

CHAPTER 5 – WAREHOUSING MANAGEMENT

Dung H. Nguyen

Faculty of International Economic Relations

University of Economics and Law

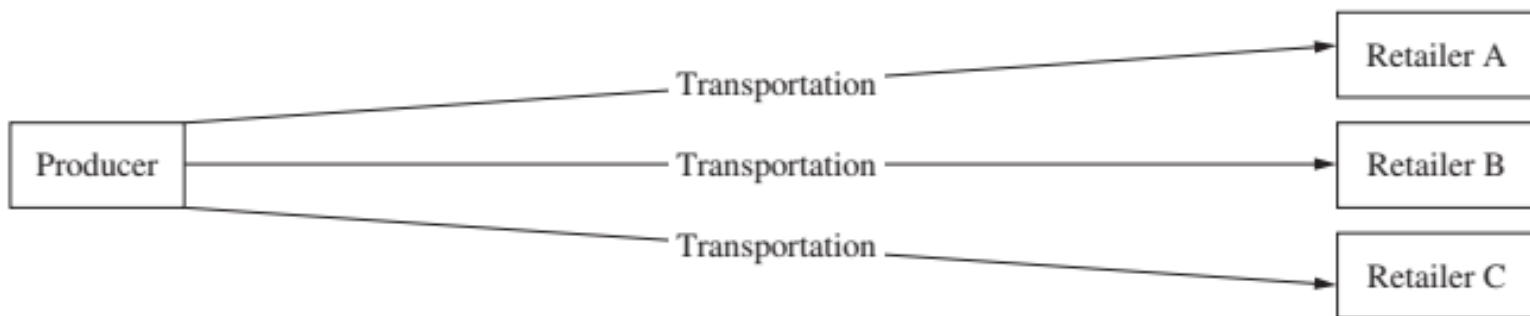


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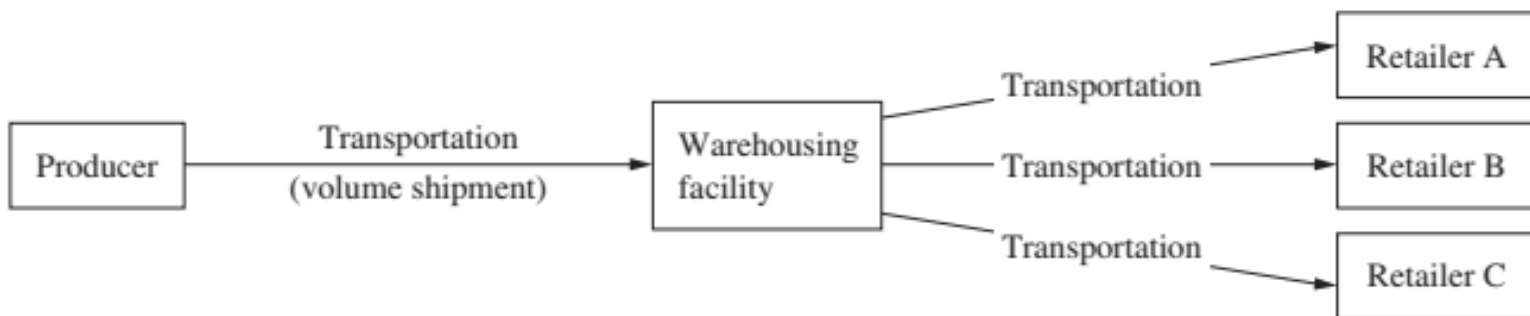
- Definition
- Types of warehouses
- Warehouse processes
- Warehouse layout
- Warehouse management system
- Temperature-controlled warehouse

DEFINITION

- Warehousing facility is part of a firm's logistics system that stores products at and between points of origin and points of consumption
- Warehousing facility = transportation at zero miles per hour!



Direct from producer to retailer: longer-haul transportation



Source: Murphy and Knemeyer (2018)

MAJOR TRADE-OFFS IN WAREHOUSING MANAGEMENT

- Storage capacity vs speed of retrieval
- Speed versus accuracy
- Lower inventory vs availability
- Volume purchases vs storage cost & availability

TYPES OF WAREHOUSES

- By locations
 - Production warehouse
 - Distribution warehouse
 - Central warehouse
 - Local warehouse
- By ownership
 - Private warehouse
 - Third party warehouse
 - Dedicated warehouse
 - Multi-client warehouse

