



دفتر :

ادارة سلاسل التوريد Supply Chain الأسبوع 1-5

لين حيدر د.عبدالله علاوين

إعداد

اللجنة الأكاديمية لقسم الهندسة الصناعية

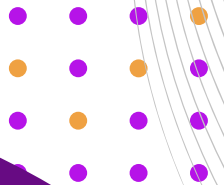
2025



Turbo IEG.Com



Turbo Team Youtube



Supply chain management

Network
Flow of Materials
and information

controlling
organizing
leading
planning

Introduction

Supply & Demand

Operations &
Supply Chains

Sales & Marketing

Supply > Demand

Supply < Demand

Supply = Demand

Wasteful
Costly

Opportunity Loss
Customer
Dissatisfaction

Ideal

Supply > Demand

Supply < Demand

Supply = Demand

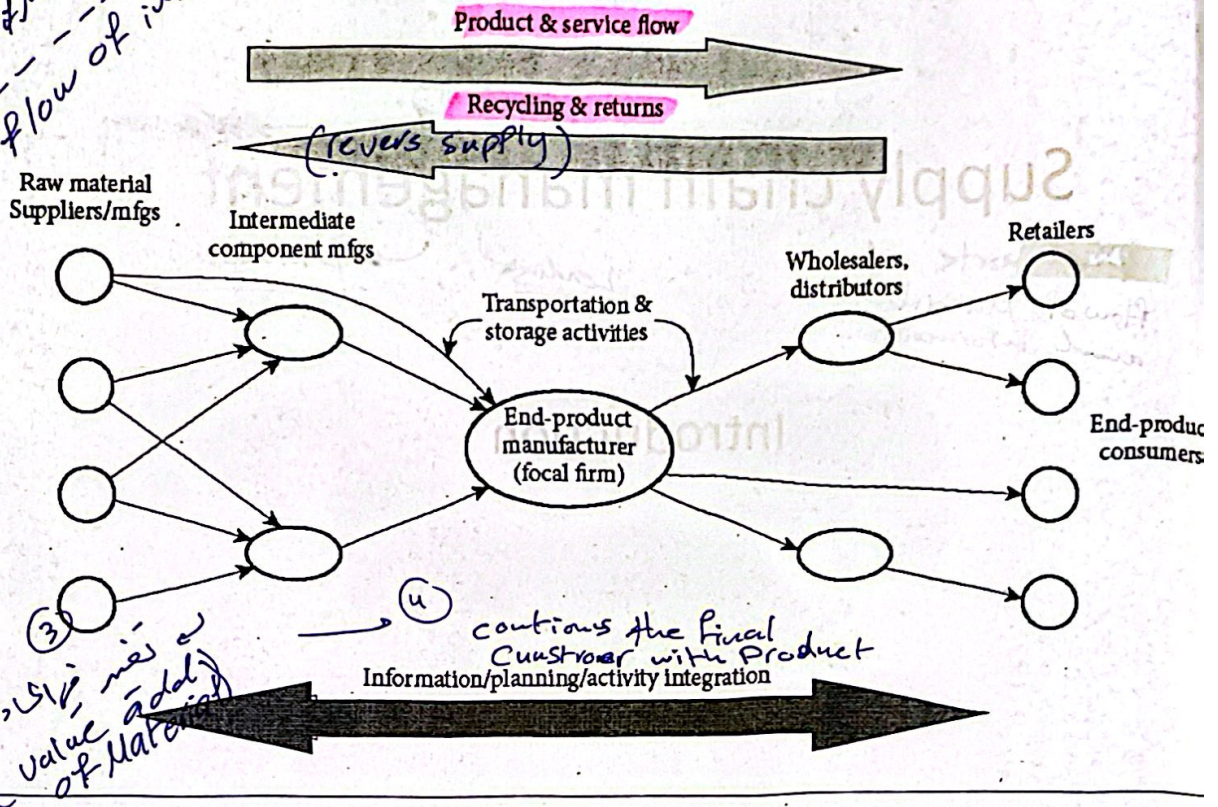
Waste
Cost

Opportunity
Loss

Ideal

What is a Supply Chain?

Flow of Material
Flow of information



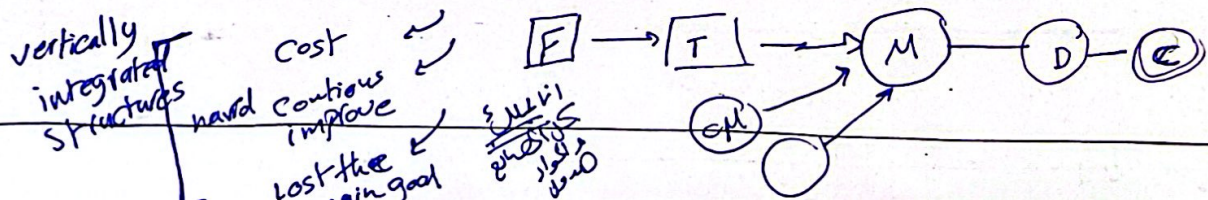
What is a Supply Chain?

A supply chain consists of the flow of products and services from:

- Raw materials manufacturers
- Component and intermediate manufacturers
- Final product manufacturers
- Wholesalers and distributors and
- Retailers

Connected by transportation and storage activities, and Integrated through information, planning, and integration activities

- Many large firms are moving away from in-house Vertically Integrated structures to Supply Chain Management —



What is supply chain ^{high qe with} ^{Low Cost} management?

controlling
planning

- The *supply chain* is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer
- *Supply chain management* (SCM) is the management across and within a network of upstream and downstream organizations of both relationships and flows of material, information and resources
 - The purposes of SCM are to create value, enhance efficiency, and satisfy customers

What is logistics? 8 right

- Logistics involves getting
 - the right product,
 - in the right way,
 - in the right quantity and right quality,
 - in the right place at the right time,
 - for the right customer at the right cost
- Its not just 'trucks and sheds'
(Add. new) very common

Key flows in SCM

- Physical flows of materials
- Flows of information that ^{flow resource} ~~others~~ ^{money} ^{knowledge} inform the supply chain
- Resources (especially finance, but also others such as people and equipment) which help the supply chain to operate effectively
 - Furthermore, not all resources in the supply chain are tangible, for example good quality inter-company relationships are often cited as a highly important ingredient of effective supply chains

[study with 4 groups of people]

