Warehouse Management

Andrea Payaro, Ph.D.

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Andrea Payaro

- 1999: Degree in Management Information System at University of Padua
- 2002: Ph.D. in Business Management at University of Padua
- 2004: Post Doc. in Business Management at University of Padua
- 2004-2011: Visiting Professor at University of Padua
- Today:
  - Consultant certified by European Logistics Association
  - CEO of P&P Consulting & Services
  - Teacher of lean management at "Cattolica" University in Milan, University of Verona and **United Nations General Service Center** in Brindisi.
  - Member of Board of AILOG, Italian Association of Logistics and Supply Chain Management

Agenda

- Introduction to Warehouse

- Warehouse Process

- Main activities

- Safety in the warehouse

- Warehouse Model Canvas

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Warehouse performance

- Part of firms logistics system that stores products between point of origin and point of consumption.

- Warehousing provides time and place utility for raw materials, industrial goods, and finished products, allowing firms to use customer service as a dynamic value-adding competitive tool.

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Warehouse operations

- Warehouses are important links between the production sites and the customers
- Need to shorten the throughput times in the supply chain
- Need for faster response to customer demand
  - Fluctuations in customer demand
  - Increase in the frequency of orders
  - Decrease in the size of orders
  - Increase in product proliferation
- Trade-offs between warehouse costs and delivery performance

Warehouse

- Once a certain order has been placed, the warehousing performance depends on
  - the time required,
  - the precision achieved,
  - the efficiency achieved in satisfying the customer demand (in your case the customer is the Peacekeeping mission)

- High performance provides a competitive advantage, so, many companies invest on the warehouse operation to improve their position in the market.

Why a warehouse?

- To store:
  - Raw materials and components
  - Work in process materials
  - Finished goods
  - (Consumable goods or assets)
- But warehouse is a cost and it's very expensive (between 2-5% of sales of corporation)

The warehouse manager

- Execute more, smaller transactions

- Handle and store more items

- Provide more products and service customization

- Offer more value added services, like assembly o quality control

- Receive and ship international orders

- Reduce the lead time – increase the quality

Warehouse system

All of these are Important

People

Information Technology & Automation

Infrastructures & Equipments
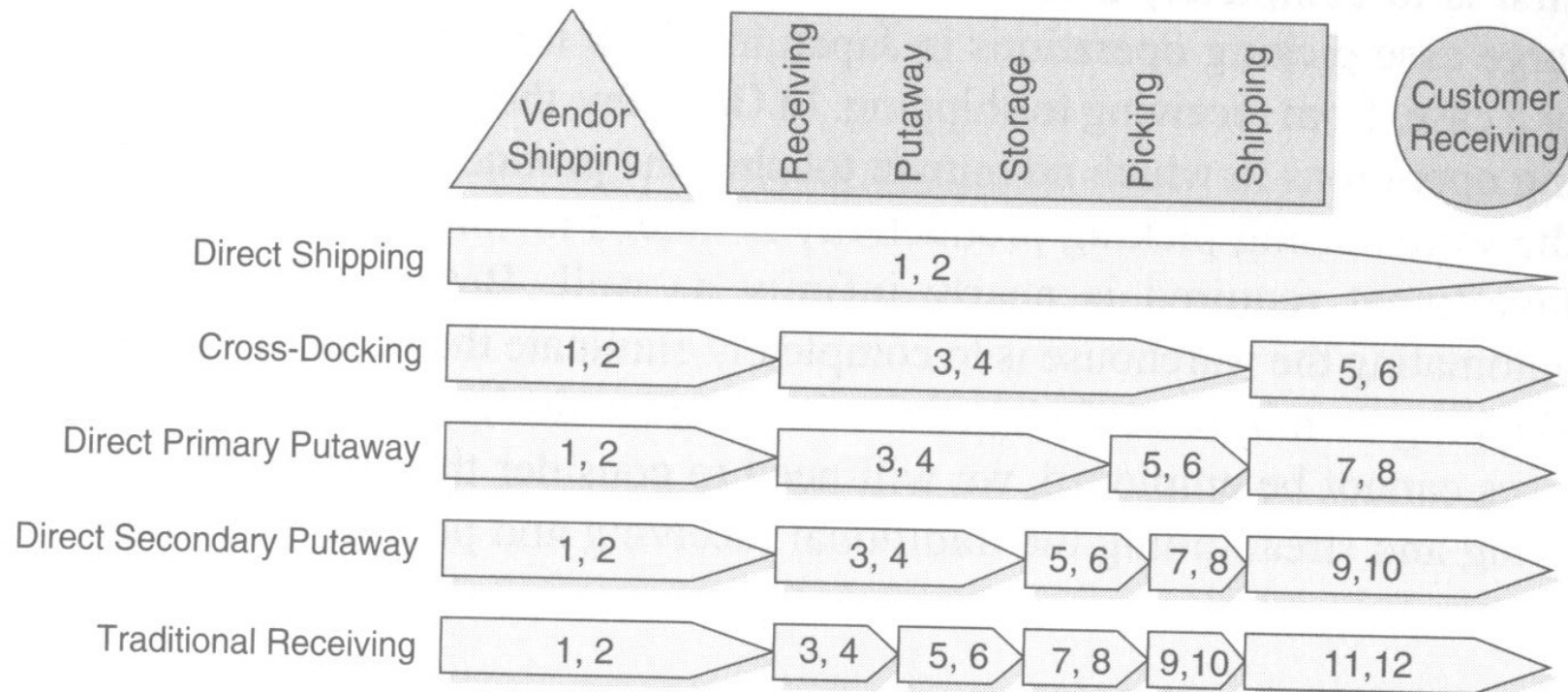
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The target

- Every warehouse has a target:
  - To give the right product
  - To the right customer
  - In the rights conditions
  - With the right quality
  - In the right time
  - At the right costs
  - With the right information

Touch analysis

FIGURE 4-1 Touch analysis for alternative receiving practices.

Touch analysis

- If the number of touches is high, then the costs are likely high

- If the number of touches is high, then it's likely that the number of mistakes or damages is high

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Cross Docking

- When the material cannot be shipped directly, the best option is cross docking.
    - Loads are scheduled for delivery into the warehouse from vendors
    - Inbound materials are sorted immediately into their outbound orders
    - Outbound orders are transported immediately to their outbound dock
    - Receiving staging or inspection is not required
   - Product storage is not required

Direct Putaway

- In direct putaway systems, staging and inspection activities are eliminated.

- The time, the space and labor associated with those operations is eliminated

- With this method we force warehouse operators to put goods away immediately upon receipt as opposed to the delay and multiple handling that are characteristic of traditional receiving and putaway activities (we also call this system free pass)

The activities

- Warehouse operations are a set of activities:
  - Unload
  - Receiving
  - Prepackaging
  - Storage
  - Refilling
  - Order picking
  - Packaging
  - Sortation
  - Unitizing & Shipping

The Flow
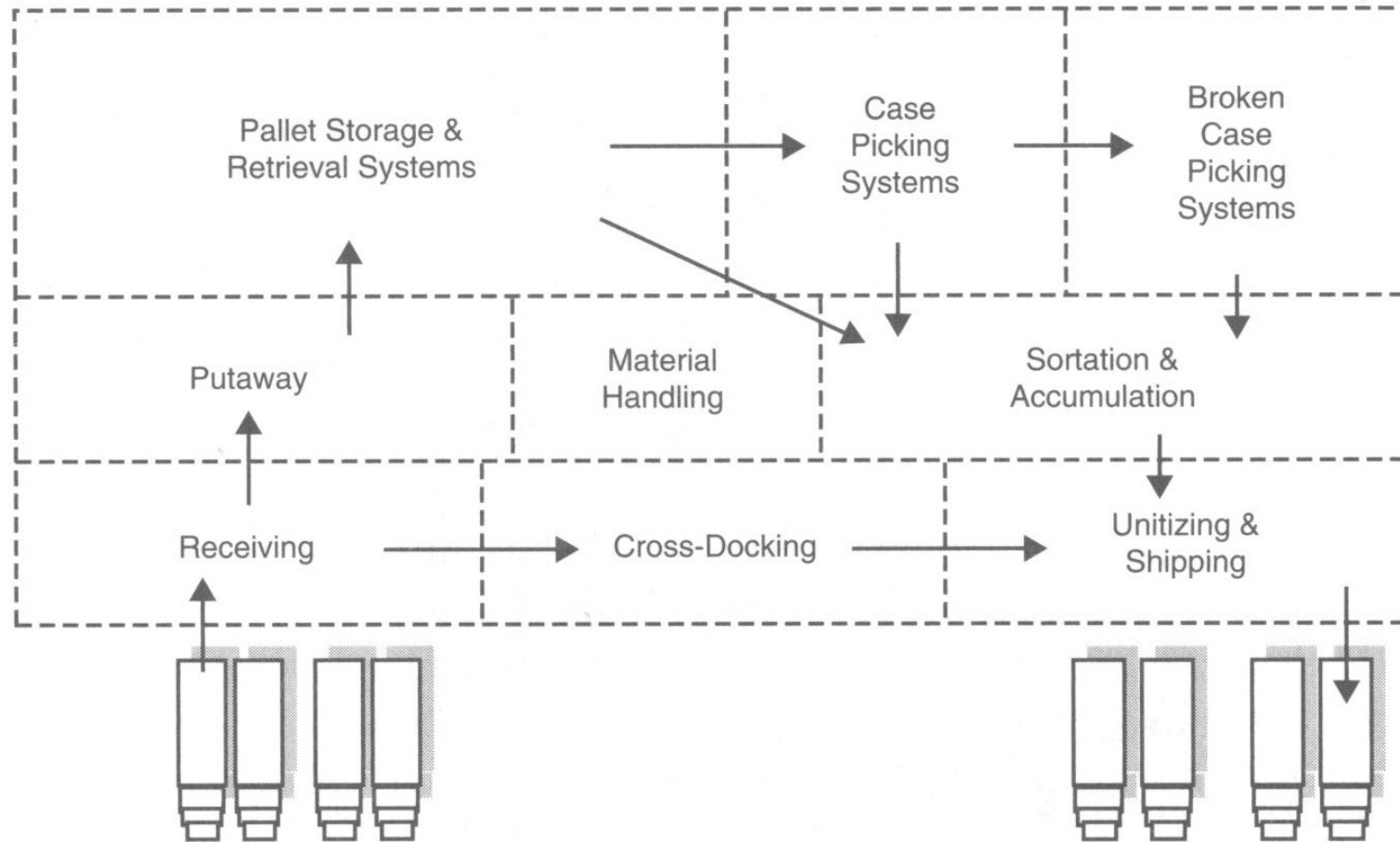
Unload

- Goods move from the truck to the warehouse

- Do we know in advance when the truck will arrive?
- Can we define the time for the unload?
- Can we reduce the time for unload?
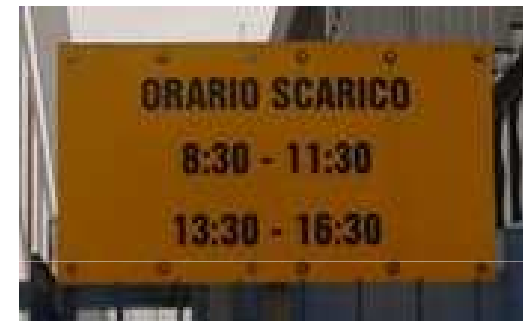- How does the unload cost?

Unload

- You must think the warehouse like the airport.
  - The landing is scheduled
  - The gate number is scheduled
  - A team is dedicated to operations

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Unload

- To reduce the time, we can define the time to unload

- This allows us to manage correctly the human resources.

ORARIO SCARICO
8:30 - 11:30
13:30 - 16:30

Signboard places in front of the company

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The dock

- How much is the unload of a truck?

- Example without a loading dock

Number of pallets per truck	33	num
Time to unload	50	min
Number of persons	2	num
Cost per hour per person	25,00	Euro
Cost per unload	41,67	Euro

The dock

- The loading dock is an area of a building where trucks are loaded and unloaded

Number of pallets per truck	33	num
Time to unload	40	min
Number of persons	1	num
Cost per hour per person	25,00	Euro
Cost per unload	16,67	Euro

| SAVING	25,00	Euro

Loading dock
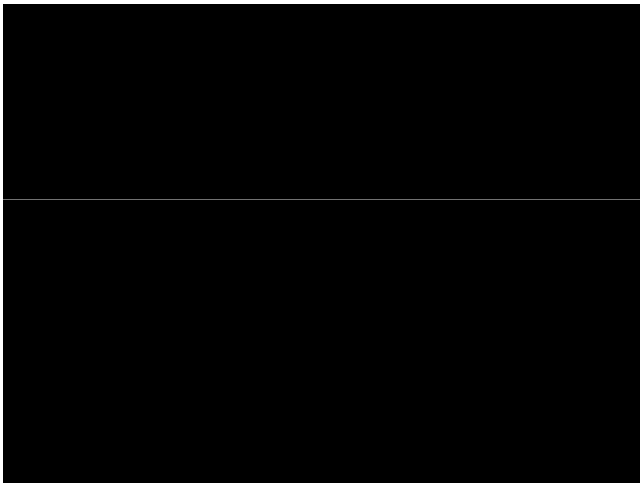
With the loading dock operations are faster, safer and cheaper.

Receiving

- Receiving is the collection of activities involved in:

A. the orderly receipts of all materials coming into the warehouse

B. He provides the assurance that the quantity and quality of such materials are as ordered

C. He distributes materials to storage or to other organization functions requiring them

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What to know about reception

- Goods quantity in input
- Goods Typology and material handling needed
- Unload Frequency
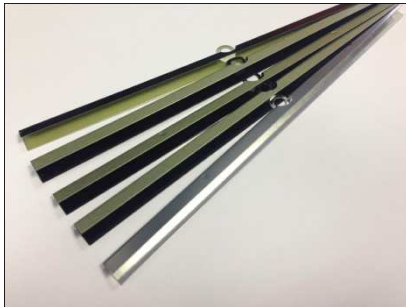
Metal profiles

Barrels

Washing machines

Fastener Systems

Reception Area

- The reception area must be sufficient for the goods in input

- The area must be distant and distinct from the shipping area

- The area must be managed in FIFO

- The area must be free before a defined hour (ex. Before 4:00 p.m.) or as soon as possible.

- Being able to "flatten" the receipts over a shift can help to loose resources. An example is to have staff who concentrate on receipts in the morning and switch to despatching in the afternoon.

Reception area

- The warehouseman in reception area needs at leaste the following documents:
  - The order
  - The shipping sheets

- The warehouseman controls if the goods received are the goods ordered. If there is a discrepancy the man doesn't accept the goods.

Check in

- A product accepted is not a good product, that is the product arrived shouldn't be:
    - in the right conditions;
    - in the right quantity
    - the right product
- In this case, it's necessary to give back the goods to the supplier

Check in models

- 100% check in: We check all products. This model is valid for high value goods and it's very expensive.

- Sample check in: We check a part of the goods unloaded. This model is the most used.

- Free pass: Nothing is checked. In this case there is an agreement between the customer and the supplier.

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What to know about check in

- What if a product hasn't got a good quality?
- How many time is necessary to check in?
- How does a man understand if a good is checked?
- Where is the area for not quality goods?

Goods to return

- If a product hasn't the right quality, we must remove the items from the reception area and move them in another appropriate area: goods to return.

- This area must be identified by horizontal and vertical signboards.

- Nobody can, without permission, remove the goods from this area. This permission derives from the procurement after an agreement with the supplier.