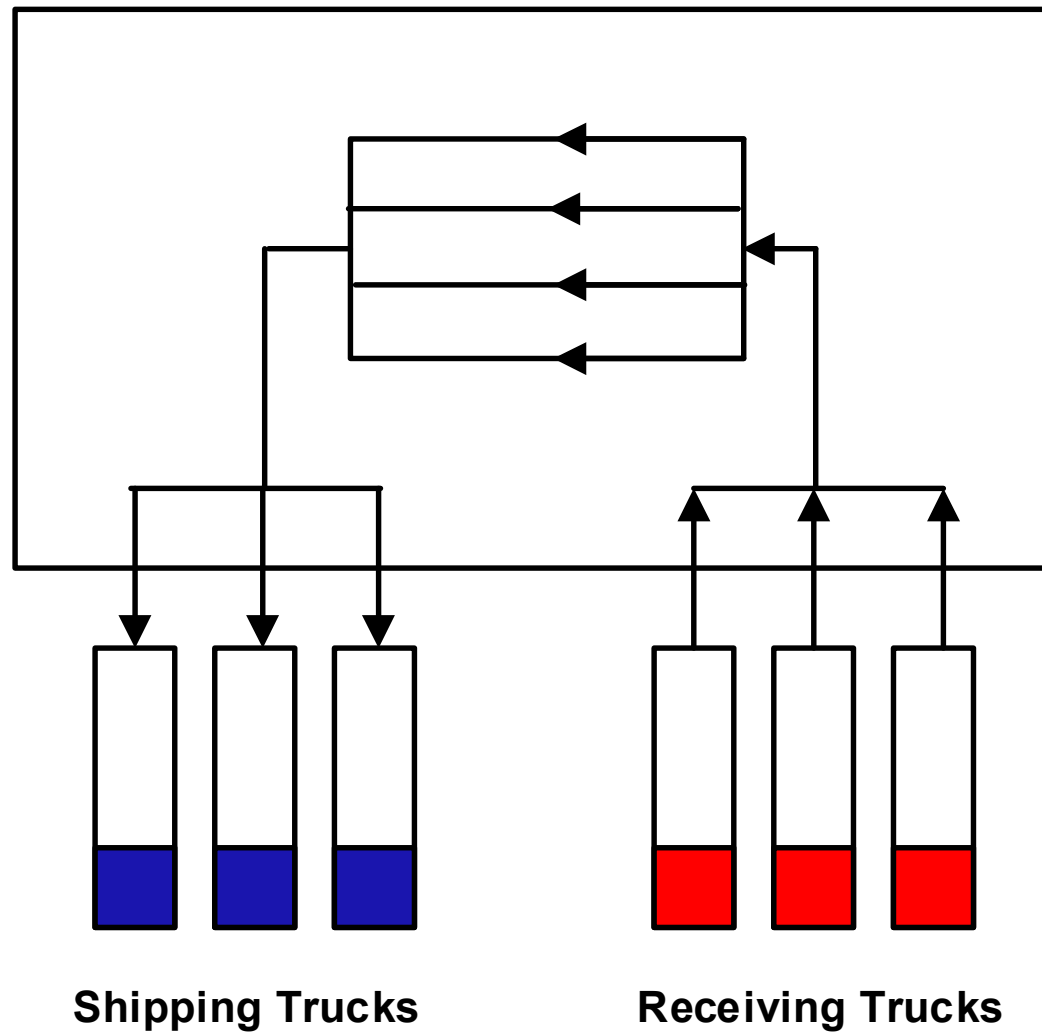
TYPES OF WAREHOUSES – BY FUNCTIONS

- Storage
- Regrouping: re-arranging the quantities and assortment of products
 - Adjustments with the product quantities
 - Accumulating: bulk-making
 - Allocating: bulk-breaking
 - Adjustments with the product assortment
 - Assorting: building up a variety of different products to particular customers
 - Sorting out: separating products into grades and qualities