Distinguishing logistics and SCM

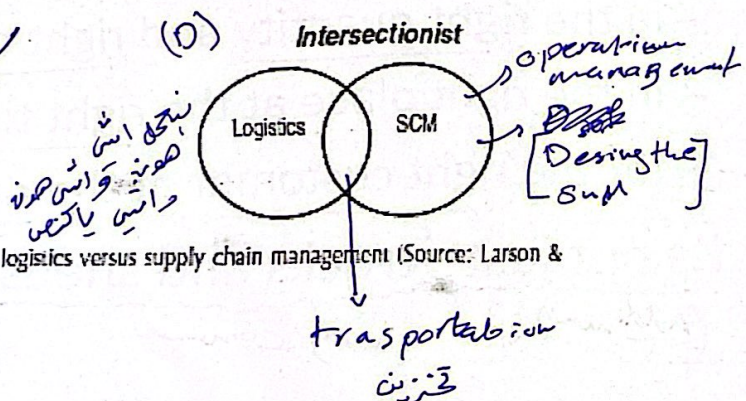
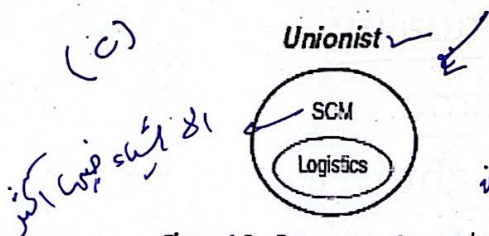
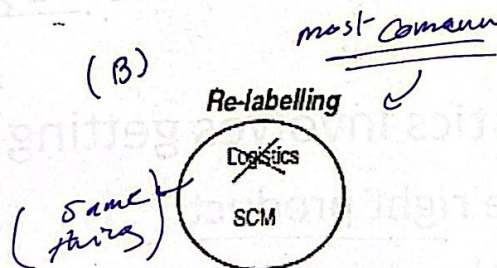
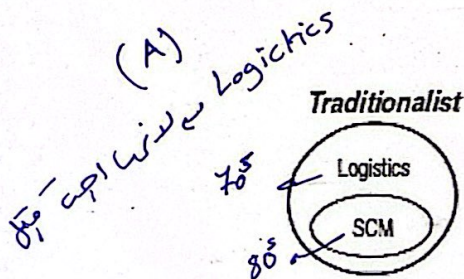


Figure 1.2 Four perspectives on logistics versus supply chain management (Source: Larson & Halldorsson, 2004)¹¹

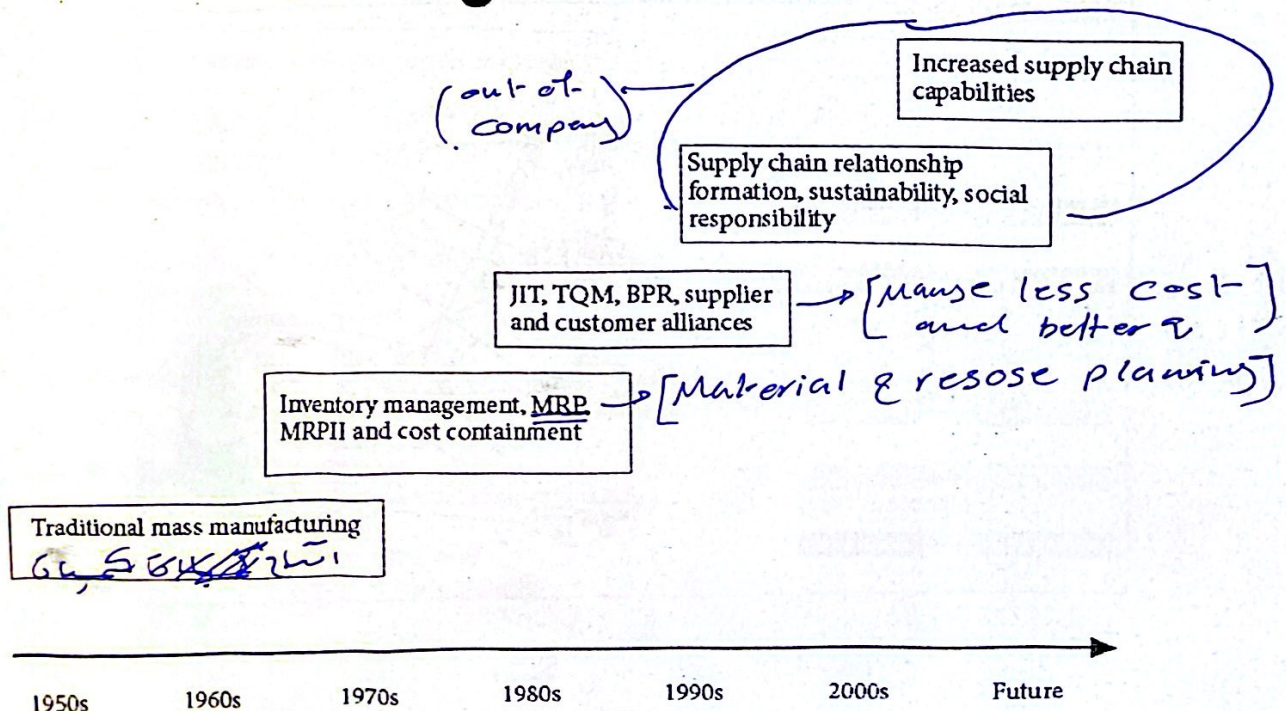
What is Supply Chain Management?

(continued)

- **Old paradigm** - Firm gained synergy as a vertically integrated firm encompassing the ownership and coordination of several supply chain activities. Organizational cultures emphasized short-term, company focused performance.
- **New paradigm** - Firm in a supply chain focuses activities in its area of specialization and enters into voluntary and trust-based relationships with supplier and customer firms.
 - All participants in the supply chain benefit. → (win-win-relation)
 - Boundaries are dynamic and extend from "the firm's suppliers' suppliers to its customers' customers (i.e., second tier suppliers and customers)." (dynamic boundaries) in supply chain
 - Supply chains also include reverse logistics activities to handle returned products, warranty repairs, and recycling.