- The goods in this area can be eliminate or returned to supplier.

Goods returned

- A product returned from the customer follow the process described above.

- In this case, the Quality control must investigate if the goods are:

  – Wrong Products Delivered: re-placing merchandise in storage;

  – Faulty or damaged Products: elimination or reparation.

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Tip

- To simplify the input of returned goods we can use the visual management

- An example:
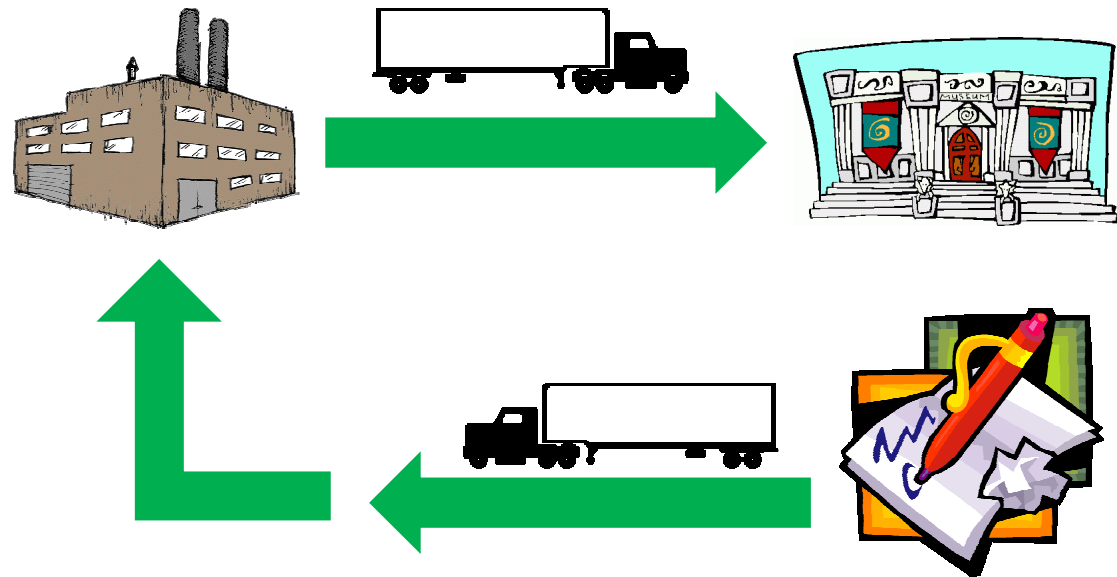
- Goods checked after the exhibition

This product don't need control

This product need control

Re-pack

- Sometimes it's necessary to change the packaging before to stock the goods. In particular:

- When different items are on the same pallet or in the same box;

- The SKU (Stock Keeping Unit) is unsafe for the operators or for the automatic devices.

Re-pack

Different products are positioned on the same box.

Pallets are unsafe for the automatic devices.
1) Boxes are positioned out of profile.
2) Bags can slip during movements.

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The safety

- It's very important to putaway the pallet or the goods only if they are safe for people and materials.

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Re-label

- When a good hasn't got a valid identification (ex. the supplier article number is different form customer article number), it's necessary to code the product.

- Before storage
  - A new label is printed
  - The label is attached on the product

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Store Management

- After the check in, the products can be located in the warehouse.

- How can we store the good?
  - By memory
  - By category
  - Fixed locations
  - Random Locations

Store by memory

- Only the warehouseman knows the position of goods. This model is useful in little spaces or with few articles.

- Strenght
  - The most economic model
  - It doesn't require information systems

- Weakness
  - The performances depend on the people
  - There is the risk to lose goods

Store by category

- Goods with similar material handling procedures are positioned in the same area.

- Strength

  - Spaces Optimization

  - Activities Optimization, because we use the same equipment to move goods

- Weakness

  - It's clear the area in the warehouse, but it isn't defined the product position

  - We must decide where put goods that can belong to different categories
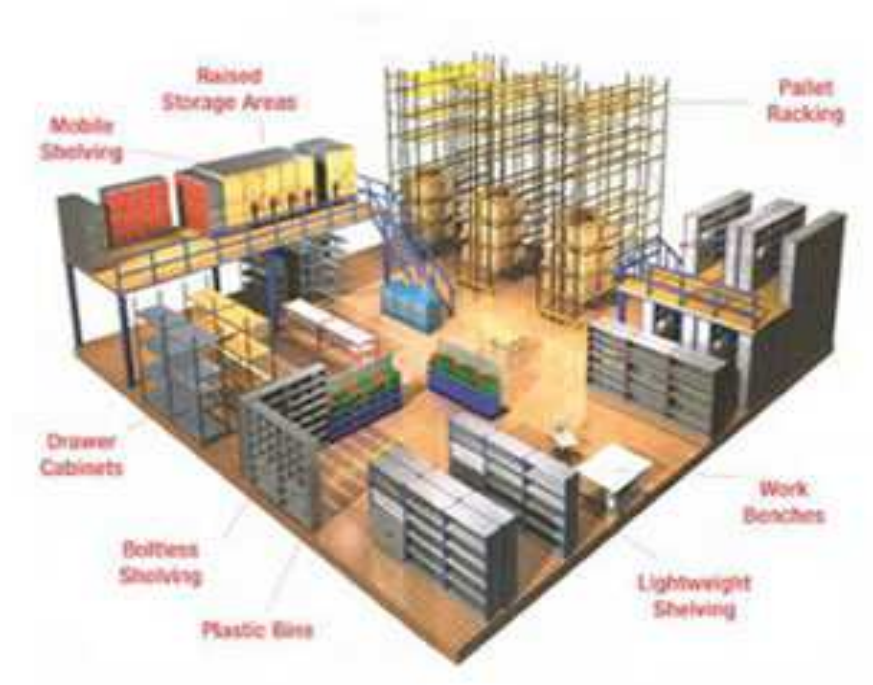
Store by category

- In a warehouse the category defines an area.

- Dimensions, shapes, weight, are only few characteristics that define the category.

- Ex. In a pharma warehouse the categories are:
  - Bulky
  - Standard
  - Vulnerable
  - Refrigerator
  - Drugs

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Categories and Areas

Every Category has
got a different:

- Shelves
- Equipment
- Picking method

Fixed location

- The right product on the right position!

- Every product has a defined position in the warehouse.

- This model is characterized by a label placed on the rack: on this label the name of the product.

- Strength

  - Warehousemen know the positions of goods

  - Reduced time of products management

- Weakness

  - Wasted storage space

Honeycombing

- It refers to the presence of empty spaces in a full warehouse.

- This is the result of the demand variations.

- When we define the number of locations, this number is valid for the present, but it can change in the future.

- If the demand planner don't communicate the forecasting to the warehouseman, the number of locations will remain the same.
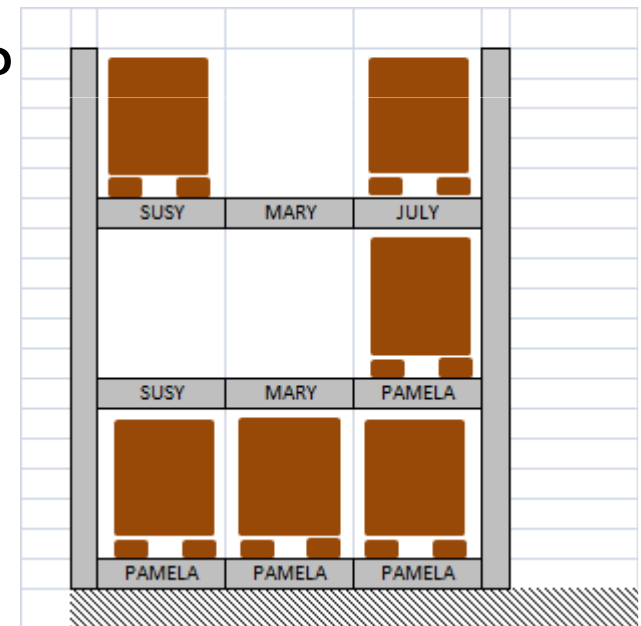
Example

- Where can I put the "Pamela" pallet?

- I've got no locations for the new pallet, but the rack is not full!
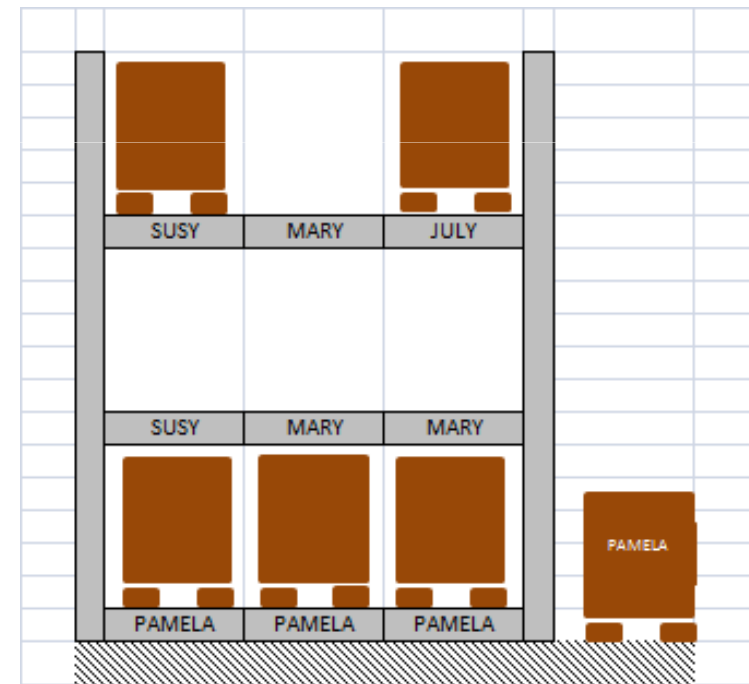
Solution

- I call the demand planner

- I ask him the demand forecasting and the comparison with the current year.

- Which product will reduce the selling ?

- Which product will increase the selling?

- After the answers, the warehouseman can change the number of locations per article.

Honeycombing example

What is it happened to these products?

Stock out or end on life? Usually the warehouseman hasn't got the answers to these questions.

Result: **storage with low efficiency**

On the shelf we find the description and the article number

Random locations

- The man or the information system (this solution is better!) decides where puts the goods.

- Every free location is available to store a good.

- Where is the product? How can we remember the position?

- It's necessary to implement a mapping system.

- With a map we can find the free location or the right product in the right time.

Random locations

- ## Strength
  - – Higher space utilization
  - – High efficiency

$$WarehouseEfficiency = \frac{AverageLocationsOccupied}{TotalLocations}$$

- ## Weakness
  - – High standardization of dimension and shapes of the pallets

The mapping

- In the warehouse the map is a systems that allows to identify clearly every single storage location.

- When a man puts in a storage location a pallet, he must record the article number and the position.

- It's important to point out that a WMS is suggested when utilizing a random storage technique.
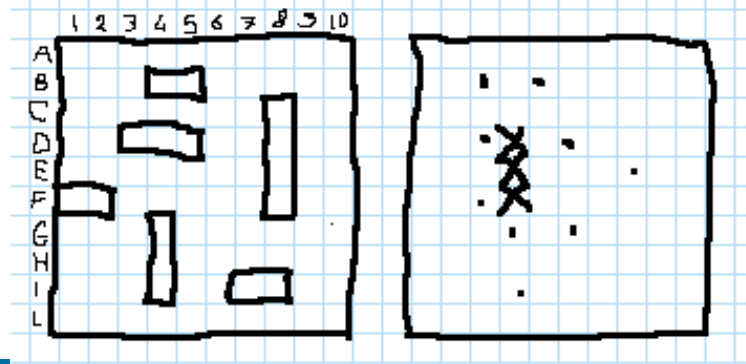
A map is needed

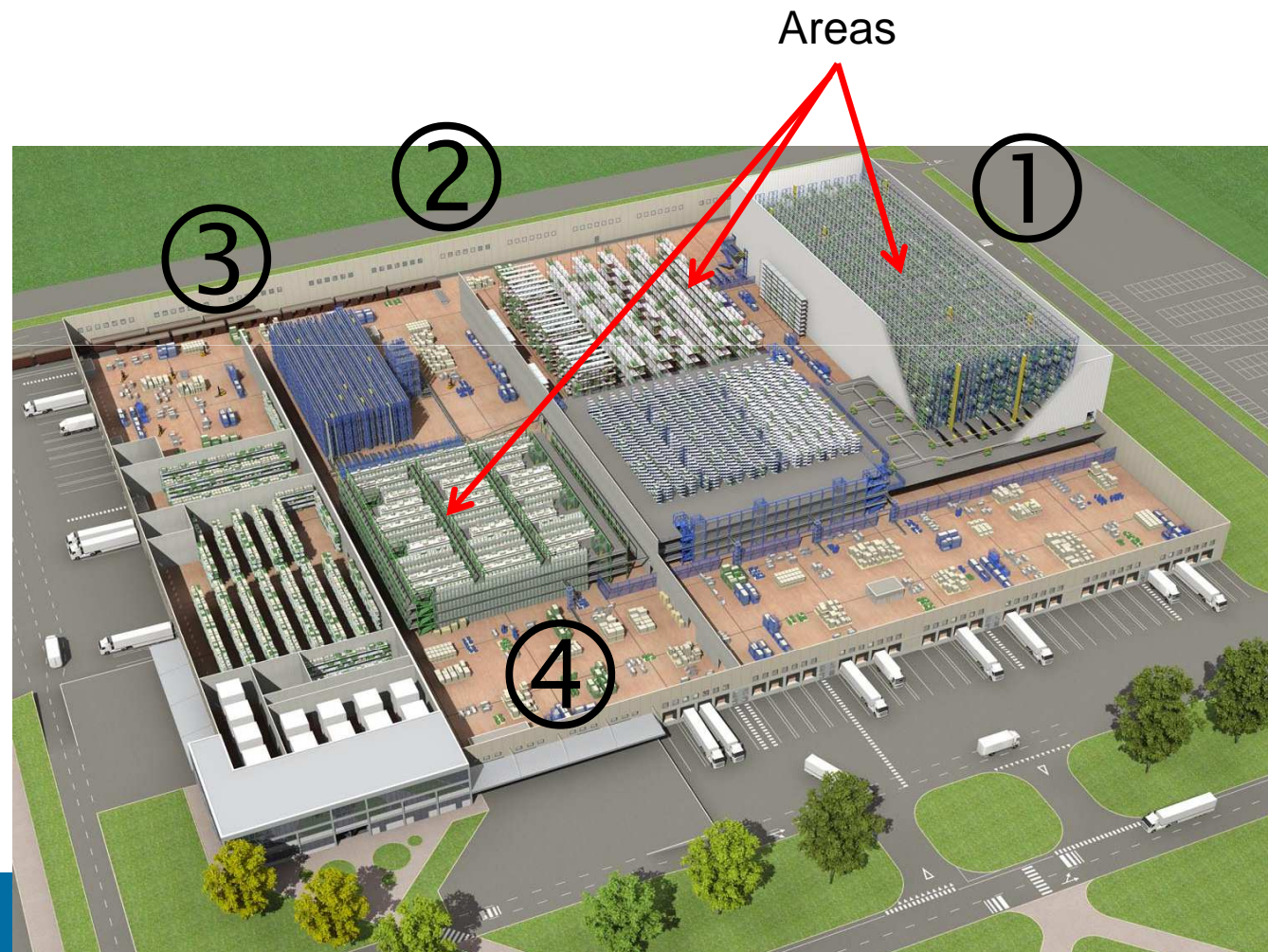Where is the car we must deliver?

