

LECTURE 02

WAREHOUSING ACTIVITIES

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OUTLINE

- 1 REVIEW
- 2 RECEIVING ACTIVITY
- 3 PUT-AWAY ACTIVITY
- 4 PICKING ACTIVITY
- 5 SHIPPING ACTIVITY

source: General references [BH09, Mul94, Fra02, Kit18]

REVIEW: WAREHOUSE \in SUPPLY CHAIN

- Warehouse \in Supply Chain
- **Warehousing management:** maximizing usage of warehouse 'resources' at 'right' service level
- Warehouse \neq Storage room because balance flows, system, policy
- Main components in warehouse are **processes/activities** & **material handling**
- Main **activities** in warehouse are:
 - **Inbound:** **before storage** i.e., receiving & put-away
 - **Outbound:** **after storage** i.e., retrieving/picking & shipping

WAREHOUSING CONCEPTS SO FAR ...

- **Idea:** **swift** & **uninterrupted** flow of materials
- **Principles:** **systematic** way to manage warehouse (activities & resources)
- **Activities:** focus on **main** activities, minimize **non-value** activities
- **Resources:** storage location, equipments, time, money, man-power, utility
- **Warehouse as:** water flow model, queuing model

Two Part Topics

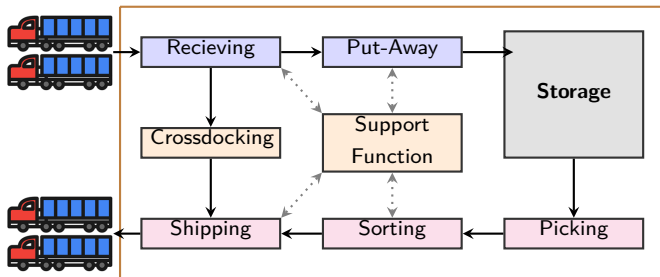
- Comprehensive **warehousing activities** & **storage policies**
- Introducing **material handling** & **storage equipments**

TRADE-OFFS IN WAREHOUSE

- **Upstream work VS Downstream work:** batch picking, sorting, unitization, sub-pallet, cross-docking
- **Space utilization VS Efficiency:** aisle width, layout design, equipment selection, storage policy
- **Current productivity VS Future expansion:** warehousing design, picking policy
- **Equipment VS Workforce:** investment, flexibility, IT (WMS)

Warehouse is **not** about space available, it is space efficiency

WAREHOUSING ACTIVITIES



source: Frazelle, E. 2001. pp 229 [Fra02]

Warehouse activity breakdown

Activities	Percentage
Receiving	10%
Put-away	15%
Retrieving/Picking	55%
Shipping & Sorting	20%

source: Bartholdi, J. & Hackmans, S. 2009. [BH09]

RECEIVING ACTIVITY

- **Idea:** unloading & preparation
- **Importance:** **initiating** all activities
- **Basic:** doing paper work & checking for quantity & quality
- **Functions:**
 - **Notification:** make appointment → low waiting time
 - **Acceptance:** compare invoice with PO → data → backlog
 - **Receiving:** inform pending shipment → reserve locations
 - **Inspection:** visual and qty check
 - **Unitization:** build unit load
 - **First package seen:** measure & register SKU

RECEIVING MANAGEMENT

- **Principle:**
 - Sort according outbound shipments:
 - Combining receiving & shipping: → crossdock
- **Receiving practice:**
 - **Direct shipment:** direct shipping to consumer, food
 - **Pre-receiving:** employ information before products arrive
 - **Scheduling:** balancing workforce (hiring temp), equipments
 - **Crossdock:** JIT warehouse
- **Issue:** yard management, fast information, near opt realtime scheduling

PUT-AWAY ACTIVITY

- **Idea:** moving SKU to 'designated' locations
- **Importance:** defining **all works** downstream.
- **Basic:** recording where SKUs are consistently
- **Put-way practice:**
 - **Direct put-away:** combine receiving & put-away (no inspection w/ RFID)
 - **Suggested put-away:** use IT to suggest locations
 - **Batched:** source products for efficient put-away
 - **Inter-leaving:** combine put-away with picking in single trip
- **Issue:** grouping philosophy, convenience location, multiple storage locations

GROUPING PHILOSOPHY

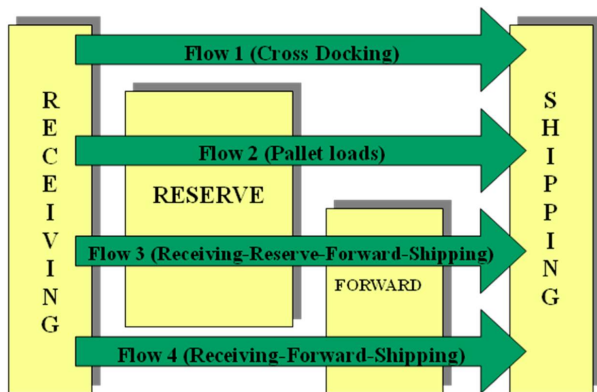
- **SKU popularity:** ABC based on frequency
- **Unload/Load:** $\#load \geq \#unload$ → put near shipping
- **Family group:** value, temperature, hazardous, physical, lot number, tax
- **SKU rotation:** FIFO (LILO), FILO, FEFO
- **Aisle width:** accessibility → equipments
- **Space utilization:** maximizing storage space; minimize congestion
- **Quality:** full pallet **VS** break bulk; equipments
- **Others:** default path, efficient tour, quick detection