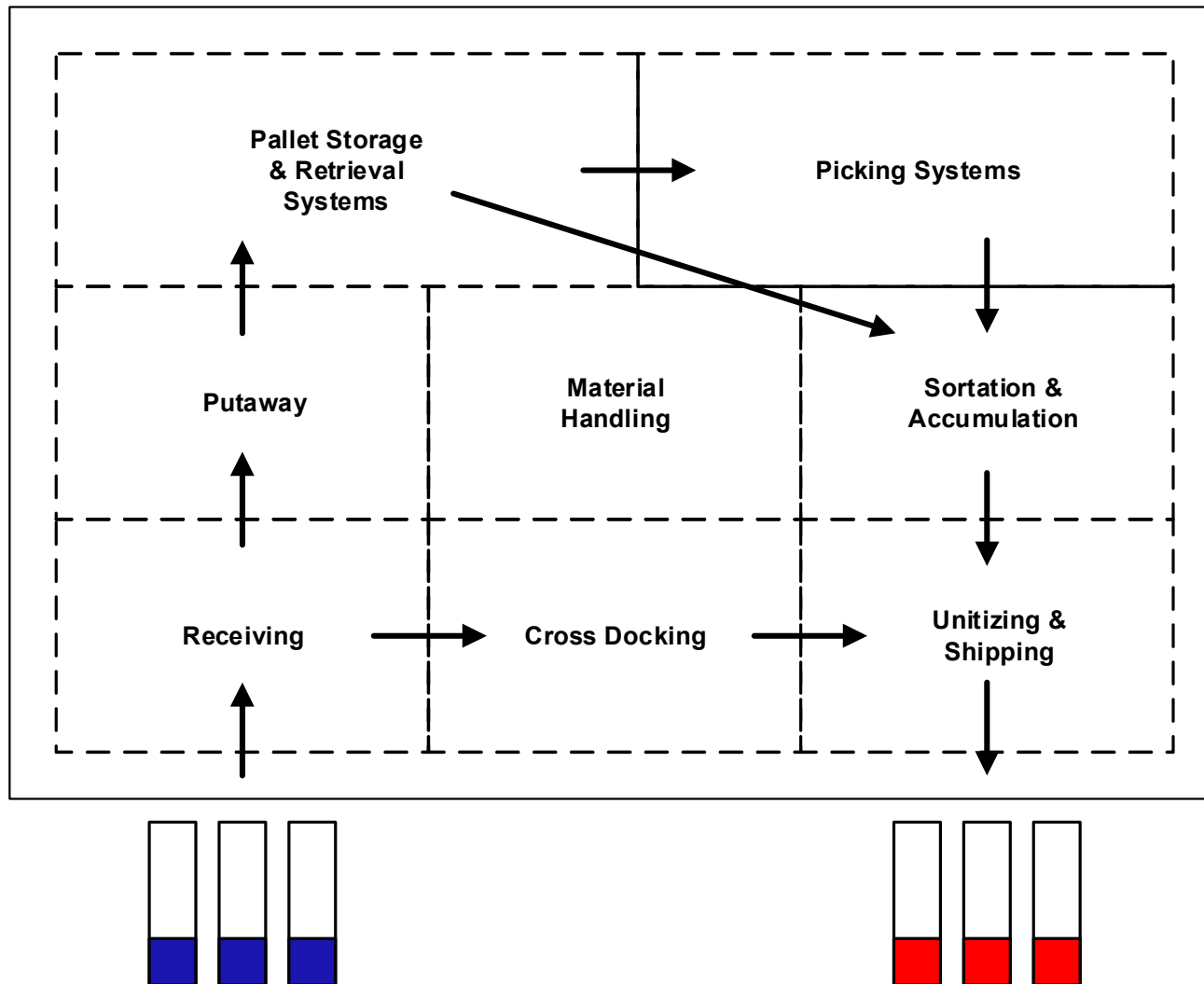
TYPES OF WAREHOUSES – BY FUNCTIONS

- Warehouses
- Intermediate, postponement, customization, sub-assembly facilities
- Trans-shipment or break-bulk facilities
- Sortation centers
- Distribution centers
- Fulfilment centers
- Reverse logistics centers
- Cross-dock centers

CROSS-DOCKING



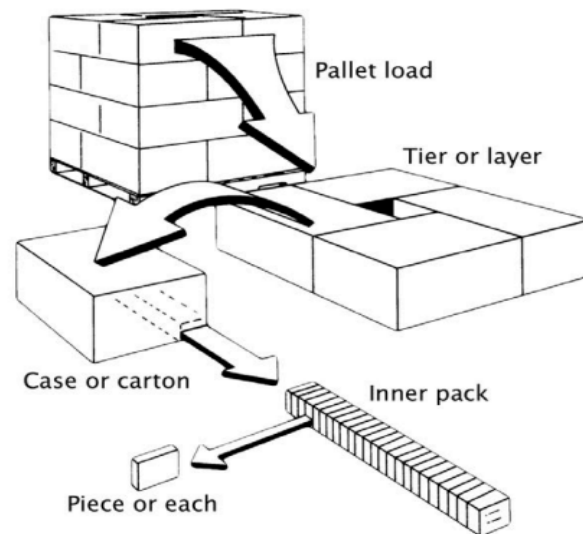
WAREHOUSE PROCESSES



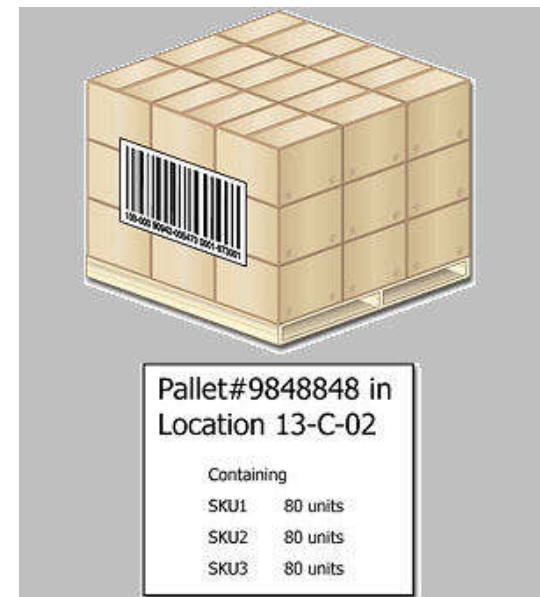
Source: Frazelle (2002)

