only for Heavily Automated DCs!*
WES Characteristics


▪ Can be Integrated WMS of Same Vendor or with Any Existing Warehouse System.

▪ Should Work for Automated, non-Automated and Hybrid DCs.

▪ One System to Manage All Automation in the DC.

▪ Game-changing Breakthrough that Starts Delivery of the “Autonomous WMS”
Represents a Step-Chain in WMS Capabilities

• 20 Years of Only Incremental Improvement in WMS Capabilities

• Softeon Warehouse Management and Execution System Starts Down the Path of New WMS Model
A WMS Market Inflection Point

WMS + WES = WMS^x

Warehouse Management & Execution System
WES Addresses Common Distribution Problems/Opportunities

- Lack of Granular Visibility to Throughput and Order Execution
- Labor Planning Challenges
  - Right Resources not in Right Place at Right Time
- Time/Cost/Approach of Adding Technologies (e.g., Picking Sub-Systems)
- Sub-Optimal Picking Execution
- Difficulty Meeting Carrier Cut Off Times/Ensuring SLAs
- High Variability in Materials Handling Equipment Utilization
- WMS Still Highly Reliant on Human Decision-Making
Fundamental Value Proposition

WES Should:

▪ Enable Companies to Meet Customer Demand and Service Commitments at the Least Possible Cost

▪ Significantly Shrink the Gap Between Theoretic and Realized DC/System Throughput

▪ Provide Single System for Management and Control of Fulfillment Across the DC
How WES Delivers Results

- Real-Time Visibility to Throughput, Bottlenecks and Events
- Direct Management and Optimization of Picking Sub-Systems
- Advanced, Configurable Optimization for Order Batching, Release, Picking and Replenishment
- Workload Balancing to Maximize Equipment Utilization and Flow
- Automated Order Release Based on Service Commitment, Shipping Schedules and Real-Time Condition Monitoring
- Use of Simulation to Plan, Re-plan and Allocate Resources
WES Architecture

WES shares same framework with Sotefon WMS, RMS, and FMS

*subset of WMS, RMS, FMS components only

FMS – Forecast Management System
RMS – Resource Management System (Labor)
WMS – Warehouse Management System
### Key WES Function Components

<table>
<thead>
<tr>
<th>Condition and Event Monitor</th>
<th>Simulation Engine</th>
<th>Shared WMS Component Library</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pick Route Optimizer</td>
<td>Automated Order Release Engine</td>
<td>Advanced Scheduler</td>
</tr>
<tr>
<td>Order Batch Optimizer</td>
<td>Capacity Manager</td>
<td>Dynamic Work Queue Manager</td>
</tr>
</tbody>
</table>

**Dynamic Rules Engine**

**MHE Integration**
Real-time Visibility to Throughput and Bottlenecks
WES Real-Time Dashboards
Shared WMS Component Library
Examples of WMS + WES Capabilities

- Advanced Cartonization
- Optimized Order Planning and Release Based on Many Variables, Including Priority, Travel Path and Distance, Bath and Clustering Opportunities, Replenishment Status, and More
- Waveless, Wave-Based, or Hybrid Picking
- Configurable Order Pool Management
- Dynamic Slotting
- Direct Management and Control of Picking Subsystems Including Voice, Pick-to-Light, Smart Carts, Put Walls, Conveyors and Mobile Robots
- Dynamic Pick Cart and Put Wall Order Assembly
- Hot Order Insertion
- Packing Operations
- Parcel Shipping
- Print-and-Apply
- Distribution Center Resource Planning Based on Simulation of Actual and Forecast Order Volumes
- Real-Time Monitoring of Activity and Throughput by Individual Processing Area in the DC
- Analytics on Available Versus Required Resources (People and Equipment) by Processing Area
- Auto Assignment of Resources to Processing Areas
- Pull-based Order Release Based on Outbound Shipping Schedules, Service Commitment, and Carrier Cut Off Times
- Labor Management and Reporting
Direct Management and Control of Picking Systems
Each Sub-system with its Own Control Software

Voice Server  
*Order Release Logic*

Pick Cart  
*Control System Order Release Logic*

PTL  
*Control System Order Release Logic*

Put Wall  
*Control System Order Release Logic*

Robot  
*Control System Order Release Logic*

Voice terminals  
Smart carts  
Pick-to-light  
Put walls  
Mobile robots
Each Sub-system with its Own Control Software