Origins of Supply Chain Management

(continued)

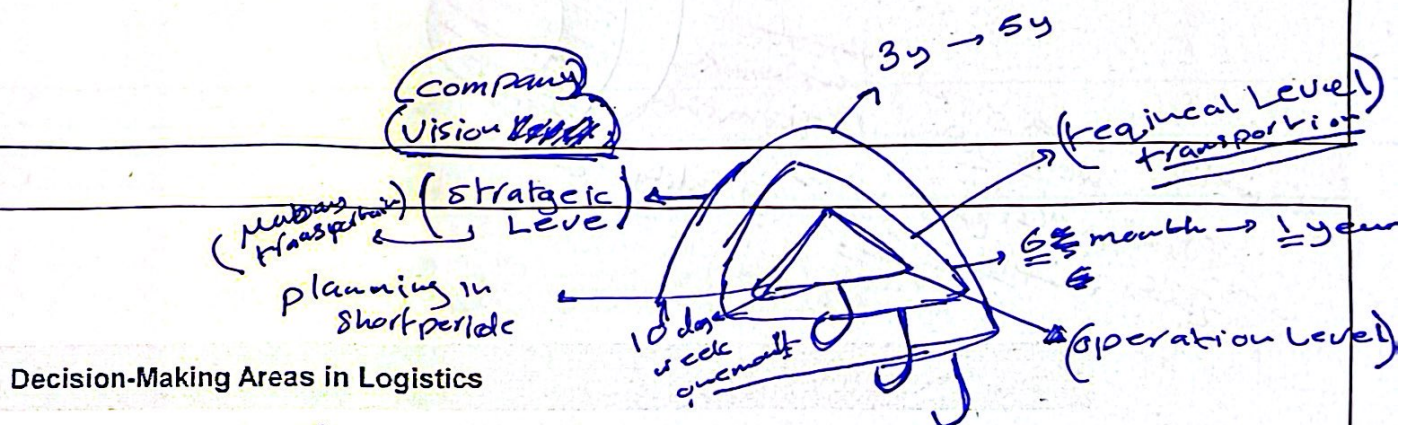


Logistics: A Better Definition

“Logistics is the process of strategically managing the procurement, movement and storage of materials, parts and finished inventory (and the related information flows) through the organisation and its marketing channels in such a way that current and future profitability are maximised through the cost-effective fulfilment of orders.”

parts & finished in
(operations)
two types of
a → materials
b → information

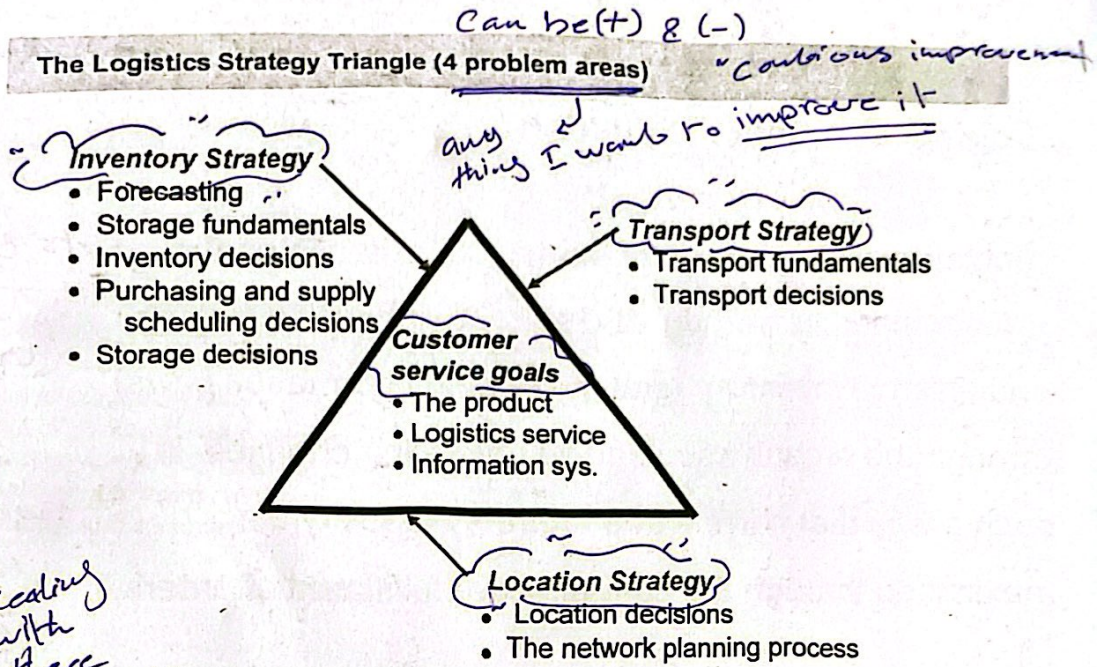
Source: Christopher, M. (2011), *Logistics & Supply Chain Management*, Fourth Edition, Pearson.



Decision-Making Areas in Logistics

Decision area	Strategic A3	Tactical A2	Operational A1
Transportation	Mode selection	Seasonal equipment leasing	Dispatching
Inventories	Location, Control policies	Safety stock levels	Order filling
Order processing	Order entry, transmittal, and processing system design		Processing orders, Filling back orders
Purchasing	Development of supplier-buyer relations	Contracting, Forward buying	Expediting
Warehousing	Handling equipment selection, Layout design	Space utilization	Order picking and restocking
Facility location	Number, size, and location of warehouses		

The Logistics Strategy Triangle (4 problem areas)



dealing with these problems

لـ تعريف الـ quality

product customer requirement



product specification

له اي area خارجيها تقاطع
مع
تقاطع المصنوع له و
ولـ متطلبات المنتج

Robust SCM

Robust SCM strategy enables a firm to manage regular fluctuations in demand efficiently under normal circumstances regardless of the occurrence of a major disruption

لـ قدره السلس على تحديد التغيير في الزمان

Resilience

قدرة النظام على العودة إلى حالته الأصلية بعد الاضطراب.

- Resilience – the ability of a system to return to its original (or desired) state after being disrupted
- Consideration of risk and resilience in SCM:
 - Encourages a whole system perspective
 - Explicitly accepts that disturbances happen
 - Implies adaptability to changing circumstances

Definition of reverse logistics

التدفق العكسي للمنتج من العميل إلى المورد
"المرتجعات"

- Reverse logistics can be defined as:
"The process of planning implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing or creating value or proper disposal"

Resilience
چشمه (resources)

A Service supply chain

- A service supply chain is the network of suppliers, service providers, consumers and other supporting units that performs the functions of transaction of resources required to produce services transformation of these resources into supporting and core services; and the delivery of these services to customers.