Put **fast-moving** items at **convenient** & **suitable** locations

NON-PRODUCTIVE ACTIVITY: STORAGE

- **Idea:** preventing SKUs for damage and/or degrading
- **Importance:** what **other thinking** of warehouse
- **Basic:** utilizing space, while maintain easy access
- **storage area:**
 - **Forward area:** storing **products** for carton/case/piece picking and customer delivery
 - **Reserve area:** storing **pallets** for pallet picking or refill other area
- **Issue:** fast-picking area, design of storage area, physical counting, housekeeping

BETWEEN RECEIVING & SHIPPING

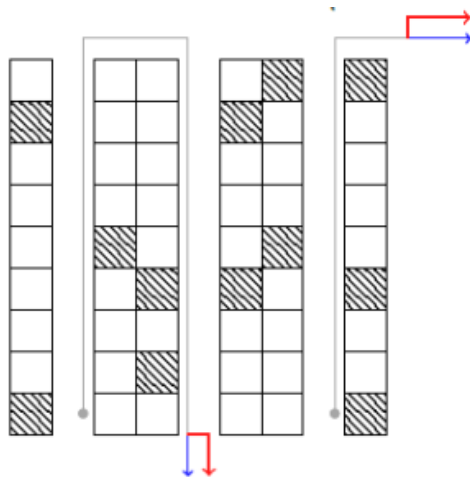


source: Mulcahy, D. 1994. [Mul94]

PICKING ACTIVITY

- **Idea:** getting SKU from 'designated' locations
- **Importance:** majority of **costs & times** incurred
- **Basic:** distributing 'order' & checking 'right' quantity
- **Principle:**
 - Minimize loose items & staging for shipping
 - Minimize paperwork & time
- **Variation:**
 - **Single order:** one tour for one order
 - **Batch [order]:** one tour for many orders
 - **Zone:** set area for each picker
 - **Wave:** coordinated between zones
- **Issue:** pick sequence, picking equipments (information/error)

PICKING VARIATION



TRIVIAL ABOUT PICKING

WMS (warehouse management system) a large software system that coordinates the activities of the warehouse

ORDER LINE number of **items** ordered by a customer

ACTUAL PICK number of **SKU** handled by a **picker**

PICK LINE number of **SKU** appeared in **pick list**

PICK FACE area of SKU directly face picker ($\# \text{ sku/m}^2$)

PICK DENSITY number of picks achieved per unit of area on the pick face ($\# \text{ pick/hr}$)

SHIPMENT INTEGRITY one order should be shipped in one shipment

ORDER SPLITTING: customer orders are split base on location of warehouse

MERGE-IN-TRANSIT: combined split order at the last warehouse before delivery

EXAMPLE: UNITS OF PICKING

Suppose product A is stored in a warehouse as **box** (in reserved area) & **piece** (in forward area). Each box of product A contains 12 pieces & handling of product A always requires **cart that has maximum capacity of 2 boxes**. Currently, the warehouse has **10 boxes & 5 pieces** of product A available. If a customer X requests **40 pieces of product A**, what are units of picking

	line	#	unit
• Order line	1	40	piece
• Pick line	2	3	box
		4	piece
• Actual pick	3	2	box
		1	box
		4	piece

HOW SHOULD WE TRACK PICKING ACTIVITY?

PICKING BREAK DOWN ACTIVITIES

Activities	Elimination Method	Equipment
Traveling (55%)	bring SKU to picker	carousel, AS/RS
Searching (15%)	illuminate SKU	pick-2-light/ RFID / pick-2-voice
Extracting (10%)	automated dispensing	scale on vehicle
Other (20%)		
<ul style="list-style-type: none"> • documenting • reaching • counting 	<ul style="list-style-type: none"> re-engineering wrist-level picking weight, unit-load count 	<ul style="list-style-type: none"> ID system carousels

source: Bartholdi, J. & Hackman, S. 2009. [BH09]

SORTING & SHIPPING ACTIVITIES

- **Idea:** preparing & checking SKU before leaving warehouse
- **Importance:** defining **productivity** of warehouse, **quality control**
- **Basic:** checking SKU, documenting transactions & loading in reverse order
- **Sorting & Shipping practice:**
 - **Container optimization:** select cost & space effective handling units
 - **Automated loading:** eliminate shipping stacking area by loading to truck
- **Issue:** equipments, yard management, stacking area, shipping integrity



TYPE OF VALUE ADDED LOGISTICS (VAL)

- **Light manufacturing:** re-boxing & re-instruction (DKSH), re-containerizing (Merck), sample assembly (Hefale), measuring & cutting (UF)
- **Labeling:** MUJI price labeling (CRC), can labeling (TUF)
- **Kitting:** component packing (HP),
- **Reverse logistics:** dispose product (Tesco), cleaning tote (7-Eleven), re-location (HomePro)

NON-VALUED ACTIVITIES

- **Documentations:** data entry, data update, e.g. stock card
- **Stock checking:** visual inspection, counting
- **Re-location:** label process (TUF), 5 S., dead stock (Siam Kubota)
- **Training:** safety & driving (HomePro),

PROBLEMS

1. What are **value-added/ main** activities in a warehouse? & which one is the most labor intensive?
2. What is **Inter-leaving**? & How this practice improve the productivity of a warehouse?
3. Many warehouses implemented location identification technology such as, bar code, QR code, or RF tag at their storage locations. How these technology integrate with **receiving & picking**

SUMMARY:

- Operating warehouse faces many **trade-offs**
- Main activities and their main purpose in warehouse are:
 - **Receiving:** defined downstream activities
 - **Put-Away:** location to pick
 - **Picking:** labor intensive
 - **Sorting & Shipping** last chance to check

REFERENCE

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