Different areas to store goods

The coordinates system
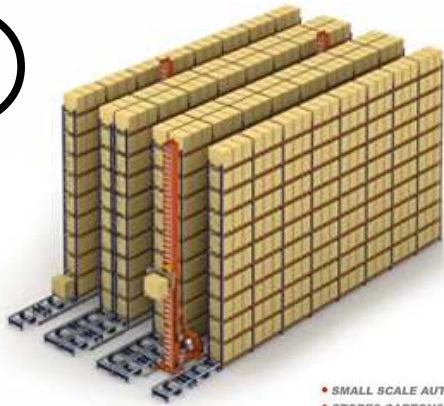
- **Four fields**
  - Area
  - Rack
  - Box
  - Level

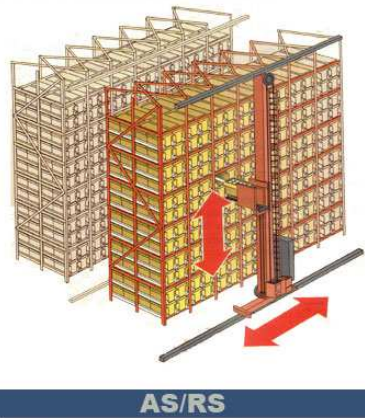Payaro Andrea

Areas and Categories

① AS//RS System

* SMALL SCALE AUTOMATED STORAGE AND RETRIEVAL
* STORES CARTONS, TOTES or TRAYS
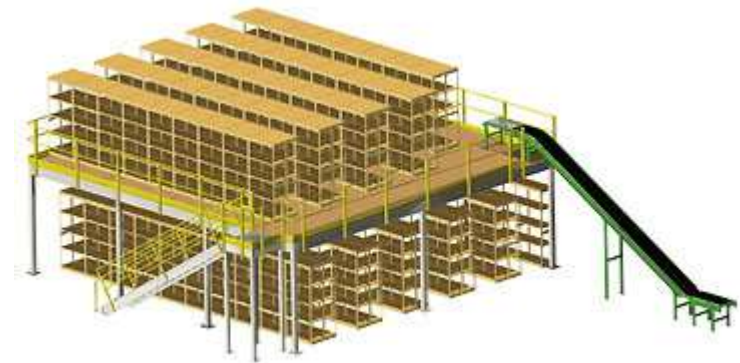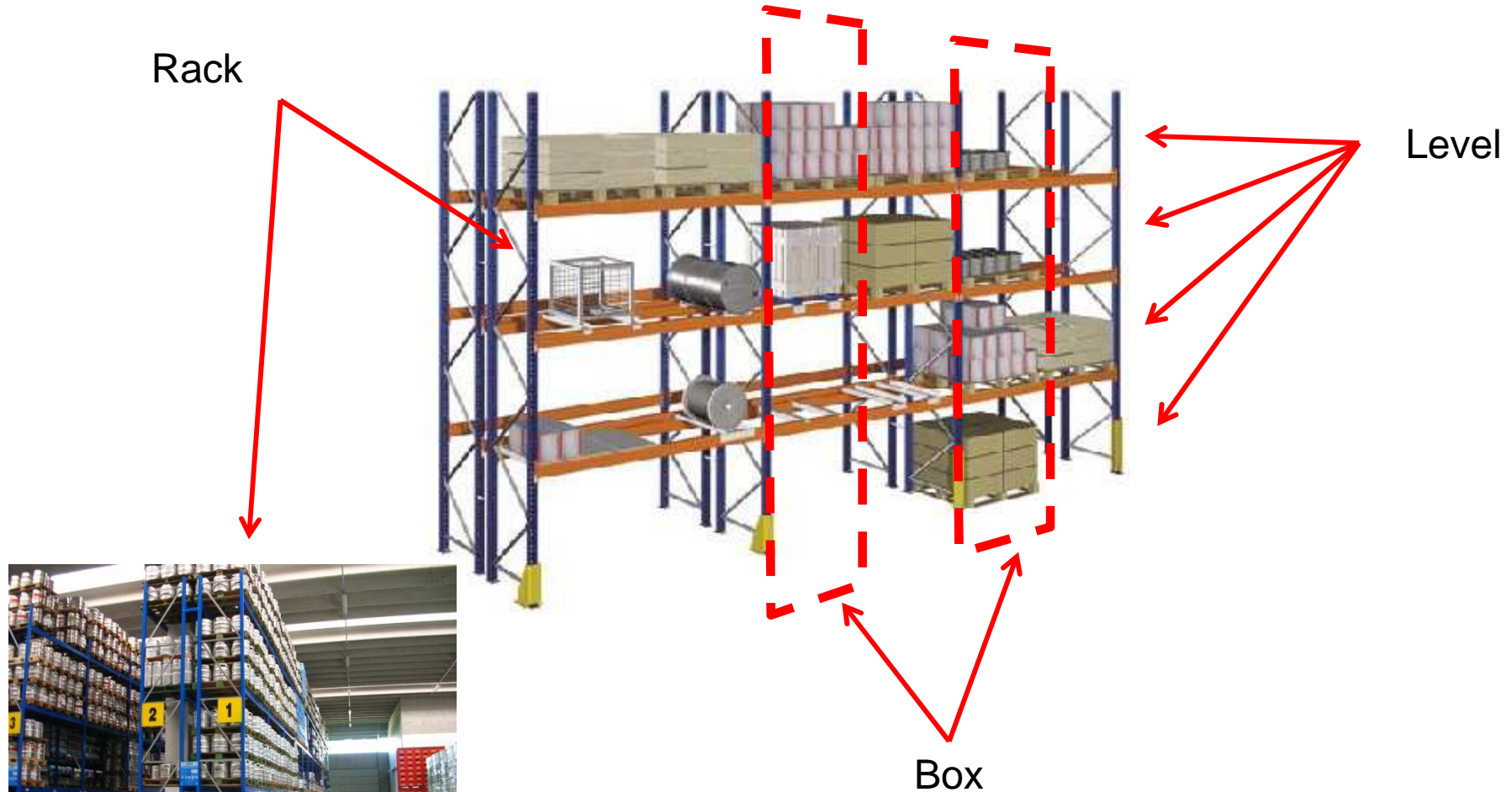* TYPICAL LOADS OF 1,000 POUNDS OR LESS

③ AS/RS

② Drive in

④ Mezzanine

The coordinates system

Rack

Level

Box

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Example

In this case the mapping system has got three fields:
-Rack
-Position
-Level

Which level?

- Here there are two example of mapping. There is only one difference between two racks: the levels. Which system is more flexible?

| 01.01.01.30 | 01.01.02.30 | 01.01.03.30 |

| 01.01.01.20 | 01.01.02.20 | 01.01.03.20 |

| 01.01.01.10 | 01.01.02.10 | 01.01.03.10 |

| 01.01.01.03 | 01.01.02.03 | 01.01.03.03 |

| 01.01.01.02 | 01.01.02.02 | 01.01.03.02 |

| 01.01.01.01 | 01.01.02.01 | 01.01.03.01 |

Solution

- The system to the left is more flexible, because the adding of a new level do not require the change of all locations.
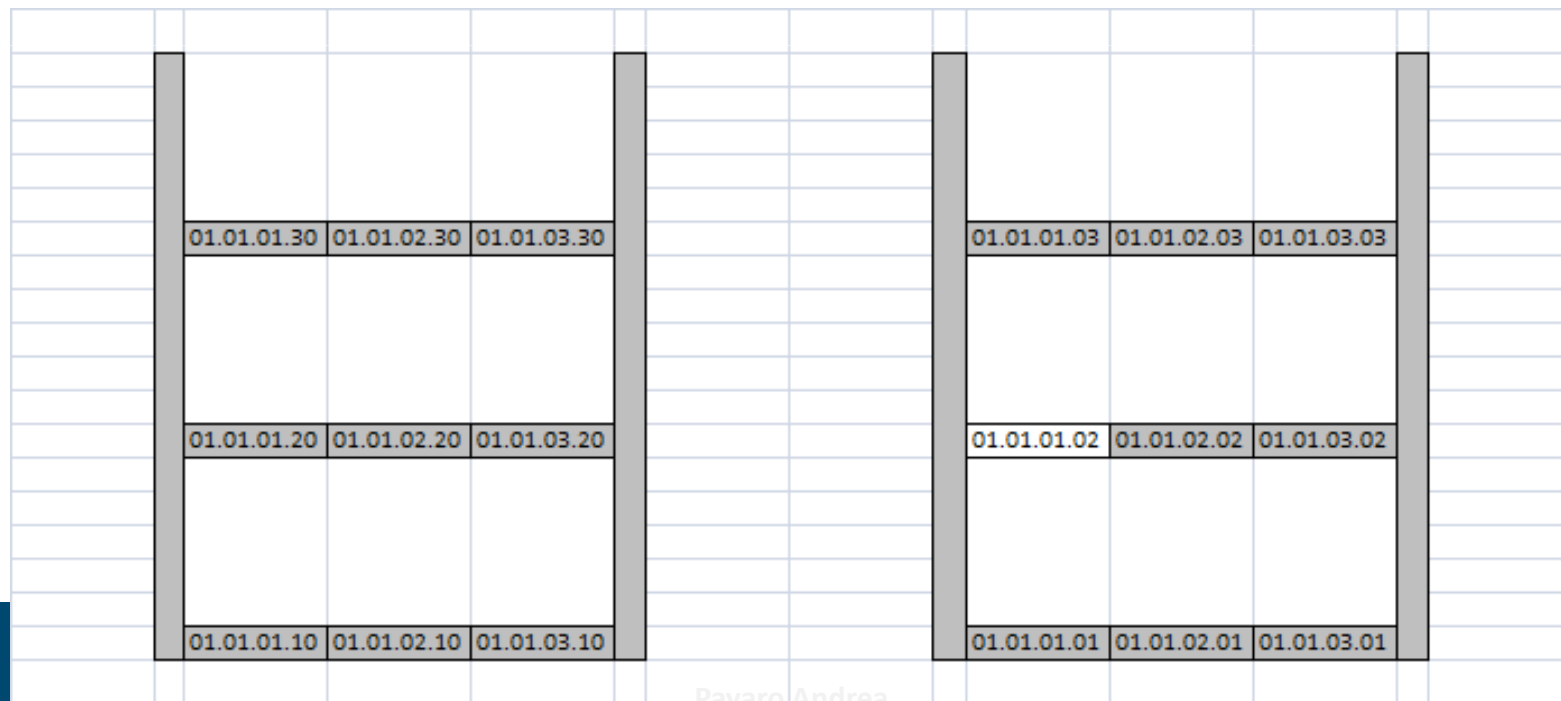
Fixed or Random

- Fixed locations is common in the picking area
- The random storage location method is useful to optimize the space utilization.

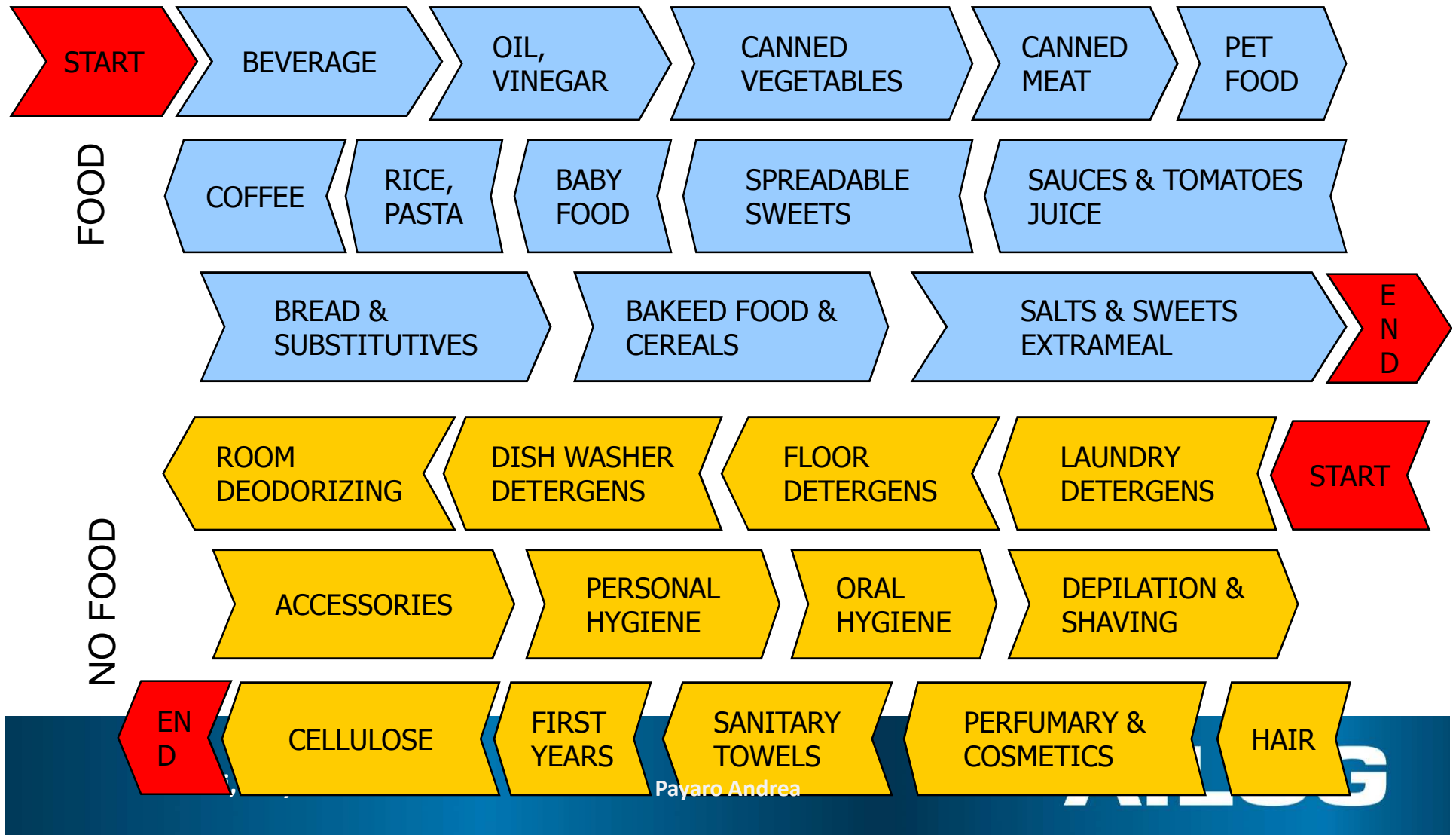The storage locations are organized with the random model

The picking area is organized with fixed storage locations

Fixed model and picking

- High weight
- Solid Packaging
- These products can be positioned on the bottom of the pallet

- Low weight
- Low stability
- Fragile Packaging
- These products can be positioned only on the top of the pallet

PICKER DIRECTION

Example of Picking Layout

Refilling

- When a picking position becomes empty, it's necessary to refill.

- What to know about the refilling
  - Who call the refilling?
 - When does the refilling start?

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Refilling

- Who call the refilling?

1. The WMS, when the inventory on the picking locations is finished or it has reached the re-order point. Algorithms define the right moment to send the message.

2. The operator, when the inventory on the picking locations is finished or it has reached the re-order point.

Refilling

- When does the refilling start?