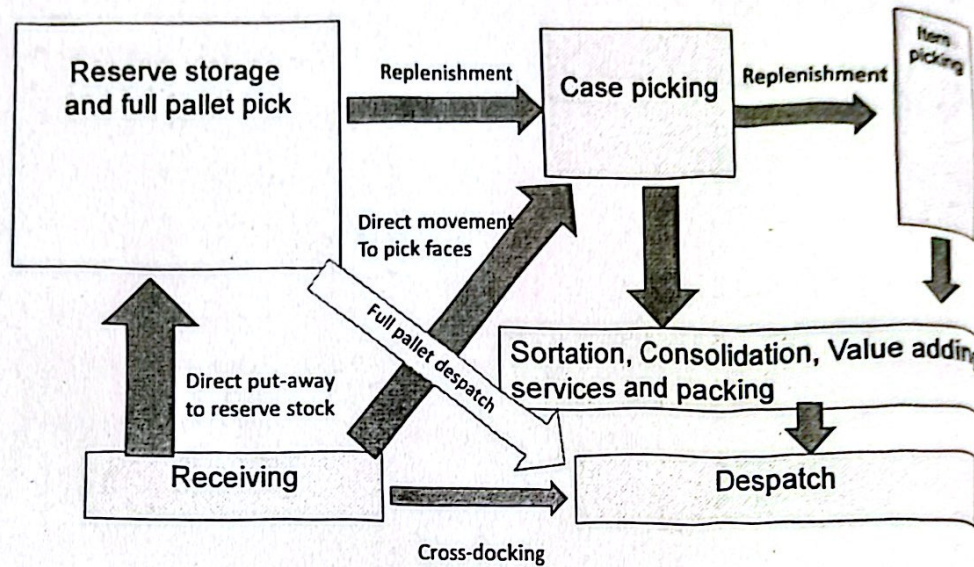
Storage and Warehousing Techniques



Warehouse Management, 3rd edition by Gwynne Richards
Published November 2017 (Kogan Page)

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Warehouse processes and flow



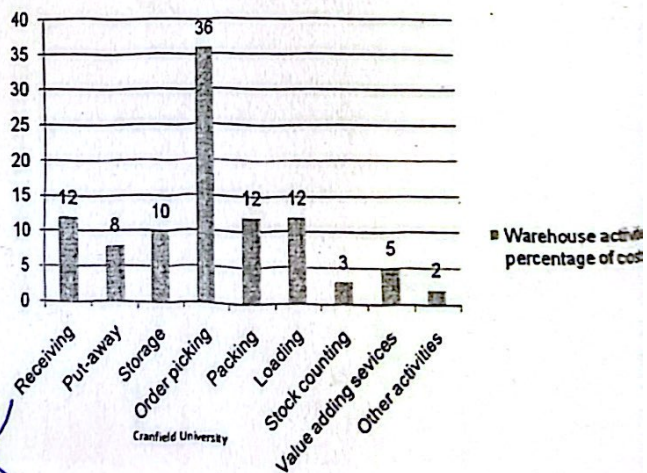
Adapted from Schmidt & Follert 2011

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→ what's happening in factor?

Warehouse functions

- Goods inward/receipt
- Inward sortation and Cross-docking
- Storage
- Replenishment
- Order picking
- Secondary sortation
- Collation
- Postponement
- Value adding services
- Despatch
- Housekeeping
- Stock counting
- Returns processing



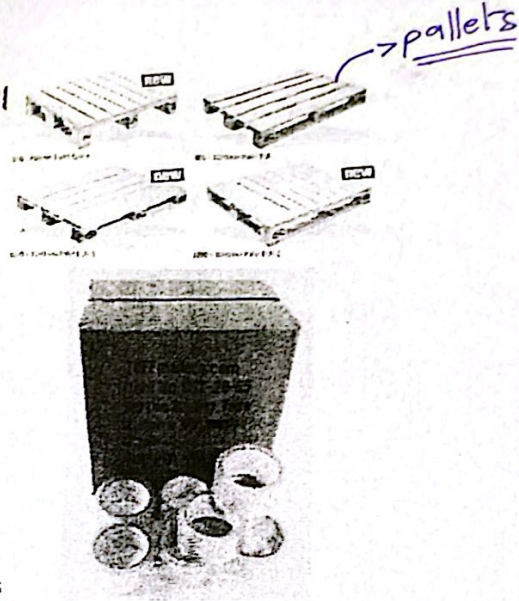
(pre-Receipt)

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Pre-receipt

(information required)

- Agree specifications with supplier
- Inform supplier of requirements re:
 - Size and type of delivery vehicle
 - Size and type of pallets
 - Size of cartons
 - Labelling requirements
 - Delivery documentation
 - Pre-notification
 - Delivery procedures
 - Unloading requirements
 - Role of the driver



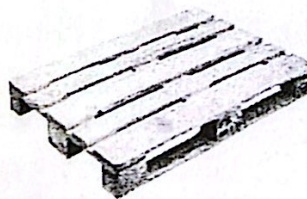
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Pallets

- Pallet rental companies
 - Charged on a pence per day basis
 - Pallets are normally in very good condition
 - Does require both suppliers and buyers to be part of the rental scheme
 - Removes requirement to collect pallets from customers



V



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Pallet Dimension (Continued...)

The following website provides a tool for calculating the pallet dimension and weight as well

<http://onpallet.com>

لے موقع لیاہہ غاٹہ
اعرفا (کلمہ)
حصولہ علیہما وغیرہ

- Open this website and play with the web page using different dimensions and weights.

Checking in Loads

- TiHi describes the arrangement of cases on a pallet.
- It stands for Timarandum Height or 'layers of' × height.
- 'Ti' means the number of boxes or cases in a pallet layer.
- 'Hi' means the number of layers high on a pallet.
- ❖ TiHi refers to the number of boxes/cartons stored on a layer, or tier, (the Ti) and the number of layers high that these will be stacked on the pallet (the Hi)

Checking in Loads

Example:

➤ A TiHi of 8×6 means 8 cases per layer; 6 layers high.

Ti and Hi →

$Ti \times Hi = \text{Pallet quantity}$

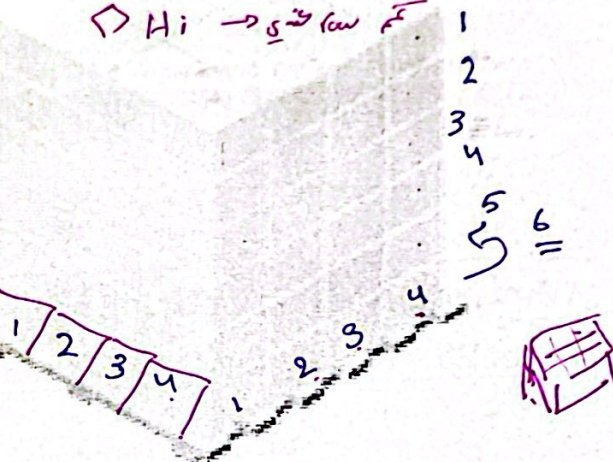
$TiHi = 8 \times 6$

$\text{Pallet quantity} = 48$

تیم واحد
بنا در این لوازم

$TiHi = \square \times \square$

TiHi
تیم واحد
بنا در این لوازم
Hi → تیم واحد



[TiHi → کتب، کراپین
معمده]

$TiHi = 8 \times 6$

$TiHi = 8 \times 4 \neq TiHi = 6 \times 8$

$\text{pallet quantity} = 48$

$TiHi = 8 \times 6$
 $\text{pallet quantity} = 48$

Checking in Loads

When pallets arrive, the TiHi must be the same as on the delivery note.