RECEIVING

- Unload the goods from the truck
- Check and count the goods
- Update the goods into the WMS
- Re-pack or re-stack on the pallets (if any)
- Attach the LP label to the pallet or container



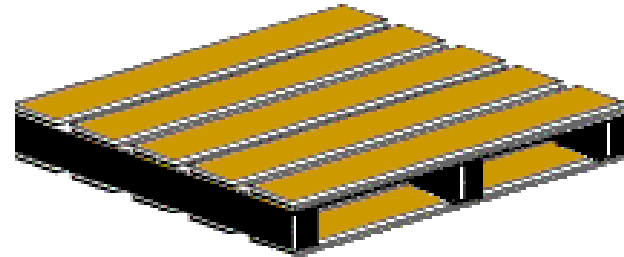
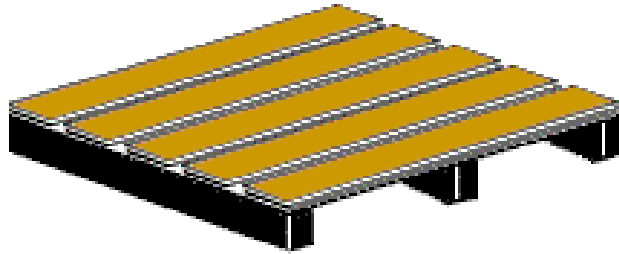
Source: Bartholdi and Hackman (2017)



Source: ibm.com

PALLETS

Two-Way Pallet

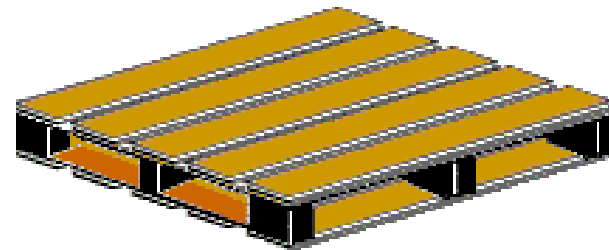
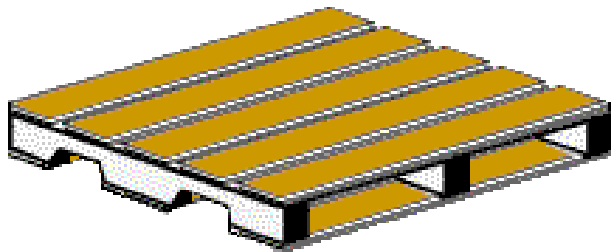


EU: 800 x 1200

USA: 1219 x 1016

Asia: 1000 x 1200

Four-Way Pallet



PUTAWAY

Moving the goods from the receipt lane to the designated storage location

- Assign a storage location to the goods
- Take the goods to the destination location
- Update the inventory level in the location
- Put-away rules:
 - ABC classification
 - Separation
 - Balancing
 - Weight
 - Close to pick locations

STORAGE

- Cycle count: count the inventory to verify the administrative quantity and the physical quantity
- Internal movements: not driven by orders