1. When the picking location is empty (stock out). This solution is adapt to guarantee the batch traceability

2. When in the picking location there are few goods.
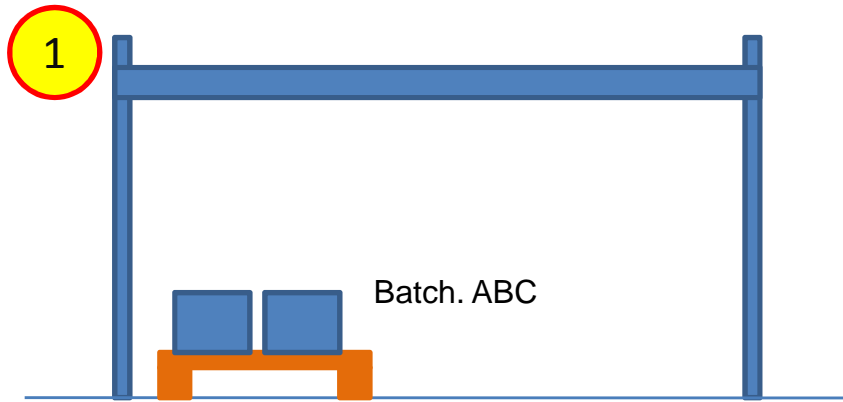
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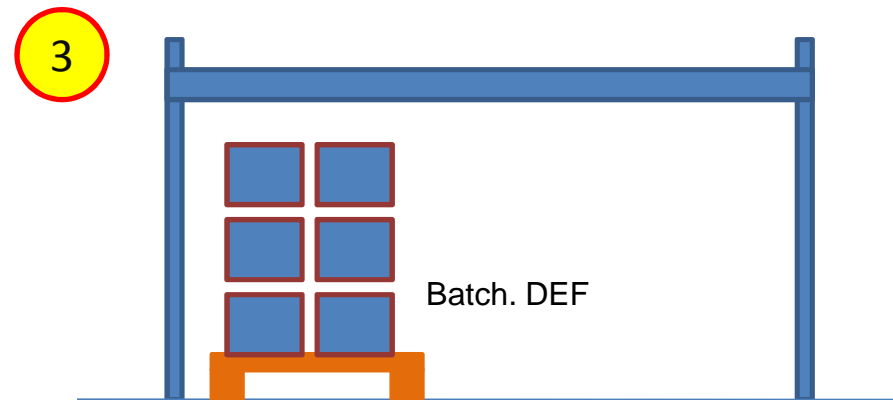# Solution 1

Solution 2

1 Batch. ABC

Picking activities

2 REFILL

Re-order Point

3 Batch. DEF and ABC
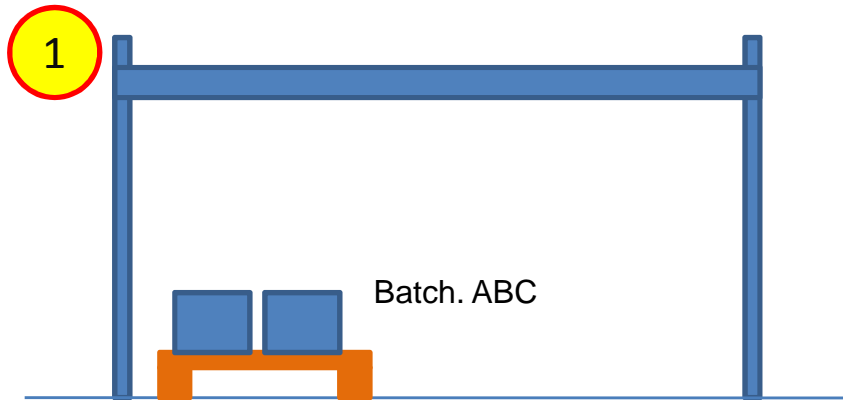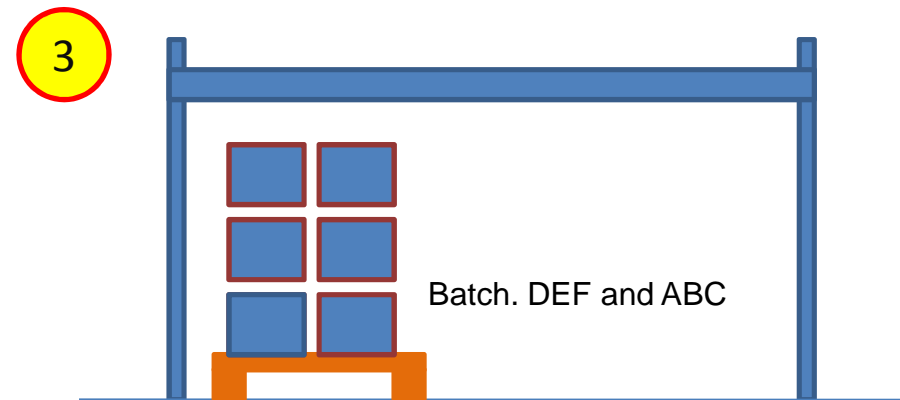
Where is the older batch?
On the top or on the bottom?
This solution don't guarantee
the position of the older batch

Refilling

From order to pick

SALES POINT → ORDER → DC

DC → ORDER MANAGEMENT → PRINT PICKING LIST → PICKING → CHECKING OF PICKED GOODS → DELIVERY → SALES POINT
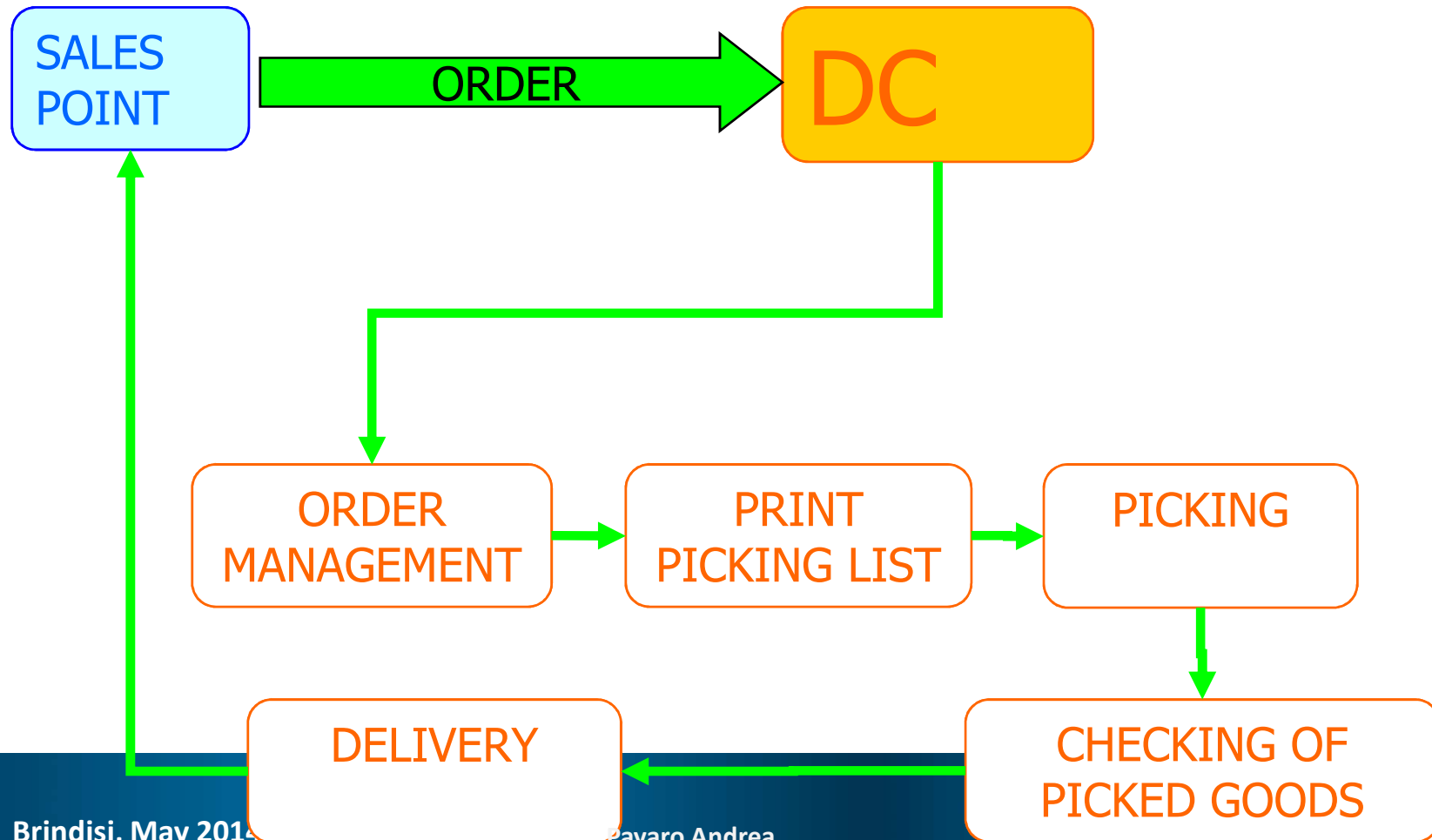
Order Picking

- The order picking consists in taking and collecting articles in a specified quantity before shipment to satisfy customers' orders.

- It is a basic warehousing process and has an important influence on supply chain's productivity.

- This makes order picking one of the most controlled logistics processes.

Pick list

- A pick list is a document that is often used to pull particular items in specific quantities from an inventory.

- The pulled items are either routed to a production floor for use in a manufacturing effort or to fulfill an order placed by a customer.

- When a pick list is used to locate and pull goods to fulfill an order placed by a client, the list often acts as the authorization to remove the goods from inventory.

- Once the list is used to physically locate and move the goods to the order fulfillment area, that same list can be used to update the inventory records.

- The detail on the pick list will be matched with the purchase order of the customer, and a packing list is generated to accompany the ordered goods to their destination.

How generate the pick list?

- The picking list must optimize the path of the picker.

- The picker must not waste time. Every movement is a waste.

- Picker must not search goods

- Picker must be safe during his operations.

The importance of picking
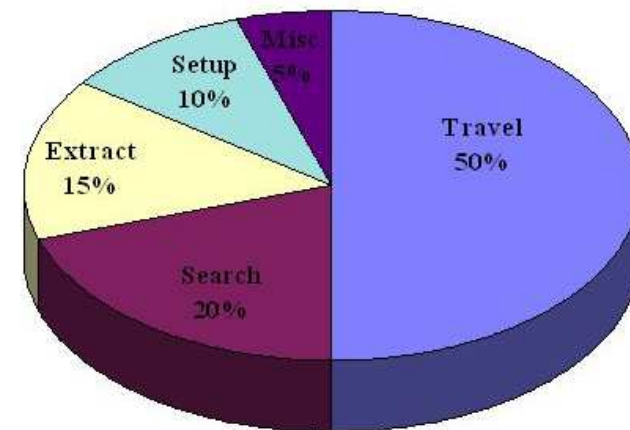
- We propose three picking list to highlight the relationship between the mapping model and the order picking.

Warehousing Costs

Order Picking Times

- The travel component weight the 50% on the total picking cost.

- How can we reduce this component?

- Easy! If now the operator goes to the product, in the future the product will go to the operator! But the future is now!

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Order pick and Map

- Exist a direct relation between map and picking list. Let's see the following examples:

  1. The order picking is generated by customer order. Normal mapping.

  2. The order picking is sorted by storage locations. Normal mapping.

  3. The order picking is sorted by storage locations. The map considers the picker's route.

1: Order picking

- The sequence of the article is determined by the customer order

ROW	ART	DESCR	QUANTITY	AREA	RACK	POS	LEV
1	RES-4040/TRASP/KG20	RESINE TRASP KG 20	2	01	03	01	10
2	RES-4080/TRASP/K1000C	RESINE TRASP K1000C	3	01	01	02	10
3	RES-5010/TRASP/KG5	RESINE TRASP KG 5	2	01	05	05	10
4	RES-5020/BOTTIC/KG20	RESINE BOTTIC KG 20	1	01	04	06	10
5	RES-5020/TRASP/K200N	RESINE TRASP K200N	2	01	02	04	10
6	RES-5020/TRASP/KG5	RESINE TRASP KG 5 BIG	3	01	01	03	10
7	RES-5030/TRASP/K1000C	RESINE TRASP K1000C BIG	1	01	03	02	10
8	RES-5030/TRASP/K200N	RESINE TRASP K200N BIG	1	01	01	04	10
9	RES-5030/TRASP/K200NC	RESINE TRASP K200NC	1	01	05	01	10
10	RES-5040/BOTT5/K1000C	RESINE BOTT5 K1000C	2	01	02	07	10

1: Spaghetti chart

The operator's path is very long. He goes through the same aisle more times for the same order.
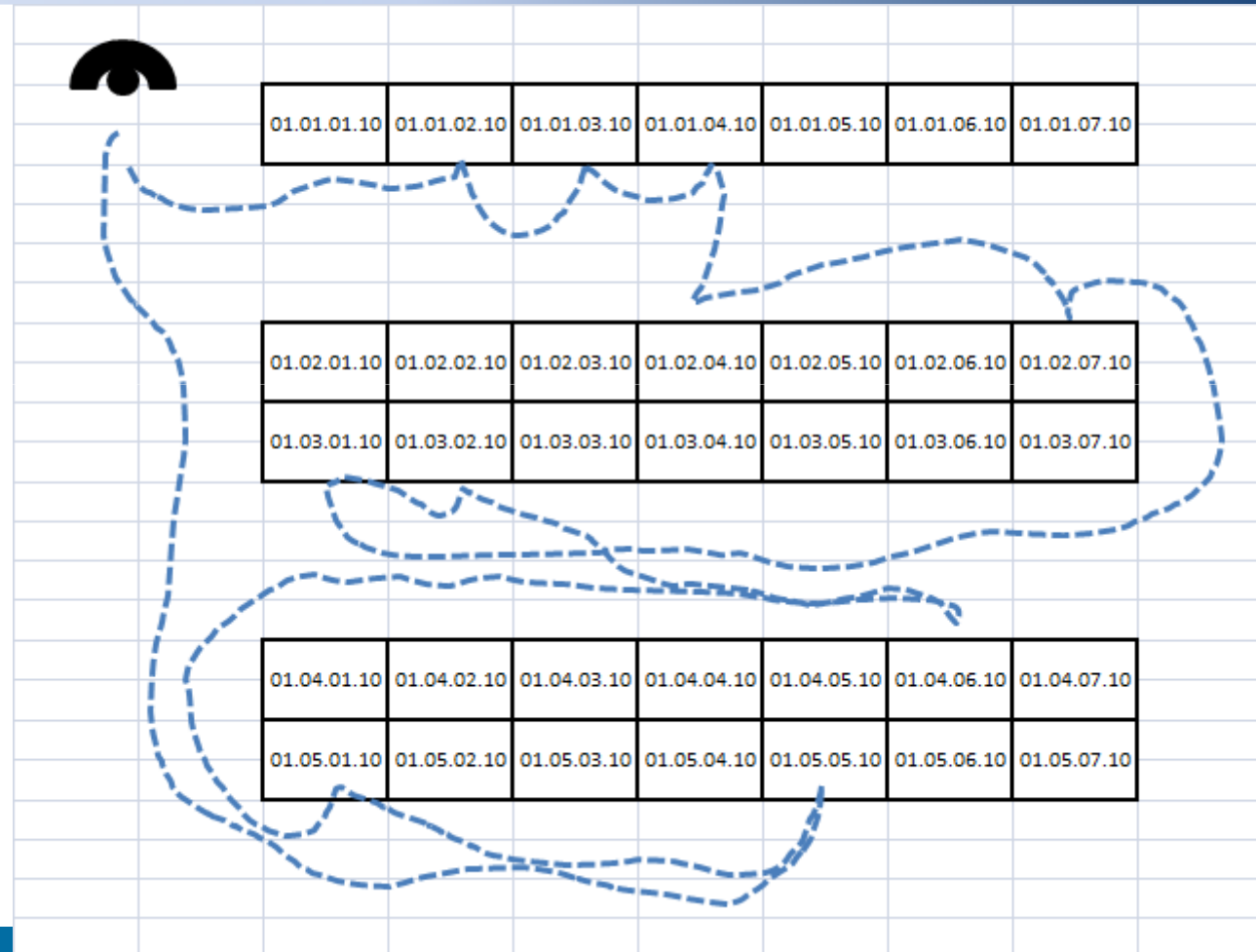
2: Order picking

- The list is sorted by storage locations: ordered by rack then by position.