Imagine this:

Pallet A = 120 cases with a TiHi of 20 × 6 20 items in each row how many rows

Pallet B = 120 cases identical to those on pallet A, but with a TiHi of 6 × 20 6 items in each row

➤ Which TiHi gives the taller pallet? B

➤ Which TiHi gives the larger 'footprint'? A

➤ How many cases make this larger 'footprint'? 20

تیم واحد
بنا در این لوازم

Checking in Loads

Distribution centre D5 Warehouse 15

P.O. 384493282 DELIVERY NO. 77033

QUANTITIES OUTSTANDING: Nothing to report

CODE	PROD	QTY	TIHI
029550003040	NC Marinades - BBQ	120	Ti x hi = 20 x 6
029550003084	NC Marinades - Frch	120	Ti x hi = 20 x 6
029550003728	NC Marinades - Ital	120	Ti x hi = 20 x 6

3 products →

quantity

W L

What problems might occur if a tihi of 6 x 20 is accepted when a tihi of 20 x 6 is on the delivery sheet?

Receiving → The right quantity by ~~by~~ (TiHi)

- Allocate the supplier a time for delivery
- Estimate time to unload, check and put-away
- Allocate sufficient labour and MHE for unloading
- Check if load requires special handling
- Check for any special handling instructions (Hazardous, fragility etc)
- Unload and check quantities and quality of delivery
- Record variances
- Check status of goods
- Label or ID tag
- Record quantities
- Clear dock area and ensure goods are on system and available to pick – dock to stock time is crucial!
- Locate - Quarantine, cross dock, pick face, reserve storage



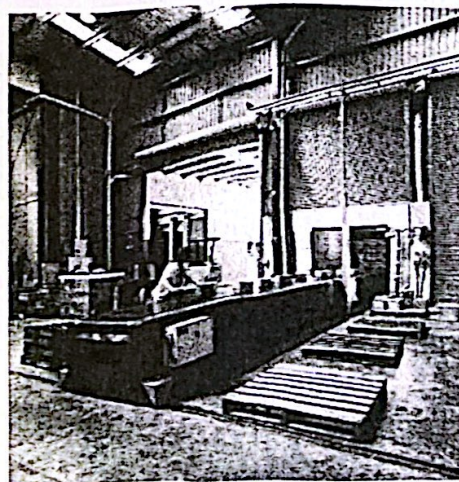
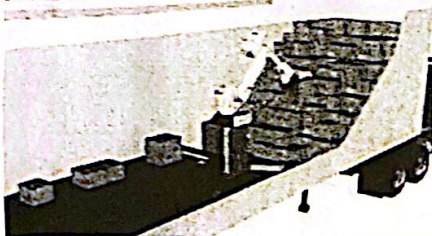
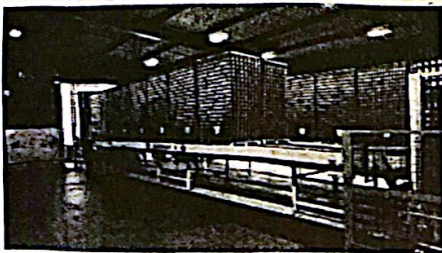
Booking in sheet

DOOR One

Time slot	Supplier	Units	Unit type	Time estimate	Eqpt	Actual time	Comments
0700	ARCO	24	Pallets	45 mins	PPT	40 mins	Vehicle was 2 hours late
0750	TCO Deli	10	Parcels	10 mins		10 mins	Urgent delivery
0805	SBH Ltd	12	Pallets	24 mins	PPT	25 mins	
0835	Delta Ltd	24	Pallets	45 mins	PPT	45 mins	
0925	Argo.com	1000	cases	3 hours x 3 staff	FLT	2hrs 50 mins x 3	Container

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In-handling equipment



(Ramp) (Ramp)

Dock Equipment

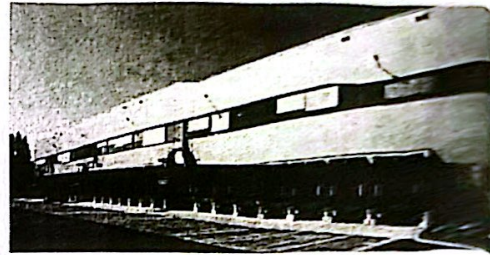
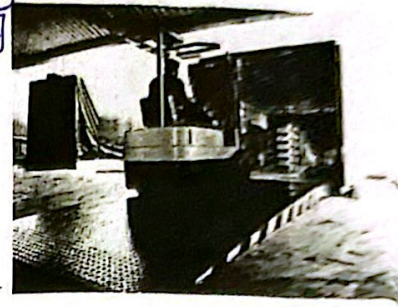
Dock Levelers

- Hydraulic
- Air Bag
- Mechanical
- Power Assisted

- Bumper Pads
- Dock Shelters
- Dock Lights
- Safety lights/warnings
- Operating procedures
- Signage in different languages



يلجى يرفع ويترك
عشاة حديد
الشاحنة مع
المسودع



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[Labelling and Put-away]

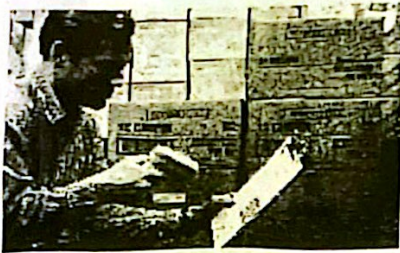
- Ensure supplier has labelled products correctly
- Produce own labels although not as efficient
- Scan labels
- System determined put-away
- Location allocation by system or manual
- Take into account size, weight, velocity, compatibility
- Quarantine areas
- Fixed or random locations?
- Check stock rotation policy
- Consolidate stock if FIFO rules allow
- Record stock against the location
- Task interleaving or dual cycling – put-away and retrieve in same movement

(first in first out)
بغضن لبقاعة الادوات
اول

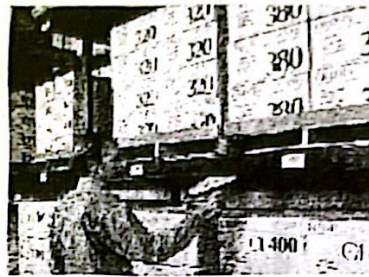
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Inbound and put away processes