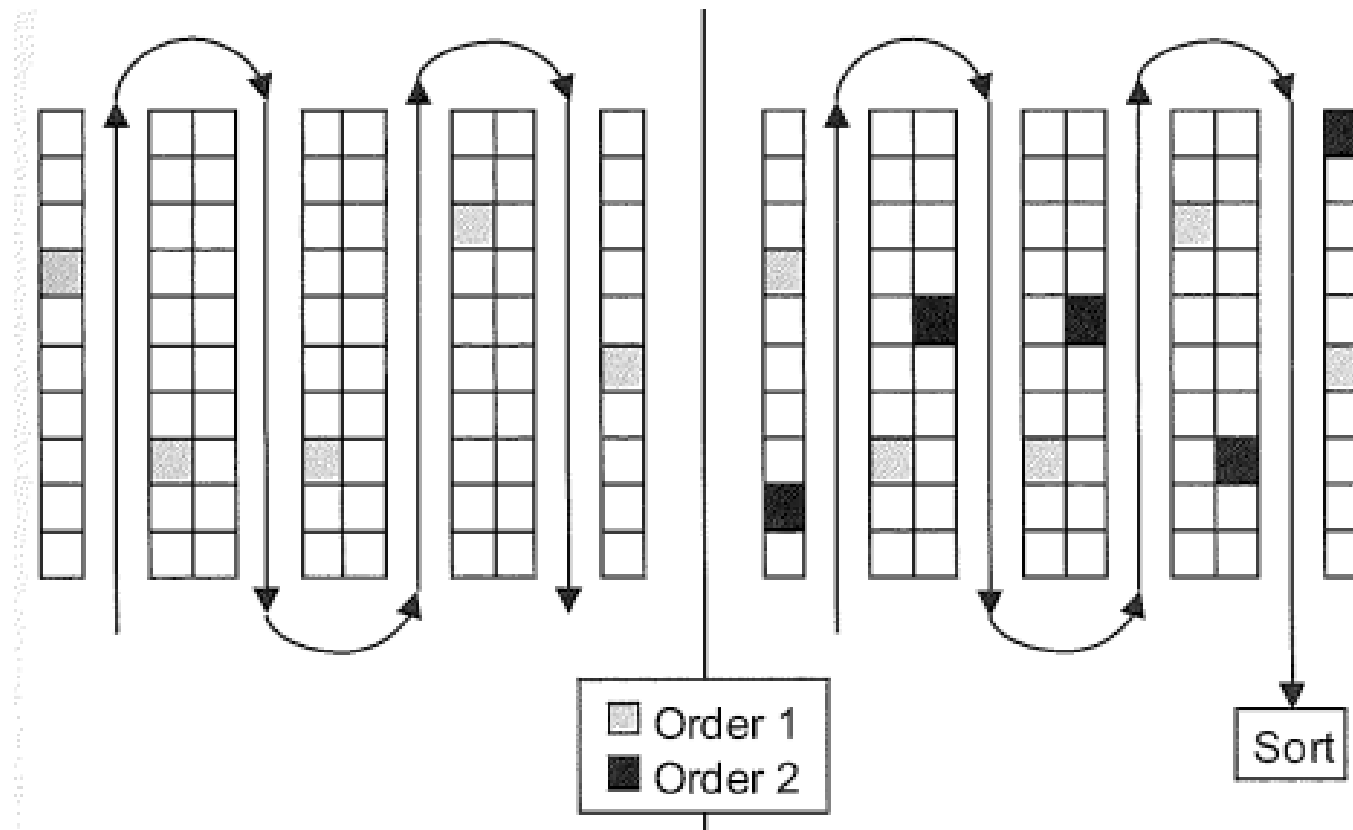
WAVE PLANNING

A wave includes orders scheduled to depart during the same period

- Order information: orders, departure time, delivery sequence
- Wave selection: select orders released to the warehouse operation
 - Inventory allocation: determine the locations for picking or replenishing
 - Pick-tour design
 - Tasks for replenishing pick locations with insufficient inventory
 - Tasks for order-picking

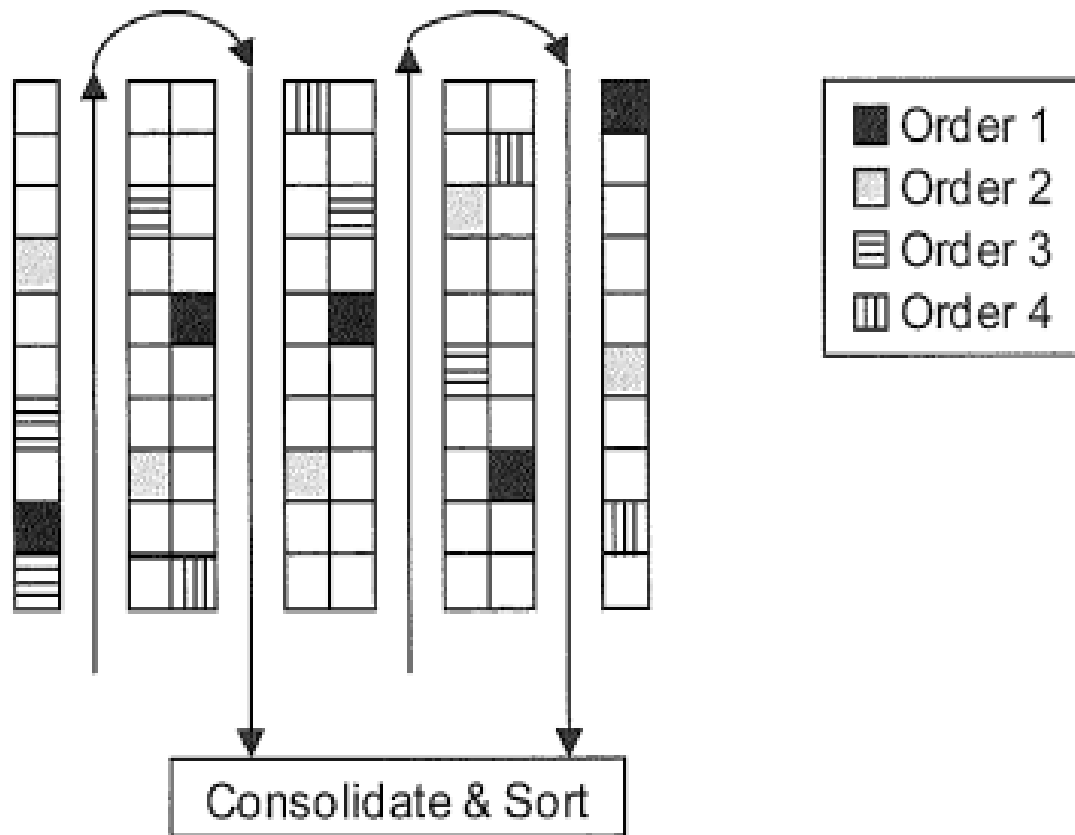
DESIGNS OF PICK TOUR

- Single-order picking: only one order is picked in a tour
- Batch-picking: multiple orders are picked simultaneously