ROW	ART	DESCR	QUANTITY	AREA	RACK	POS	LEV
1	RES-4080/TRASP/K1000C	RESINE TRASP K1000C	3	01	01	02	10
2	RES-5020/TRASP/KG5	RESINE TRASP KG 5 BIG	3	01	01	03	10
3	RES-5030/TRASP/K200N	RESINE TRASP K200N BIG	1	01	01	04	10
4	RES-5020/TRASP/K200N	RESINE TRASP K200N	2	01	02	04	10
5	RES-5040/BOTT5/K1000C	RESINE BOTT5 K1000C	2	01	02	07	10
6	RES-4040/TRASP/KG20	RESINE TRASP KG 20	2	01	03	01	10
7	RES-5030/TRASP/K1000C	RESINE TRASP K1000C BIG	1	01	03	02	10
8	RES-5020/BOTTIC/KG20	RESINE BOTTIC KG 20	1	01	04	06	10
9	RES-5030/TRASP/K200NC	RESINE TRASP K200NC	1	01	05	01	10
10	RES-5010/TRASP/KG5	RESINE TRASP KG 5	2	01	05	05	10

2: Spaghetti chart

This path is more reduced than the previous. However the operator goes through the same aisle more times for the same order.
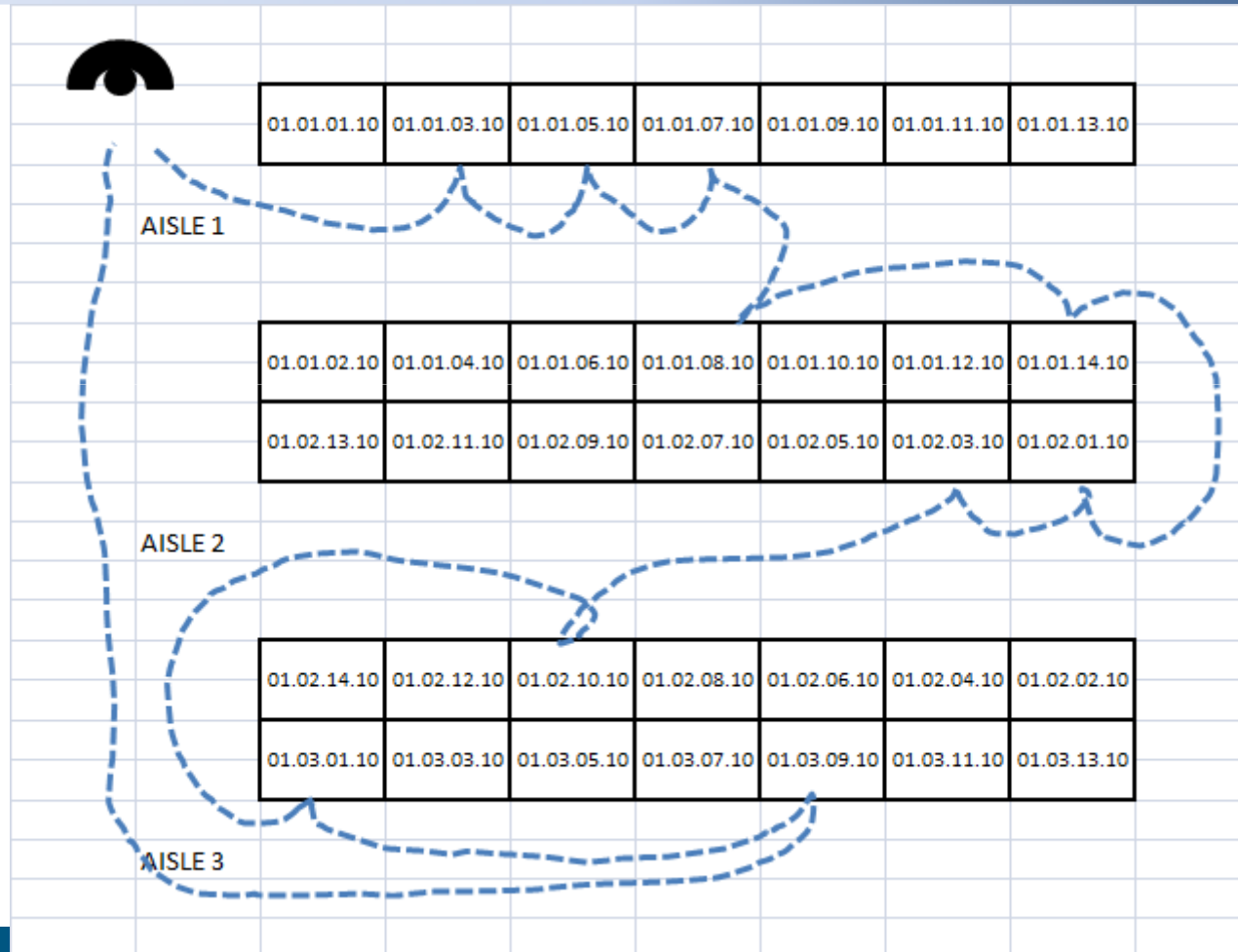
3: order picking

- The list is sorted by storage locations: ordered by aisle then by position.

ROW	ART	DESCR	QUANTITY	AREA	AISLE	POS	LEV
1	RES-4080/TRASP/K1000C	RESINE TRASP K1000C	3	01	01	03	10
2	RES-5020/TRASP/KG5	RESINE TRASP KG 5 BIG	3	01	01	05	10
3	RES-5030/TRASP/K200N	RESINE TRASP K200N BIG	1	01	01	07	10
4	RES-5020/TRASP/K200N	RESINE TRASP K200N	2	01	01	08	10
5	RES-5040/BOTT5/K1000C	RESINE BOTT5 K1000C	2	01	01	14	10
6	RES-4040/TRASP/KG20	RESINE TRASP KG 20	2	01	02	01	10
7	RES-5030/TRASP/K1000C	RESINE TRASP K1000C BIG	1	01	02	03	10
8	RES-5020/BOTTIC/KG20	RESINE BOTTIC KG 20	1	01	02	10	10
9	RES-5030/TRASP/K200NC	RESINE TRASP K200NC	1	01	03	01	10
10	RES-5010/TRASP/KG5	RESINE TRASP KG 5	2	01	03	09	10

3: Spaghetti chart
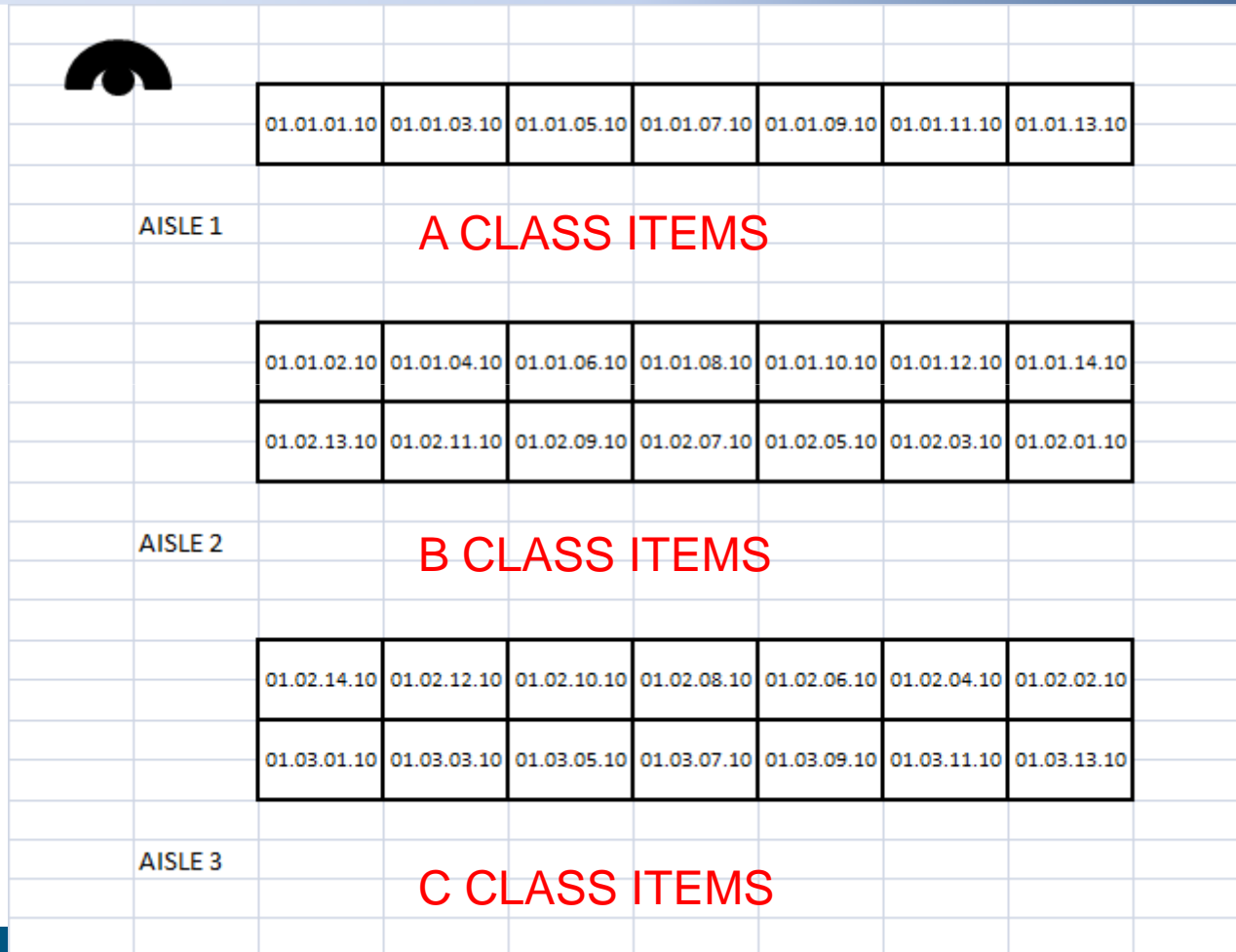
Performances

- To improve the order picking performances you can:

1. Define the best storage locations of products
   - ABC / Category

2. Decide the best picking model
   - Full Pallet picking
   - Basic picking
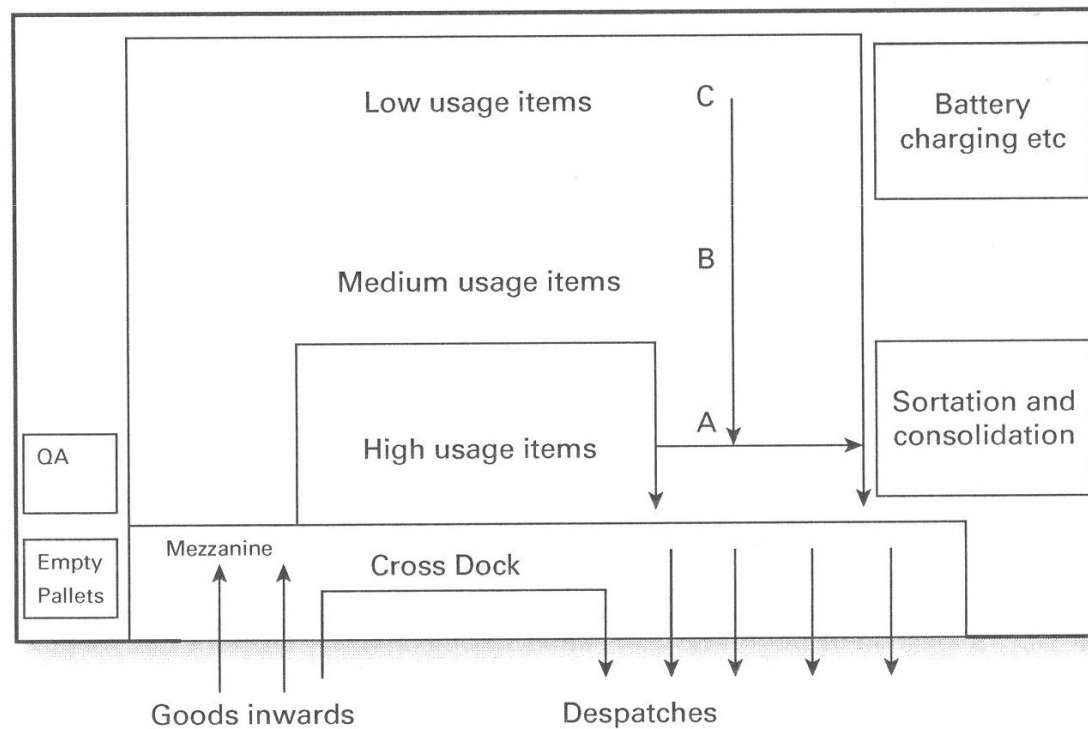   - Batch picking
   - Wave picking
   - Zone picking

Payaro Andrea
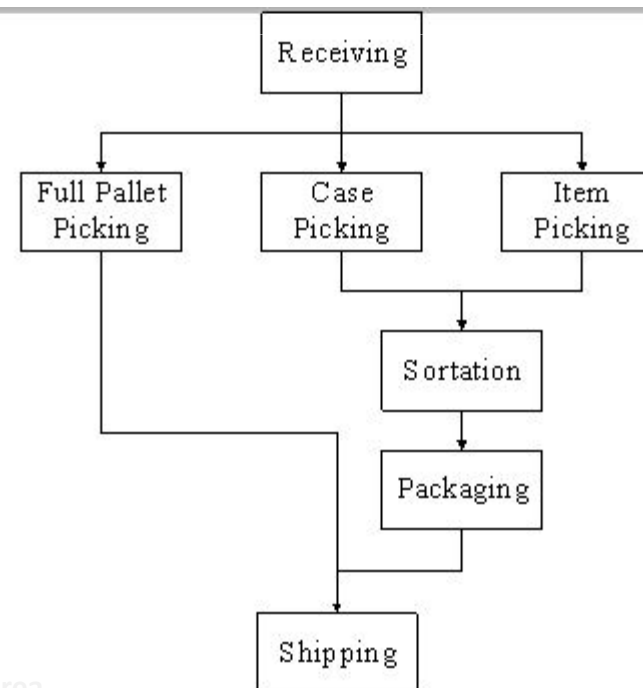
ABC

- The ABC item analysis

- If 20% of your items completely satisfy 80% of your orders, then these are "A" items. Set up a short pick line for these items and place slower moving "B" (items that satisfy 15% of orders) items in the next closest area and the slowest "C" (items that satisfy 5% of orders) moving items farthest away.