Issues:
- High Cost Hardware
- Cannot Optimize End-to-End Picking Processes
- Subsystems Operate in Silos
The Better Way

Real-Time API Integration

WMS

Real-Time API Integration

voice terminals

smart carts

pick-to-light

put walls

mobile robots
The Better Way

The Benefits:

▪ Better Decision Based on Complete Information
▪ Optimization Specific to Each Approach
▪ Improved Exception Handling

Real-Time API Integration

voice terminals
smart carts
pick-to-light
put walls
mobile robots

WMS
Pick Route Optimization
Dynamic, “Aware” Pick Release Management

Condition and Event Monitor
Advanced Scheduler

Sample criteria
- (Pick/Replen) Zone balancing
- Channel based priority
- Continuous Wave
- Carrier/Service Level based
- Capacity based (Resources)

Process Channels

ERP  Ecommerce (Web)  Customer Service

Orders

Dynamic Order Orchestration & Optimization

Pallet Pick  Case Pick  Each Pick  PTL  Odd Size Pick  Cluster Pick  Pick to Belt  Case Replenishment  Pallet Replenishment

Putwall

Shipping

Parcel

LTL

P&D

Packing/Pack Stations

Shipping

POWERED BY POSSIBILITIES.
Optimization of Order Batching (Example #1)

- Cartonization in picking sequence
- Cluster Building based on relative proximity between picking locations of containers
- **Parameter driven batching/cluster-building** based on
  - Cart size
  - Number of free carts
  - Wait times
  - Resource availability
- Strike the right balance between optimization of cart build and on-time task completion (Static Cart Vs Dynamic / Perpetual Cart)
- Intelligent Hot Order Insertion
Optimization of Order Batching (Example #2)

Incoming Order Streams

Dynamic Order Pool

Pick Carts

Pack Stations

Put Walls

Autobagger
Optimization of Order Batching (Example #2)

- Sophisticated Order Planning:
  - Picks not Good for Wall
  - Best Picks for Wall
  - Wall Constraints
  - Cluster/Batch Picking Opportunities
  - SKUs/Order
  - Inventory/Replen Status
  - Size of Product/Carton
  - SKU Bar Codes Yes/No
  - More….
Optimization of Order Batching (Example #2)

Incoming Order Streams

Dynamic Order Pool

- Advanced Features
  - Batch and Cluster Picking on Same Cart
  - Pick from Lights/Non-Light Areas Together
  - Dynamic and Virtual Wall Assignment
  - Multiple Operators per Wall
  - Wave Overlap on Wall
  - Hot Order Insertion into Best Cart
  - Complete Integration with Packing
  - Metered Carton Flow into Walls
  - More

Pack Stations

Put Walls

Autobagger

Pick Carts
New “Plug and Play” Approach to Adding Technology
Automated Order Release
Auto Order/Work Release

- **Dynamic Rules-based Auto Release of Order/Tasks**
  - Order Attributes (Priority, Ship Date, Customer, and such)
  - Resource Capacity and Standards
    - Labor & Resource Type (Case Pickers, etc.)
    - Equipment (Cart, Robots, etc.)
    - MHE (Put Wall, Conveyor, Sorter, Diverts, etc.)
  - Reprioritization
  - Workload Balancing needs
  - Real-time feedback (changes in priority and/or ship times, inventory, capacity)

- **Identifying best channels of work (Pallet Pick, Put Wall, Case Pick, etc.)**
  - For example - Ability to accumulate full case picks into pallet picks based on configurable amount of time for newer orders

- **Configurable Rules**
Auto Order Release – Rule Definition/Configuration

<table>
<thead>
<tr>
<th>Seq #</th>
<th>Rule ID</th>
<th>Description</th>
<th>Category</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ORDER_PRIORITY</td>
<td>Order Cut Off Time Update and Prioritization</td>
<td>ORDER</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>FG_TASK_CREATOR</td>
<td>Builds Full Pallet and Case Pick for Vacuum SKUs</td>
<td>ORDER</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>ORDER_HOLD_RELEASE</td>
<td>Order Hold Release</td>
<td>ORDER</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>REPL_PRIORITY_UPDATE</td>
<td>Replenishment repriority</td>
<td>ORDER</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>REPLACEMENT_CLEANUP</td>
<td>Replenishment Cleanup</td>
<td>ORDER</td>
<td></td>
</tr>
</tbody>
</table>