DESIGNS OF PICK TOUR – ZONE PICKING

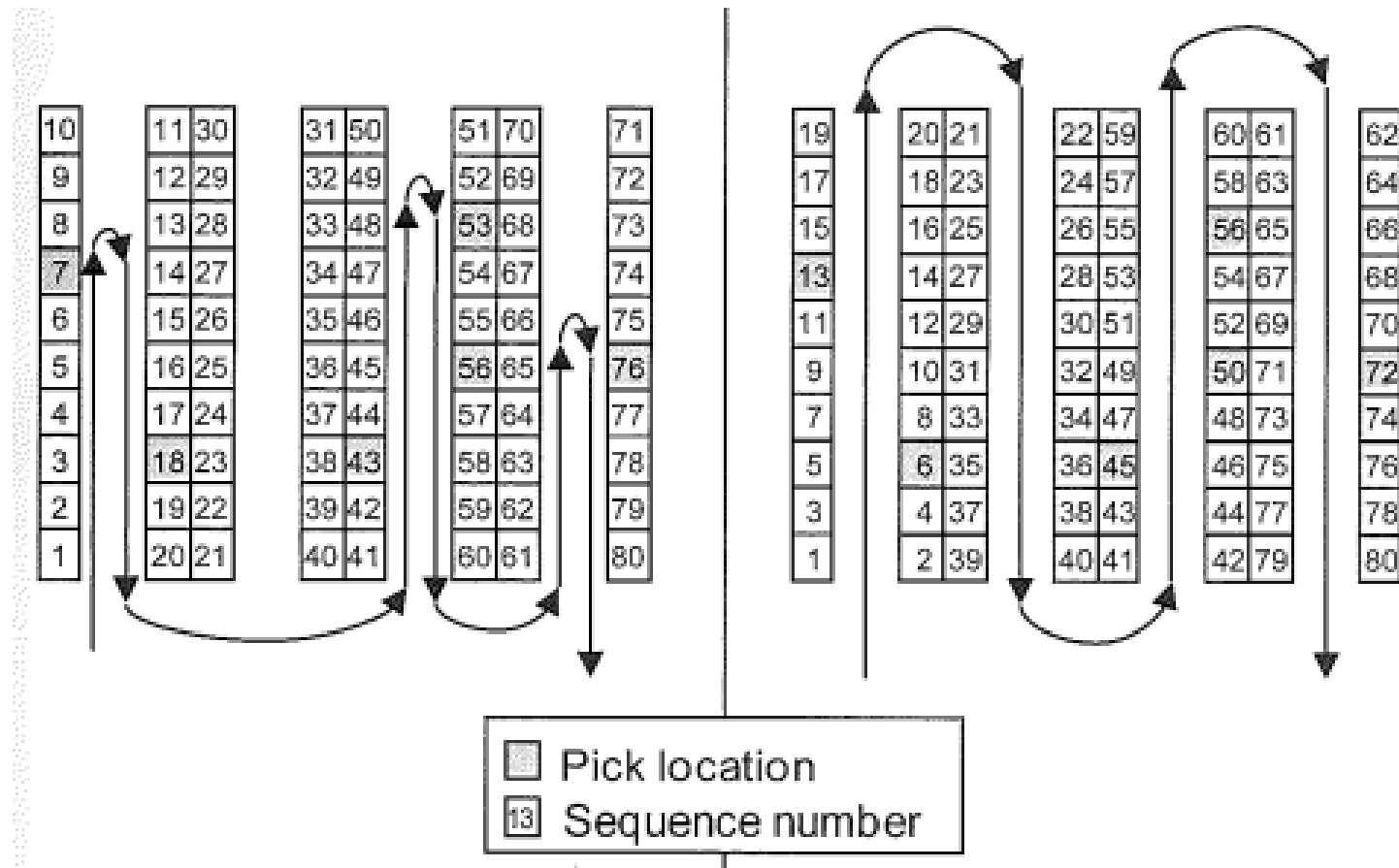
Pick tours are restricted to respective zones in a pick area



Source: van den Berg (2012)

DESIGNS OF PICK TOUR – PICK SEQUENCE

Each location has a unique sequence number



REPLENISH

Move the goods from the bulk location to the pick location

- Pick location assignment
 - Static pick location: assign a product to the same pick location
 - Dynamic pick location: assign the product to a new empty pick location

PICK

- Pallet picking, case picking, piece picking
- Pick verification



ORDER PICKING VS STOCK REPLENISHING

- Same time and/or same area for workers who pick orders and those who replenish stocks?
 - Fewer managerial personnel
 - Increasing congestion
- Determine different aisles in picking and replenishing