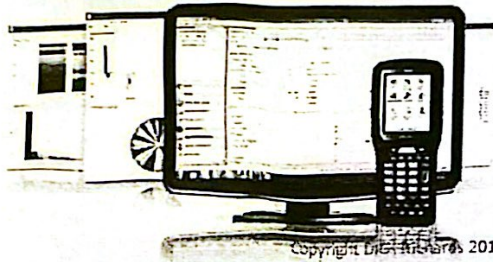
Labeling & Put away



Inbound check



Location verification and put-away



WMS (Warehouse Management System)

لە هەون، لایفایە قەتەن ب مەن بەرێجە عەنی کە مەاعەلەب
[input system]

Fixed v Random storage

(فەینا خەتەر)
الکۆمە

(جەتەر اکبەر اقەمە عەنی)
Fixed locations total = 453 (p.u.)

Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
K1	100	155	100	140	100	120	120	100	100	120	150	150
K2	50	20	51	30	30	30	40	50	50	40	40	50
K3	10	5	12	17	10	10	5	10	10	5	5	10
K4	90	80	80	75	75	75	80	80	95	90	80	90
K5	40	40	50	50	135	130	130	130	50	40	40	40
SUM	290	300	293	312	350	365	375	370	305	295	315	340

155
51

Random locations

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مشکلات
انۆ مەعەلەب
او لایفایە
عەنی
الکۆمە
الکۆمە

but

لە یەکێتی اقەمە اقەمە
عەنی
الکۆمە

The importance of Unit Loads

Used by manufacturers, retailers and service providers, unit loads are key cost drivers. They impact on transport, storage, handling and packaging, which together represent 12-15% of the retail sales price.



Developing more Efficient Unit Loads is critical to the success of Efficient Consumer Response and is estimated to save 1.2% of the retail sales price.

E.g. Prescribed length and width is seen as a must by manufacturers and retailers, with the 600x400 master module accepted as the basis in Europe for 1200 x 800mm pallets.

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Order Picking Methods

Paper pick lists

Pick by label

Pick by voice

https://www.youtube.com/watch?v=yy53EMEmx_c <https://www.youtube.com/watch?v=BcbhbGRXZRE>

Barcode scanning

<https://www.youtube.com/watch?v=CJW5D5SDAgw>

<https://www.youtube.com/watch?v=Xe7UaH20n7A> https://www.youtube.com/watch?v=86ttdeSB9_g

Radio Frequency identification

<https://www.youtube.com/watch?v=gEQJxNDSKAE>

Pick By light /Pick to light

<https://www.youtube.com/watch?v=tPIQpKi-Ko>

Frage: بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

$(\begin{matrix} ||| & || & || & || \\ 2 & 3 & 4 & 5 \\ & & 6 & 5 \\ & & & 7 & 7 & 8 \end{matrix}) \rightarrow \text{Amazon Share}$

passive technology

(transportant)

(On tracking animals or hospitals)

Step 4

Location I.D.

- 4 E 14 C 1 or
- 04.05.14.03.01

Where

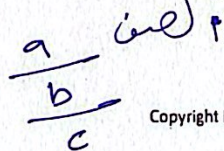
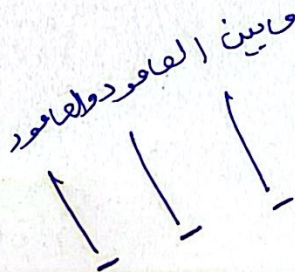
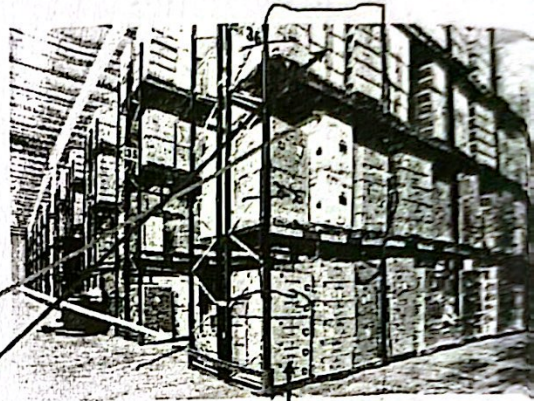
4 (04) = zone

E (05) = Aisle

14 = Bay

B (03) = Level

1(01) = Pallet, Shelf or bin position



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Picking systems

- Picking is paramount to any warehouse operation
 - It is the most labour intensive
 - It is fundamental to customer service
 - There are often extensive floor space requirements
 - There may be limited scope for automation

On average up to 65% of the warehouse operating expenses can be attributed to the Picking function.

On average travel time accounts for 50% of the total picking time (Petersen C.G. 2002).

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ABC/Pareto Analysis

1000 items

A: مهم
B: نصف
C: غير مهم

Ranking (by frequency)	Order frequency in period	Cumulative frequency	Cumulative % of total frequency	Cumulative % of number of stock lines	Category
1	300	300	30	5	A
2	225	525	52.5	10	A
3	150	675	67.5	15	A
4*	125*	800*	80	20	A
5	40	840	84	25	B
6	30	870	87	30	B
7	25	895	89.5	35	B
8	25	920	92	40	B
9	15	935	93.5	45	B
10	15	950	95	50	B
11	10	960	96	55	C
12	8	968	96.8	60	C
13	6	974	97.4	65	C
14	5	979	97.9	70	C
15	5	984	98.4	75	C
16	4	988	98.8	80	C
17	4	992	99.2	85	C
18	3	995	99.5	90	C
19	3	998	99.8	95	C
20	2	1,000	100	100	C

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له ممكن ان يكون تصنيف

[AA → item]
[AB → item]