**Detail**

<table>
<thead>
<tr>
<th>Seq #</th>
<th>Description</th>
<th>Input Flag</th>
<th>Constraint</th>
<th>Output Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Order Ship Cut-Off Time Update (Based on Order Drop Time)</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>2</td>
<td>Order Priority Update</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>11</td>
<td>Order Prioritization - Previous Load Day, Today's Shipment</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
</tr>
</tbody>
</table>
Auto Order Release – Putwall Example

- **Representative Rules for Auto Release of Orders designated for a Put Wall**
  - Put Wall Pairing (One resource per wall or 2 back-to-back walls)
  - Ability to release batches for paired put-wall after 'x' % of Put Wall processing is complete
  - Just in time Cart Build (Creation of Pick task) based on Put Wall completion status
  - Prioritization of batches eligible for cart build based on status of put-wall completion.
  - Maintain balance of workload across Put Walls by feeding the right Put Walls
    - Put Wall level queue (number of totes) configuration
  - Ability to pick for multiple Put Walls in one cart / task
  - Ability to activate / deactivate Put Walls based on resource availability
  - Assign homogeneous orders (units/lines ) to a single Put Wall to reduce overall time taken for put-wall release
  - “Elastic” Put Wall (Use a Put Wall of 100 slots to process more than 100 orders by dynamically allocating and releasing Put Wall slots)
  - Ability for priority orders to side-step regular queue and hit the Put Wall at the next possible opportunity
Optimizing Equipment Utilization

- Case Picking
- Piece Picking
- Replenishment
- Advanced Scheduler
- Metered Flow to Automation Systems
- Real-Time Visibility
- Put Wall
- Case Sorter
- Unit Sorter
Simulation-Based Resource Planning
Simulation-Based Resource Planning

How It Works

- Simulation Engine Combines Available Order Pool Forecasts for Additional Work Likely to be Received based on Order History/Patterns
- Understands Current Resource Plan/Allocation across Processing Areas (e.g., Pallet, Case, Piece Pick; Put Walls; Replenishment, etc.)
- WES Simulates Expected Work (Demand) against Current Resources Plan in a Time-Phased Manner
- Identifies by Time Block where there is Demand-Resource Imbalance
Demand vs. Capacity Dashboard from Simulation
Dynamic Capacity Management

SHIFT TIMINGS

08:00
10:00
11:00
12:00

Orders

Pallet Pick  Case Pick  Each Pick  Cluster Pick  Case Repl  Pallet Repl  Putwall

Demand  : 1150
Capacity  : 1200
# of Tasks  : 20
# of Resources  : 10
Est. Time  : .96
Suggested Resources  : 9
Resource Gap  : 1

Demand  : 2000
Capacity  : 1200
# of Tasks  : 1
# of Resources  : 8
Est. Time  : 1.67
Suggested Resources  : 13
Resource Gap  : -5
Case Studies

- Fast Growing Omnichannel Retailer
- Home Products Manufacturer
- Major Sports/Outdoor Apparel Brand
- Well-Known Home Appliance Maker
Benefits of Next-Generation WES

- Double Digit Improvement in Labor Productivity
- Significant Reduction in Supervisory Overhead
- Reduced/Better Managed Overtime
- Improved Throughput
  - Closing Gap between Theoretic and Actual Throughput of a Facility
- Easily and Quickly Evaluate and Deploy New Sub-Systems/Technologies
- Consistently Meet Service Commitment with Little “Chaos”
- Improve MHE Utilization
  - Additional Throughput or Reduce Required Capacity

Benefits Applicable to Automated, Manual and Hybrid DCs!
Where We Are Headed

- **Beginning of an Era of Autonomous Warehouse Software**
  - Automated Decision-Making
  - Self-tuning (in part through use of AI/ML)

- **Advanced Focus on Product and Process Flow**
  - Reduce/Eliminate Process Bottlenecks and Dwell Times
  - Flow Distribution™
For more information:

Speaker #1 email:  DDongre@Softeon.com
website: www.Softeon.com

Speaker #2 email:  DGilmore@Softeon.com
website: www.Softeon.com

Join us at our second presentation on what’s new in WMS for 2020 – 2 times available!

Tuesday @ 2:15pm and and Thursday @ 1pm in Theatre D

Visit us @ MODEX Booth #7466