SORTATION

- Manual or automatic sortation



Source: bastiansolutions.com

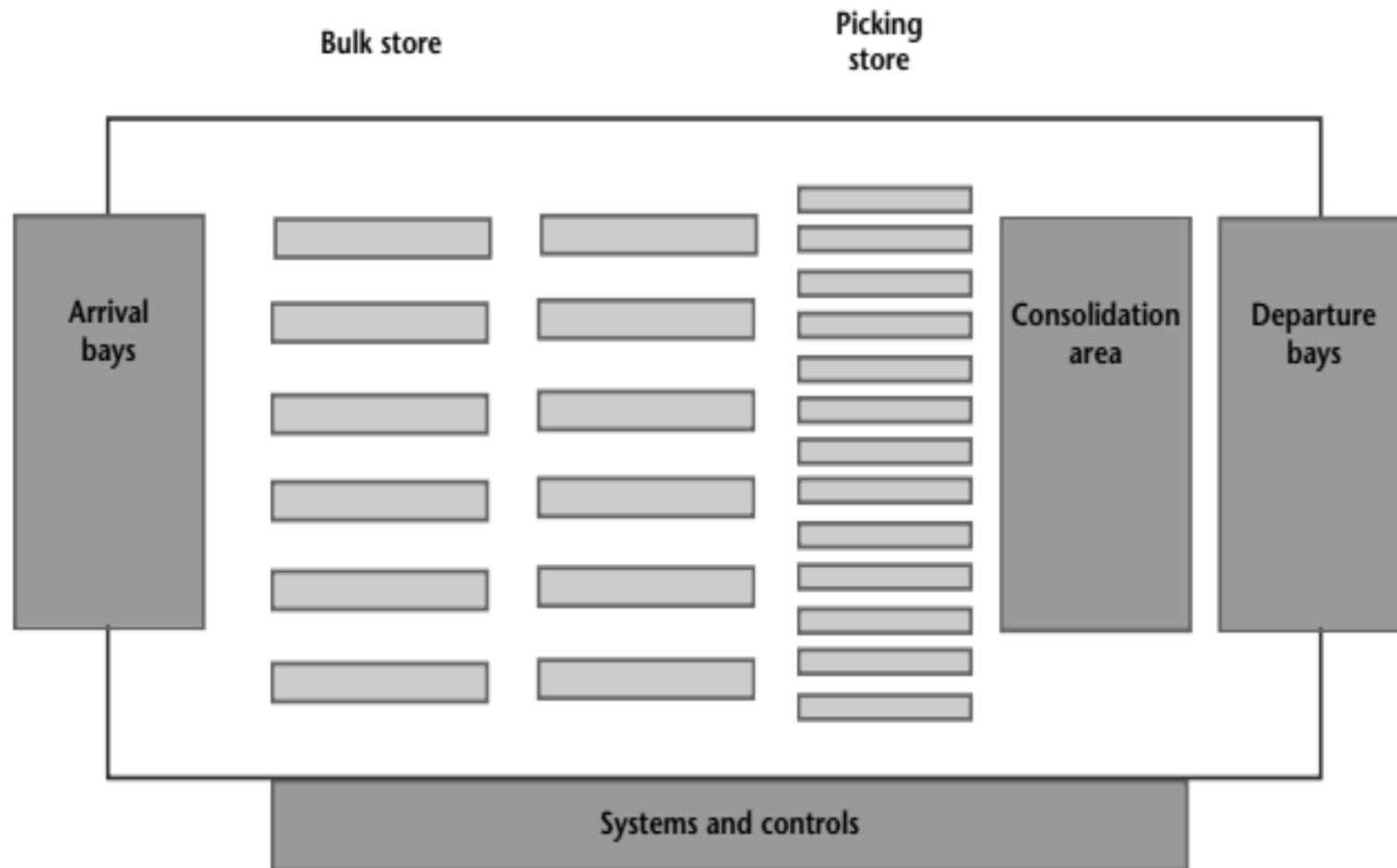
UNITIZING AND SHIPPING

- Individual pieces are packed together in a carton
- Cases are packed in a box
- Boxes are loaded into a container → Loading sequence!
- Shipping documents are generated
- Update shipping goods in WMS

WAREHOUSE LAYOUT

- It is the physical arrangement of storage racks, loading/unloading areas, equipment, offices, etc.
- Essential elements:
 - An arrival bay/dock
 - A storage area
 - A departure bay/dock
 - A material handling system
 - An information system