ABC Stratification

| 01.01.01.10 | 01.01.03.10 | 01.01.05.10 | 01.01.07.10 | 01.01.09.10 | 01.01.11.10 | 01.01.13.10 |

AISLE 1   **A CLASS ITEMS**

| 01.01.02.10 | 01.01.04.10 | 01.01.06.10 | 01.01.08.10 | 01.01.10.10 | 01.01.12.10 | 01.01.14.10 |
| 01.02.13.10 | 01.02.11.10 | 01.02.09.10 | 01.02.07.10 | 01.02.05.10 | 01.02.03.10 | 01.02.01.10 |

AISLE 2   **B CLASS ITEMS**

| 01.02.14.10 | 01.02.12.10 | 01.02.10.10 | 01.02.08.10 | 01.02.06.10 | 01.02.04.10 | 01.02.02.10 |
| 01.03.01.10 | 01.03.03.10 | 01.03.05.10 | 01.03.07.10 | 01.03.09.10 | 01.03.11.10 | 01.03.13.10 |

AISLE 3   **C CLASS ITEMS**

U Flaw and ABC

FIGURE 9.4 U-flow warehouse (courtesy of University of Huddersfield)

Through Flow and ABC

FIGURE 9.5 Through-flow warehouse (courtesy of University of Huddersfield)
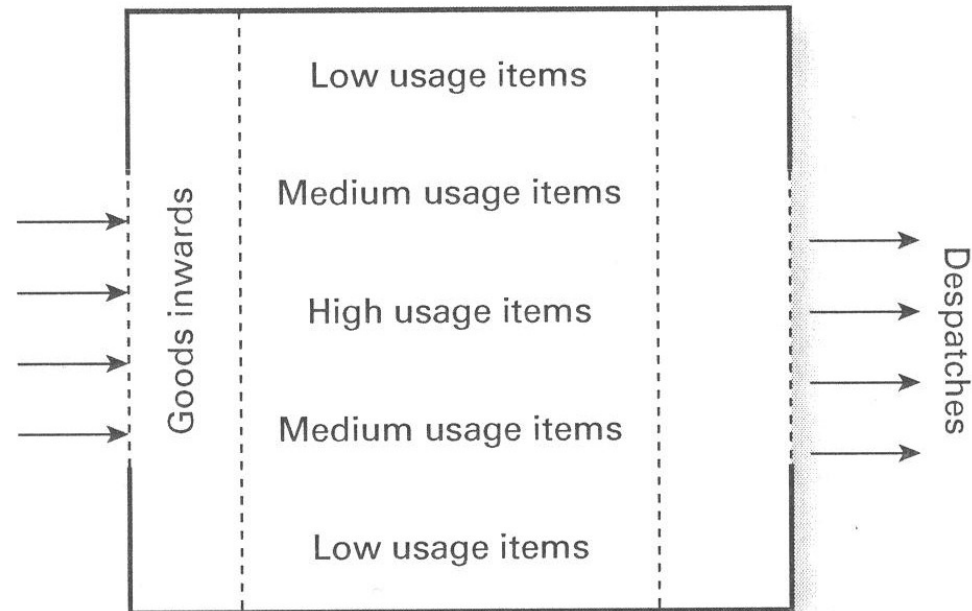
Order picking methods

- The main order picking methods are:
    - Basic picking: An order picker is assigned and he picks only one order per time.
    - Batch picking: An order picker is assigned and picks multiple orders simultaneously, minimising trips to each location.
    - Zone picking: Each order picker is assigned a specific zone and will only realise order picking within this zone.
    - Wave picking: A variation of zone and batch picking. Rather than orders moving from one zone to the next for picking, all zones are picked at the same time and the items are later sorted and consolidated into individual orders/shipments

    Sometimes a combination of picking methods is needed to handle differentproducts and order characteristics

What to know about picking

- Use barcodes to verify everything before you pick

- When you pull a product, you can read the barcode of the good AND the barcode of the location. In this manner you reduce the likelihood to make a mistake.

- Minimise product touches : Regardless of what order picking method a company uses, it is important to identify and record the number of times an item is handled from the time it is ordered to the time it leaves the facility.

- If the pick process is enough accurate that further QC checking, or shipping checking is not required.

Tools

Finger scanner

Augmented reality

Hand held scanner

Voice Picking

The summary of picking

Table 4.3 Summary of picking methods

Picking method	Equipment	Picks per picker	Orders/pick density
Basic	HPT/PPT or MLPT*	Moderate to high	High number picks per order
Batch	HPT/PPT or MLPT	Low	Low number of picks per order
Zone	Plus possible conveyor for moving to next zone	Low to moderate	High number of orders and SKUs
Wave		Moderate to high	High number of orders and SKUs

Picking and areas

- When the warehouse is divided in different areas, it's necessary to organize the picking.

AILOG
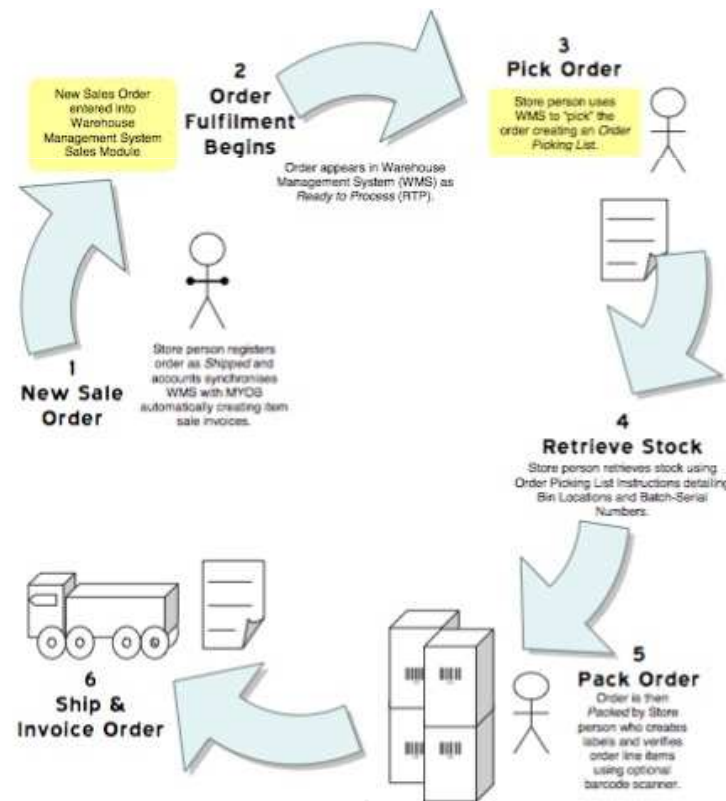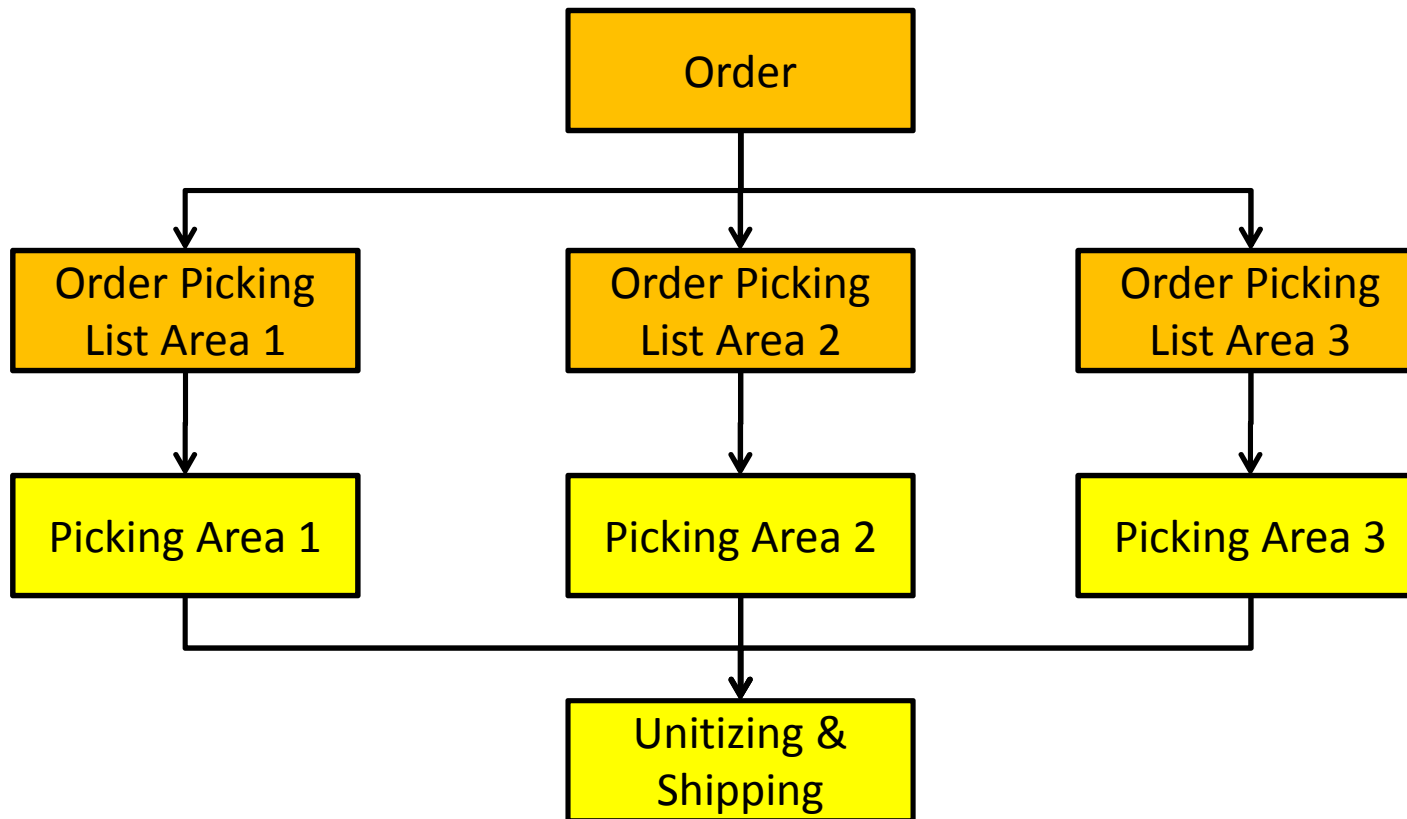
Unitizing

- In this area goods are prepared to load

- Unitizing is the final packaging step before product goes out the door.

- This is the way to maintain the load's integrity as it travels through the supply chain or your warehouse.

- The right application secures and stabilizes the load and protects the product while in transit. It can also significantly reduce the amount of product returned as a result of shipping damage and ultimately reduce the overall cost of packaging.

AILOG

- Manual
  - Manual unitizing involves little in the way of equipment and is done by hand. In this application, a worker moves around the load holding the handles of a roll of film, unrolling, applying and wrapping the product as they circle.
  - Products that are unusual in shape and size, such as curtain rods, doors and siding, are good candidates for manual unitizing.

AILOG
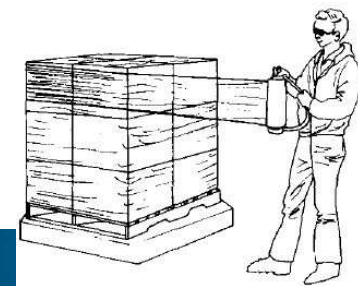
- **Semi-automatic equipment**
  - An operation that unitizes more than 15 loads per day can likely justify some level of automation based on savings in labor, back strain and unitizing material costs.
  - An operator delivers a pallet load of product by lift truck to the unitizing equipment or has a hand in applying, guiding and detaching the binding material during the process.

AILOG

- Stretchwrapping
  - Stretchwrapping is the most common way to unitize a load.
  - A semi-automatic stretchwrapper needs an operator to tie the film to the load before wrapping begins and to cut the film after wrapping is complete.
  - Fully automatic stretchwrapping systems attach and cut the film without human intervention.
  - The best stretchwrap solution depends on two important factors: stability of the load and the need for throughput.
 - The machines can wrapping from 40 to 120 loads per hour.

- Stretch hooding
  - With this method, the unitizing equipment stretches a hood or bag over a load, which then contracts back to its original size once in place.
  - In this process, however, an over-sized bag is placed over the load then heated to shrink around the load. Heat can be applied to the load manually with a heat gun or the load can move by conveyor through a heat tunnel to shrink the material.

Transfer   Crimp, seal and cut   Stretch   Wrap   Release

With courtesy of Beumer, Germany
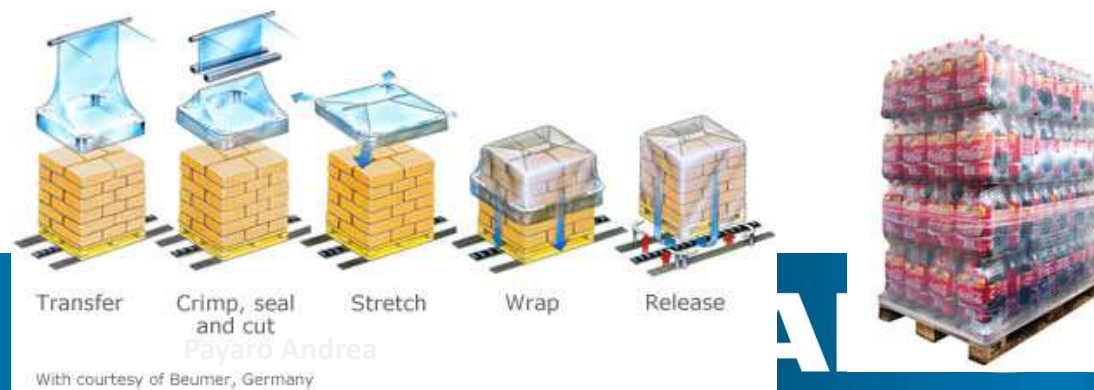
- Strapping

  – Strapping is a good option for a variety of products where surface protection is not the primary concern

  – Strapping materials include steel and plastic, with plastic having a number of benefits. Plastic strapping has excellent elongation and recovery characteristics, stays tight and absorbs impacts without breaking.

a
b
c
d
e

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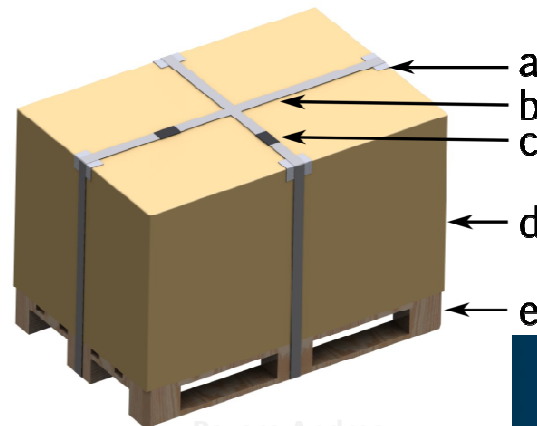
- Cornerboard
  - As its name implies, cornerboard can protect product corners by adding a strong, hard edge to the load. It also serves to support the load, add stacking strength and improve load stability during transit
  - Cornerboards can be a good option any time you have layers of small boxes that when stacked are not stable.
  - At the same time, cornerboards provide significant benefits when shipping lumber, plastics, metal, furniture, appliances and other products that need edge protection from strapping that secures the unit or simply from transit induced damages.

ATLOG

Shipping

- This is the final activity in a warehouse

- Put the packed product in the proper area
- Prepare the shipping documents
- Take the product and load it on the truck

Top Mistakes

- In the warehouse management we can identify some mistakes that can compromise the operations performance .