له معايير التصنيف ه قوه
ه تحركات
ه الاستهلاك
ه سكرين ايبين
ه صيحات

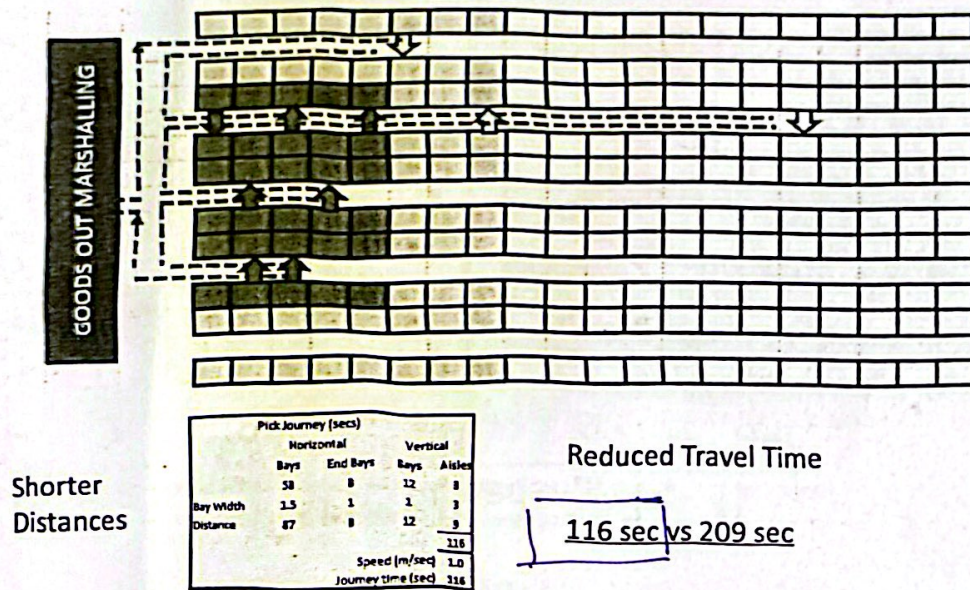
Why is ABC Analysis Important?

GOODS OUT MARSHALLING

Take an example:

200 full pallet, ground floor pick positions
5 aisles

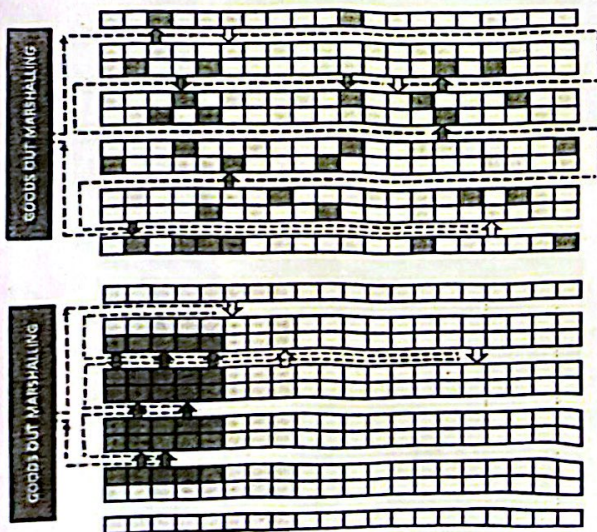
Why is ABC Important?



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(purpose) ABC method *(reducing the travel time)*

% Benefit



	Slotting	Non Slotting
Journey Time	116	209
Pick Time (10 items @ 7.5 sec)	75	75
Start & End	70	70
Total	<u>261</u>	<u>344</u>

24%
Reduction

Courtesy of



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The human factor → Factor

- Safety first
- Ergonomic design of storage system and equipment
- Light loads (max 25 kgs men, 15 kgs women)
- Adequate lighting
- Comfortable temperature
- Clear instructions ✓
- Clear labelling ✓
- Adequate breaks
- Good communication with team
- Good supervision

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Replenishment

→ restock the goods

When using pick or forward locations

- Replenishment is the replacement of goods picked from the forward locations
- Goods are transferred from bulk or reserve locations
- This can be done overnight, at the beginning or end of a shift or during the picking process depending on the urgency – however try not to replenish at the same time as you are picking
- Ensure sufficient items in pick location for duration of shift if possible

- Biggest error is to have an empty pick location



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Value Adding Services

- Labelling
- Kitting
- Sub-assembly
- Testing
- Packing
- Shrinkwrapping
- Tagging
- Kimballing
- Promotional work (e.g. BOGOF)
- Gift wrapping
- Call centre support

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Despatch



- Random quality checks on exit depending on product value
- Pack products securely and safely
- Weigh product as an alternative to physical count
- Recording of batch numbers, serial numbers etc.
- Load manifest compilation
- Loading in sequence
- Load optimisation (e.g. Cubiscan)
- Smooth the flow of despatches
- Vehicle sealed and recorded

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Housekeeping/Supervision

If you have a large warehouse you may have separate teams for the following:

- Provision, allocation and maintenance of equipment
- Replenishment of fast moving items
- Dealing promptly with non-conforming, lost or found stock
- Security of high value or hazardous stock
- Identification of non-moving stock
- Ensuring efficient space utilisation
- Work flow and congestion
- Cleanliness of warehouse
- Review of procedures

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Minimising Theft

→ RFID on pallets

- Staff training and awareness
- Use of CCTV
- Use of lockable cages or Carousels for high value goods
- Parking of cars away from the warehouse
- Random searches
- Regular cycle counts
- Staff vigilance
 - Especially in dark, less accessible areas of the warehouse. These are prime areas from which product will disappear. Same goes for inventory near exit doors. Staging areas for both incoming and outgoing shipments may be too close to the dock doors. If no one is around to keep an eye out, it would be easy to take something and put it in a truck.
- Conduct security surveys/audits (Independent)
- Use security tags for vehicles leaving the warehouse

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Stock counting

- Perpetual inventory or cycle counting
 - Use ABC analysis to determine how many and how often you count which items of stock e.g. 8% of A, 4% of B and 2% of C items
- Monthly, quarterly, annual stock checks
 - Depends on what you agree with your auditors



N.B. You need to be organised:

Who's counting, are they trained and motivated, what are you counting, when do you count, what tools do you need.

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Stock turn →

و قد يشترط البضاعة بتقلبها
لأنه يعني البضاعة
التي تذهب في
الوقت القصير
والتي تذهب
في وقت قصير

- How often stock turns over in a warehouse
- How to calculate:
 - Divide the total throughput of items by the average number of items in stock
- Or
- Divide the total cost of sales by the total average cost of goods stored at a particular time

Examples of stock turn

100+: Japanese manufacturing company

30-100: Good European manufacturing or distribution

10-30: Typical European manufacturing ✓

10 - 35: Retailer

<10: Poor European manufacturing

<2: Maintenance stores

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Main types of storage systems

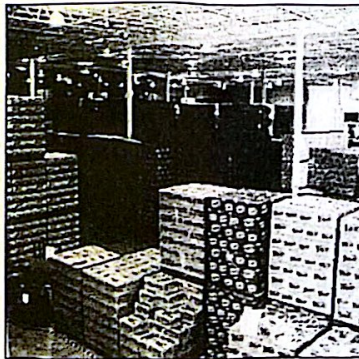
- Block stacking
- Wide aisle racking
- Cantilever racking
- Narrow aisle racking
 - Automated
 - Manual
- Drive-through/ Drive-in racking
- Sliding or Mobile racking
- Double deep racking
- Push-back racking
- Flow or Live racking
- Mezzanine
- Carousels