WAREHOUSE LAYOUT



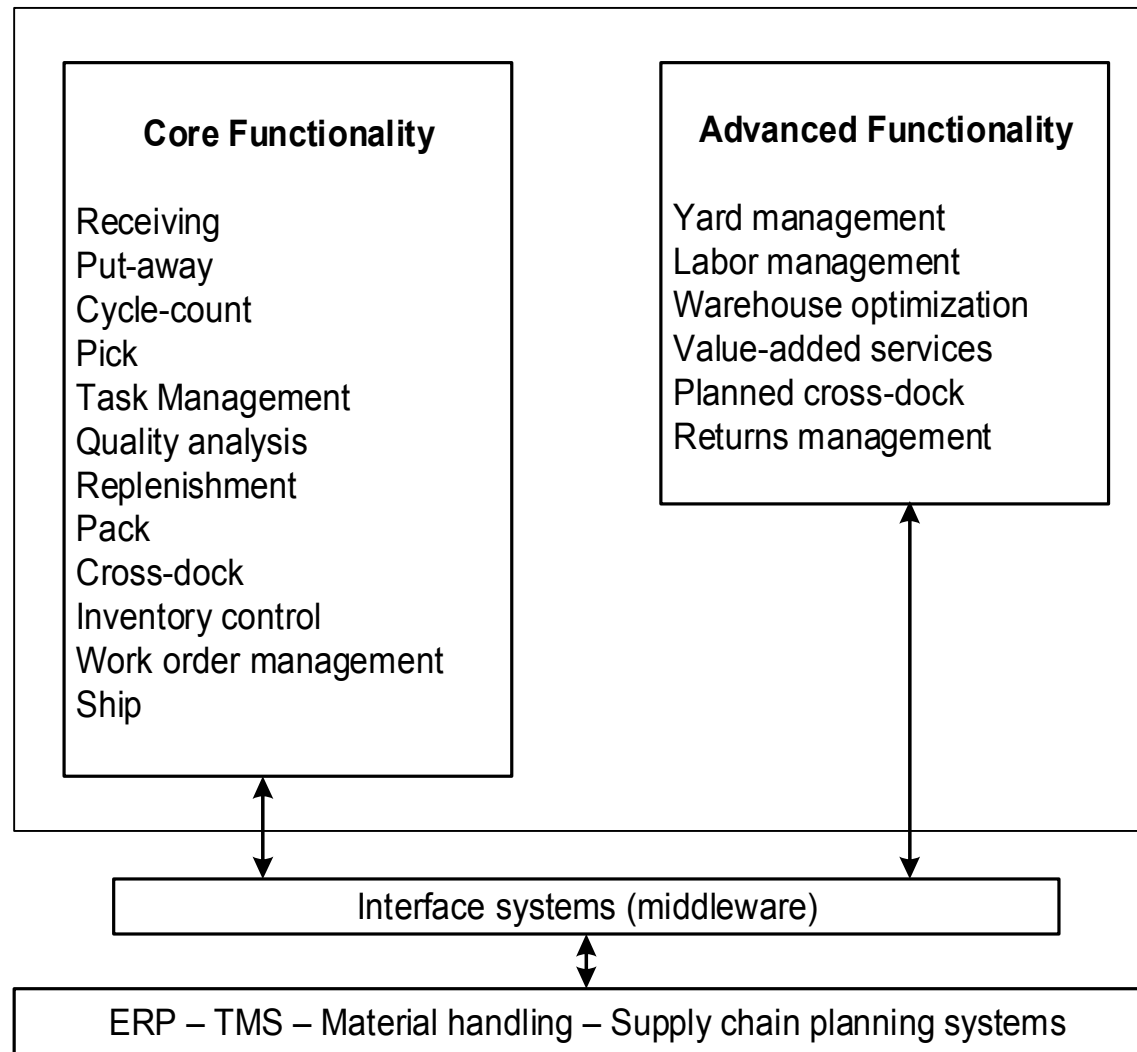
Source: Waters (2003)

TRADE-OFFS

- It is cheaper to build up than build out!
 - Build out: more land
 - Build up: increasing warehouse equipment costs
- Two docks vs Single dock
 - Single dock: less space; specific times for receiving and shipping
- Standard aisle vs Narrow/Very narrow aisle
 - Increasing aisle space → decreasing space capacity
 - Narrower aisles require specialized storage and handling equipment

→ Aisle size = head length of lift truck + load length + space of maneuverability & pallet overhang

WAREHOUSE MANAGEMENT SYSTEM



WAREHOUSE PROCESSES WITH WMS

- Pre-receiving: receiving files from supplier, download files to scanner
- Receiving and put-away: scan & verify incoming cargo, scan & update put-away location
- Picking and delivery: receiving D/O, generate pick list, generate transport plan, delivery instructions

TASKS COMMUNICATION

- Batch communication: tasks are communicated group by group with a certain time delay
- Real-time communication: tasks are communicated in the real time



Source: zebra.com

TEMPERATURE-CONTROLLED WAREHOUSE

Types of temperature control

Type	Temperature	Product examples
Frozen	−30° to −10 °C	Meat, fish
Chilled	−5° to 0 °C	Fresh meat, fish, poultry
Cool	−1° to 5 °C	Dairy produce
Cold	5° to +15 °C below ambient	Citrus produce

Type	Examples	Typical deliveries
Frozen	Meat	2/3 times a week; 48-hour order cycle
Chilled	Fresh meat	Daily/3 times a week; 24/48-hour order cycle
Cold/cool	Dairy produce, Citrus produce	2/3 times a week; 48-hour order cycle

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THANK YOU!