- These mistakes are classifiable in:

  - Mental mapping

  - Procedures

  - Responsibility

  - Order

  - Measure

  - People

Mental mapping

- The product's locations are in the mind of people.

- When a warehouse is managed with the memory method, it is possible to forget the position of product.

- The risk are the obsolescence of goods or the loss of materials.

AILOG

Procedures

- In the warehouse there aren't procedures to define the exact method to load or unload.

- Persons make the same thing in different manners. This is not quality and the no-quality is a cost.

- Moreover, in this situation is very difficult to guarantee good performances

Responsability

- Everybody enter in the warehouse and pick the goods.

- Persons that belong to Sales, quality, research and development pick the product from the shelf in the warehouse and they don't update the inventory.

- When the warehouseman find a damaged product, he throws away without update the warehouse management system.

Order

- The order is a safety problem
- We have got problem with the order when
  - The ware is not on shelf or on a rack
  - The ware is out of the proper areas
  - The warehouse is dirty
  - Information are not clear
  - The goods are not stored in proper manner

AILOG

Order

Clothes

Lighting systems

Fastening systems

Measure

- In the warehouse we don't measure the performance.

- "*Power is nothing without control*" the well known slogan of Pirelli Tyre.

- Which are the metrics?

KPI

- **Average inventory level**: As the name implies, this is the average inventory levels maintained in the system. Your goal is to reduce this without negatively impacting the other metrics.

- **Line item fill rate**: This is the total number of line items filled divided by the total number of line items. This metric applies to products or orders that contain multiple products. Again, you want this as high as possible without sacrificing average inventory levels.

- **Order fill rate**: This is the number of orders filled on time divided by the total number of orders during a time period. You want this to be as close to 100 percent as possible. Order fill rate and average inventory levels can be conflicting. Trying to maintain a high fill rate typically means maintaining more inventory.

KPI

- **Service level**: This represents the likelihood of having available stock in a replenishment cycle. You use the service level to calculate the safety stock in the inventory models. You usually set this value based on your customer expectations.

- **Turnover ratio**: This ratio tells you whether average inventory levels are in line with sales. Calculate turnover by dividing annual sales by average inventory level. You typically want this number to be large. For example, a ratio of 5 means that your sales are 5 times greater than your average inventory levels. In this case, many operations managers say they're carrying 5 turns of inventory.
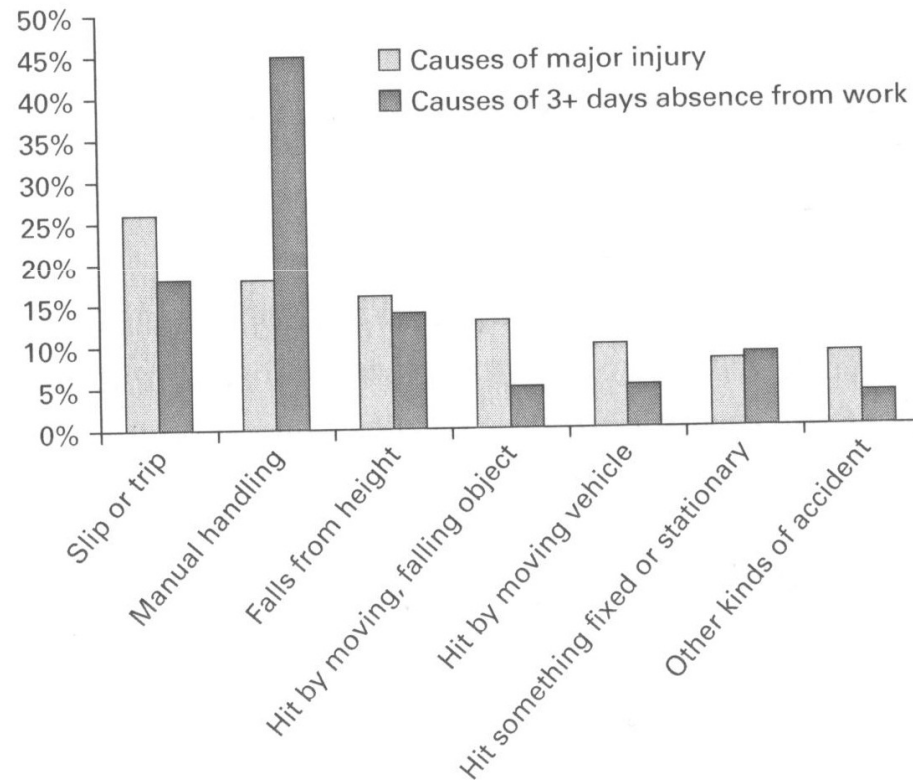
Lead time

- The **lead time** of an object through a system is the interval between the time it enters the system and the time it leaves it.

- **Order fulfillment lead time** is defined as the interval between the placement of the order and receipt of the goods by the customer.

People

- Unused Employee Creativity is a mistake
- Losing time, ideas, skills, improvements, and learning opportunities by not engaging or listening to your employees
- This would be the inability to fully utilize the knowledge and skills of your employees.
- The whole intention is to create an environment where the people want to take ownership of their equipment.
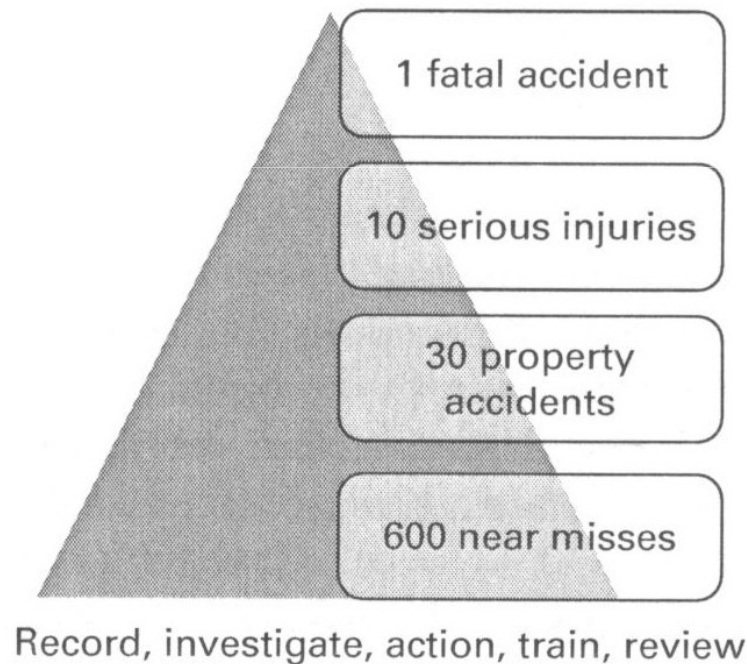- A healthy employee is a more productive worker.

Safety and warehouse

FIGURE 15.1 Main causes of injuries in the warehouse (www.HSE.gov.uk)

The Accident Pyramid

**FIGURE 15.2** The accident pyramid (adapted from Bird and Germain 1996)

1 fatal accident

10 serious injuries

30 property accidents

600 near misses

Record, investigate, action, train, review

Material handling

- Material handling is the transport or the support of goods done by one or more persons

- The operator must
  - Lift
  - lay
  - Push   a weight
  - pull
  - lead
  - move

These activities can be a risk for the health of the operator (muscular or skeletal diseases)

Manual handling of loads (MHL)

- Attention to
  - Loads with instable equilibrium
  - Physical efforts
  - Loads very weight, cumbersome or bulky
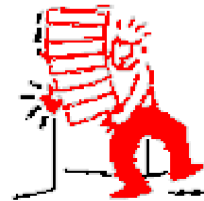
Push or pull ?

Ergonomics — Manual handling
Part 2: **Pushing and pulling**

Snook S.H. and Ciriello V.M.

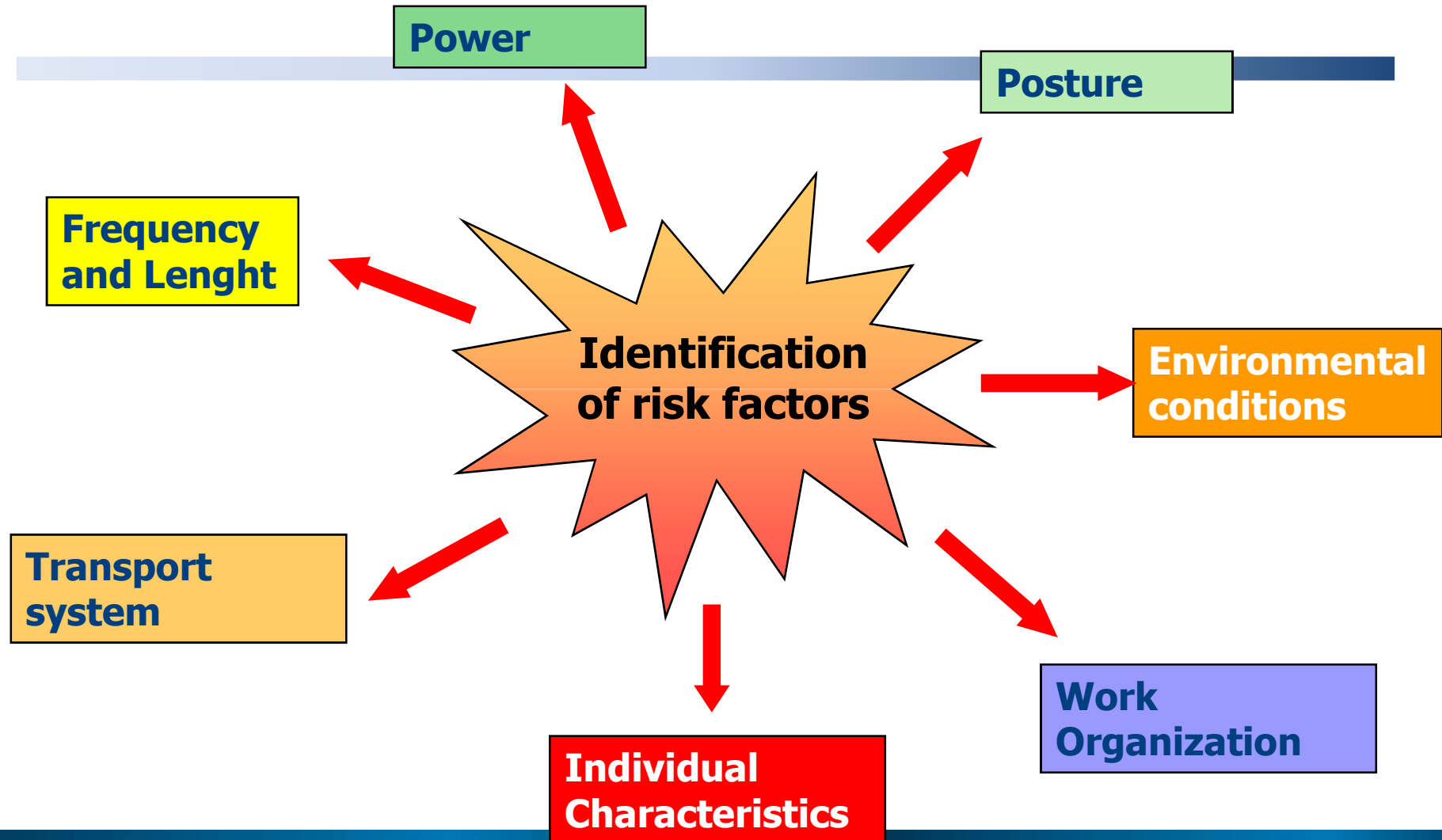*The design of manual handling tasks: revised tables of maximum acceptable weights and forces.*

Ergonomics 1991, vol 34, no. 9, 1197-1213

PUSHING IS PREFERABLE

Risk factors

Power

Posture

Frequency and Lenght

Identification of risk factors

Environmental conditions

Transport system

Individual Characteristics

Work Organization

- The uncomfortable positions cause the reduction of power.

- The man must adopt a "natural" position at the beginning or during the movement

- You have to avoid impulsive movements, they increase the tiring out

- You have to limit all the movements that require either repetitive twistings or flexures

Posture
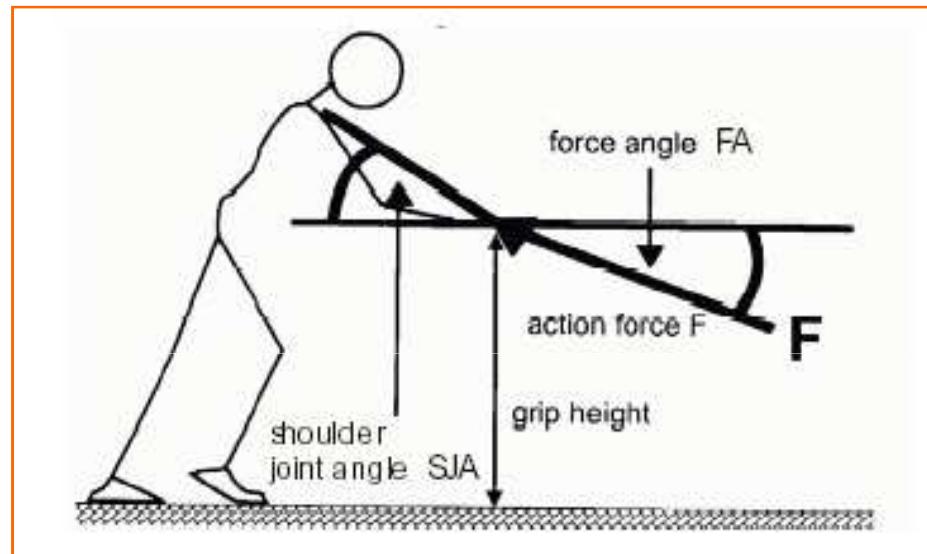
Check:

- ✓ Hands position (not too high and not too near)
- ✓ Elbows bent.

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Some tools can reduce the risk of overload

Manual forklift
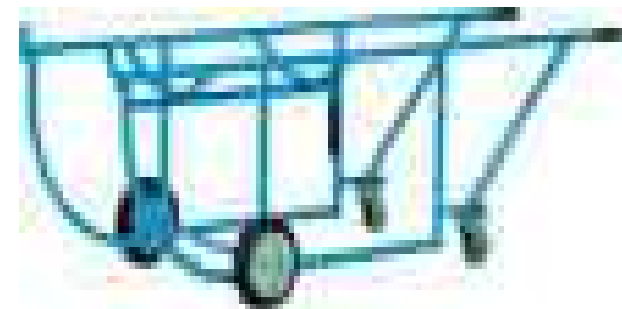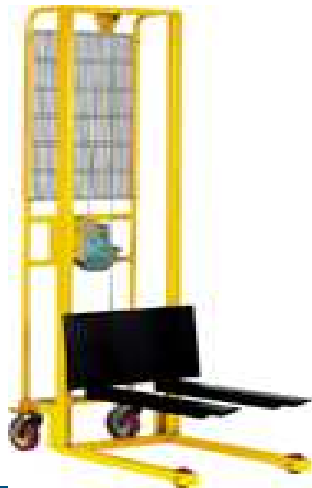
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AILOG

Reduce the risks

Reduce the risks

Ergonomics

The lift of a weight od 20 Kg cause a compression on your back of 300 Kg.

When the load is far from your body, the compression becomes of 650 Kg.

NO

Yes

ATTIVITA' DI SOLLEVAMENTO

VALORI DI RIFERIMENTO - ISO 11228-1

4.3.1 Manual lifting
An initial screening of non-repetitive manual lifting in ideal conditions requires the determination of the object's mass (step 1).
The recommended limit for the mass of the object is presented in Annex C.

Table C.1 — Reference mass (m_{ref}) for different populations

Field of application	m_{ref} kg	Percentage of user population protected			Population group	
		F and M[a]	F	M		
Non-occupational use	5	Data not available			Children and the elderly	Total population
	10	99	99	99	General domestic population	
Professional use	15 20 23	95	90	99	General working population, including the young and old	General working population
	25	85	70	95	Adult working population	
	30 35 40	See NOTE			Specialized working population	Specialized working population under special circumstances

NOTE   Special circumstances. While every effort should be made to avoid manual-handling activities or reduce the risks to the lowest possible levels, there may be exceptional circumstances where the reference mass may exceed 25 kg (e.g. where technological developments or interventions are not sufficiently advanced). In these exceptional circumstances, increased attention and consideration must be given to the education and training of the individual (e.g. specialized knowledge concerning risk identification and risk reduction), the working conditions which prevail and the capabilities of the individual.

[a]   F: Female, M: Male

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LIFTING ACTIONS

REFERENCE MASS - EN 1005-2

Table 1 — Reference mass (M_{ref}) taking into consideration the intended user population

Field of application	M_{ref} [kg]	Percentage of			Population group	
		F and M	F_{emales}	M_{ales}		
Domestic use[a]	5	Data not available			Children and the elderly	Total population
	10	99	99	99	General domestic population	
Professional use (general)[b]	15	95	90	99	General working population, including the young and old	General working population
	25	85	70	90	Adult working population	
Professional use (exceptional)[c]	30 35 40	Data not available			Special working population	Special working population

[a] When designing a machine for domestic use, 10 kg should be used as a general reference mass in the risk assessment. If children and elderly are included in the intended user population, the reference mass should be lowered to 5 kg.

[b] When designing a machine for professional use, a reference mass of 25 kg should not be exceeded in general.

[c] While every effort should be made to avoid manual handling activities or reduce the risks to the lowest possible level, there may be exceptional circumstances where the reference mass might exceed 25 kg (e.g. where technological developments or interventions are not sufficiently advanced). Under these special conditions other measures have to be taken to control the risk according to EN 614-1 (e.g. technical aids, instructions and / or special training for the intended operator group).
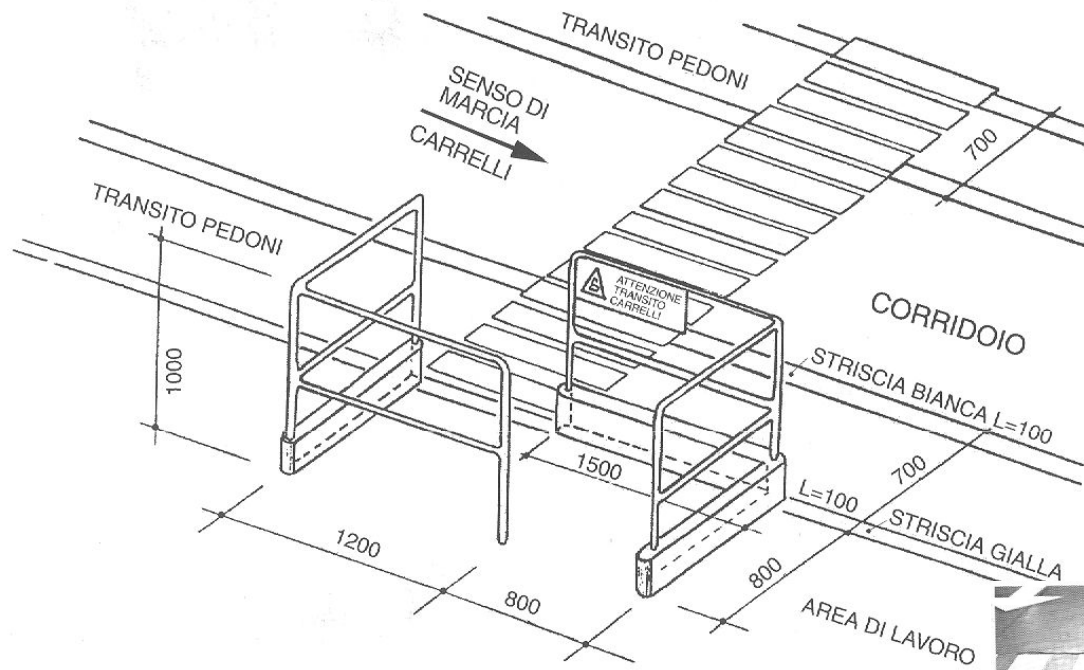
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The NIOSH Lifting Equation

- The NIOSH Lifting Equation is a method to assess risk of low-back disorders in jobs with repeated lifting.

- The RWL is defined for a specific set of task conditions as the weight of the load that nearly all healthy workers could perform over a substantial period of time (e.g. up to 8 hours) without an increased risk of developing lifting-related low back pain.

- **Recommended Weight Limit (RWL) = LC x H x V x D x A x F x C**
  - LC = Load Constant = 23 kg
  - The weight of the object being lifted/lowered (H)
  - Height of the hands at both the start and end of the lift/lower. (V)
  - The vertical travel distance of the hands from the start to the end of the lift. (D)
  - The horizontal distance of hands on the load from the mid-point between the ankles at the start and end of lift. (H)
  - Angular location of the load relative to a line 'sticking out' from the worker's navel, if the worker was standing in a neutral posture. (A)
  - Frequency of lifts (average number of lifts per minute and total duration of lifting). (F)
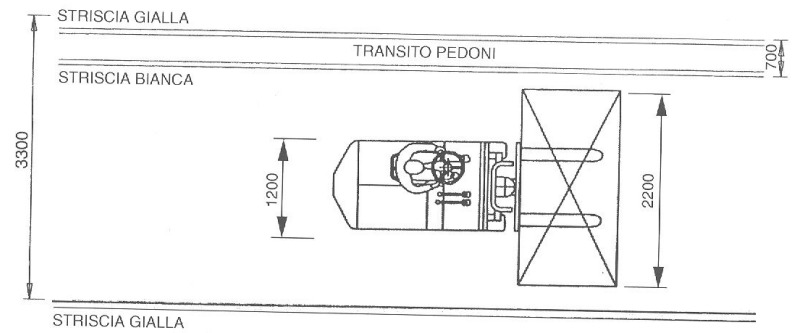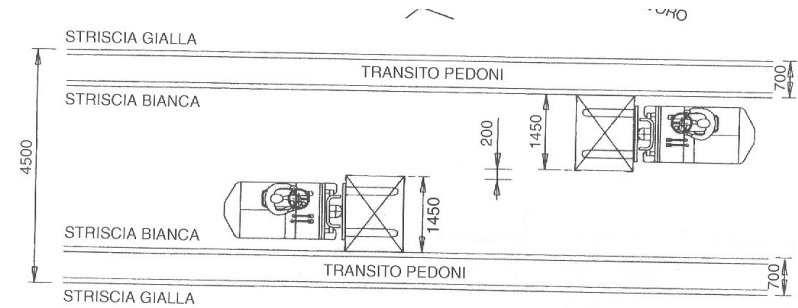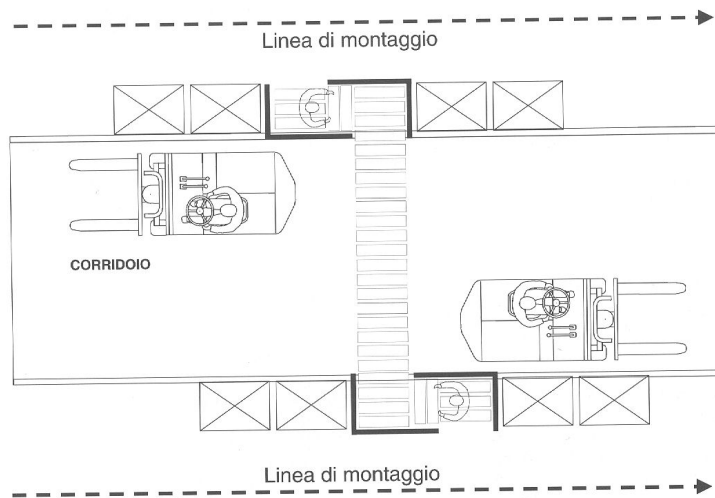 - How well the load can be grasped (based on presence and type of handles). (C)

Lifting index

- Lifting index (LI) is the ratio of the actual load weight and the recommended weight limit.

- LI = L / RWL

- LI values >1 indicate increased risk.

Crossing

Aisles

STRISCIA GIALLA
TRANSITO PEDONI
STRISCIA BIANCA
4500
STRISCIA BIANCA
1450
1450
200
700
700
TRANSITO PEDONI
STRISCIA GIALLA

STRISCIA GIALLA
TRANSITO PEDONI
STRISCIA BIANCA
3300
1200
2200
700
STRISCIA GIALLA

Linea di montaggio
CORRIDOIO
Linea di montaggio

Don't do

- Climb onto the racks
- Use the forklift like a lift
- Tamper with the structures dedicated to the storage of the ware
- Lift or move down loads with persons near the forklift
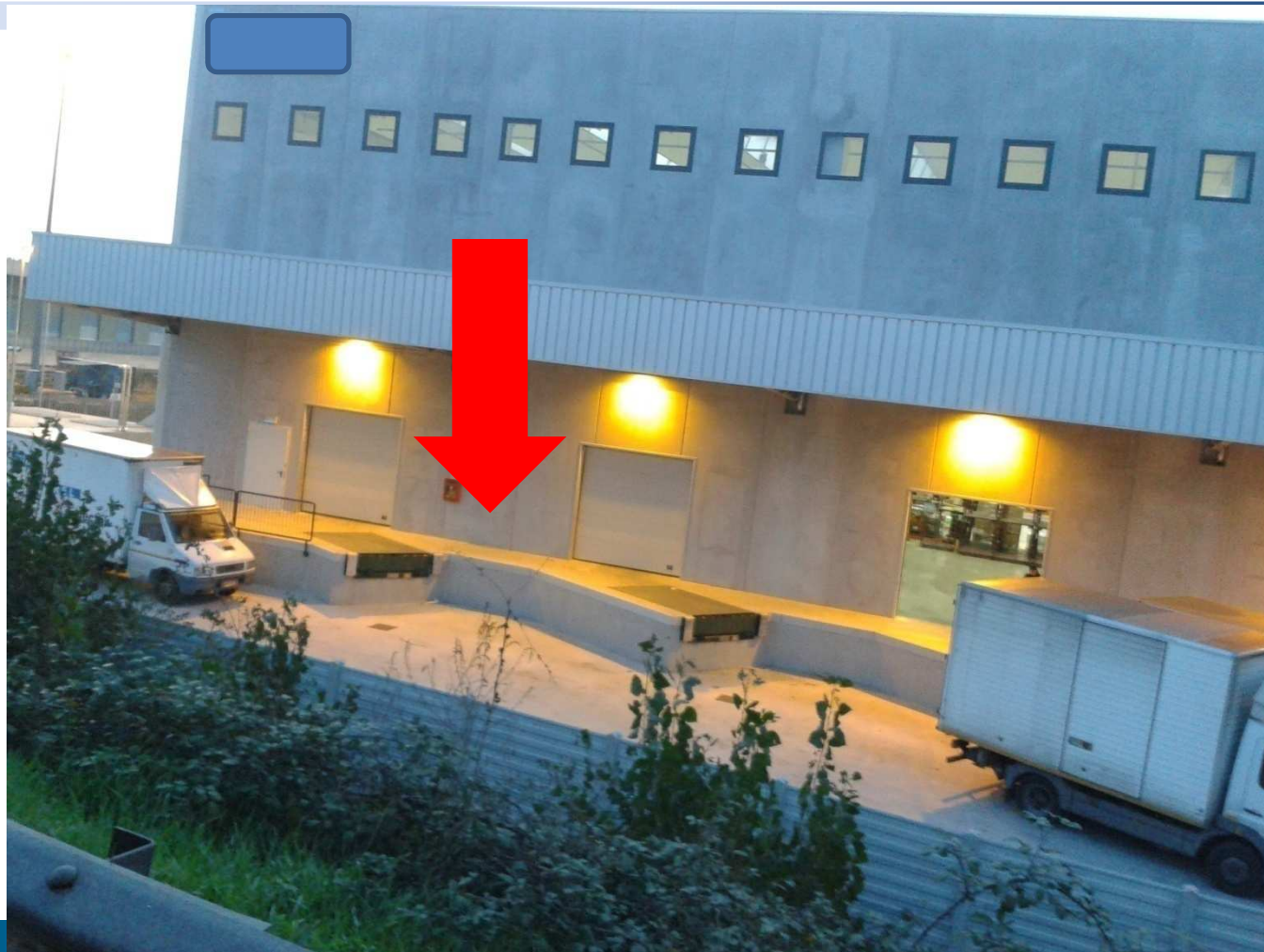- Lift or move down unsteady loads

Breaking

Parapets

Steady loads

Vertical Picking

PRELIEVO VERTICALE
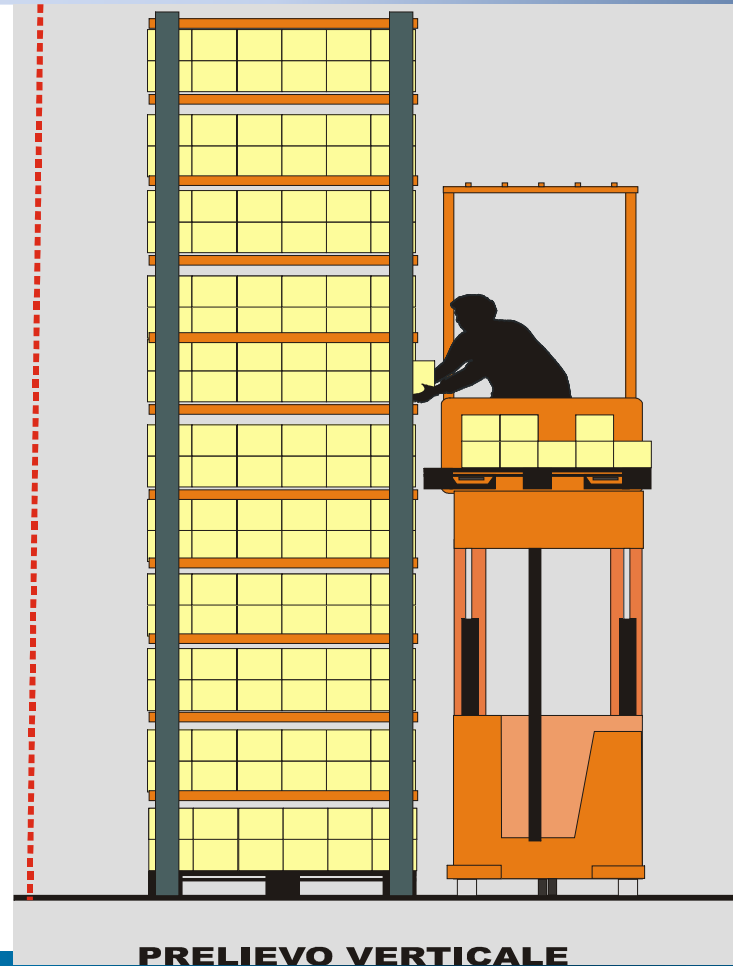
Visibility

Storage

Picking

Thank you!

Today we live the choices made in the past.

Now we can choose how to live in the future.

Payaro, 2014. Help! How defend yourself from marketing and its strategies. Aras Ed.

Andrea Payaro

andrea@payaro.it

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