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Storage Equipment

Bulk Storage/Block Stack

- High density storage on the warehouse floor.
- Unit loads stacked on top of each other
- Best for large quantities of a single SKU (stock keeping unit)
- Allowable stack heights (3 or 4)
- Low utilization threshold



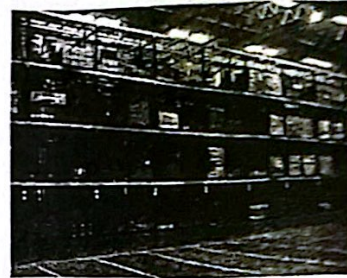
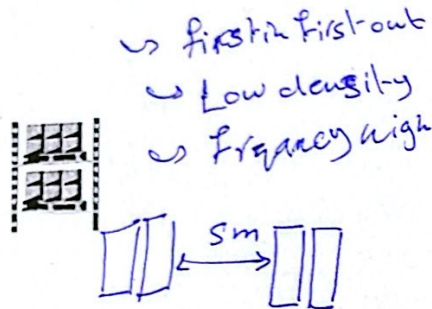
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(density)
(كثافة)
(Last in - First out)
(تدعم العربة)
(high frequency)
(تدعم العربة)

Storage Equipment

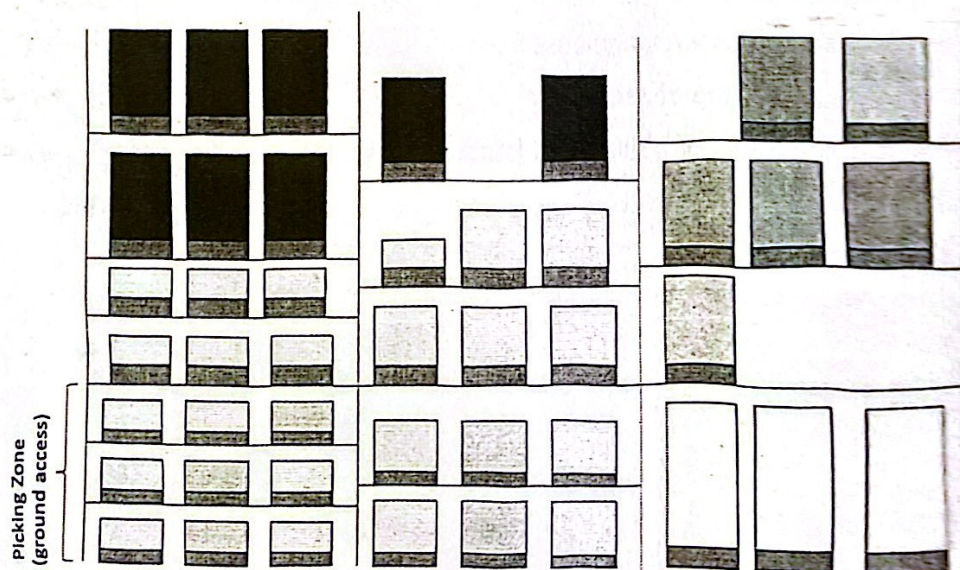
Adjustable Pallet Rack APR

- Consists of uprights, beams and back supports
- Anchored to floor with adjustable beams
- Must know weight capacity, width of rack opening and the distance between bearing beams
- Flexible and easily reconfigurable



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Rack configuration options



Layer Pallet Pick

Half Pallet Pick

Full Pallet Pick

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Warehouse storage methods

Very Narrow aisle racking

Consists of uprights, beams and back supports

Anchored to floor with adjustable beams

Requires less space than APR

Must know weight capacity, width of rack opening and the distance between load bearing beams

→ First-in First-out

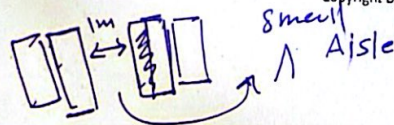
→ high density

→ U. frequency

high Cost



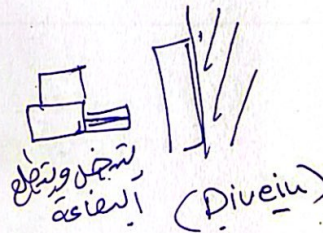
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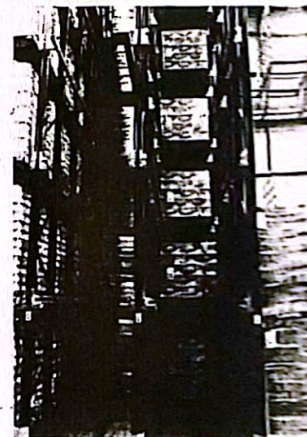
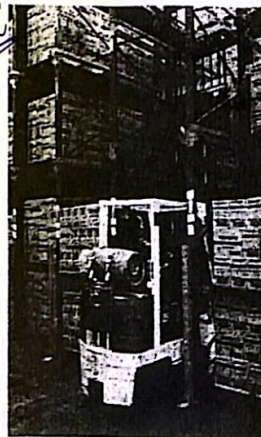
Storage Equipment

Drive-in/Drive Through Rack

- Similar to pallet racking but the forklift can drive into the rack
- High density storage medium for large quantities of single SKUs
- Need good quality pallets
- LIFO - Drive In
- FIFO - Drive Out



→ first in - last out
→ high density
→ Low frequency



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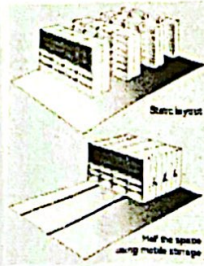


Drive in Drive out

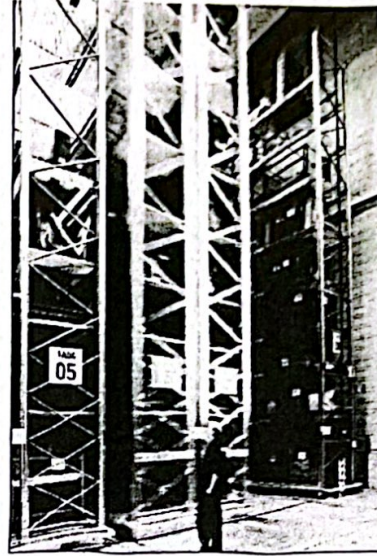
Storage Equipment

Sliding Rack or Shelving

- Mounted on guides or rails
- Highly space efficient
- Very effective for small parts and high SKU
- Strong medium for slow moving parts



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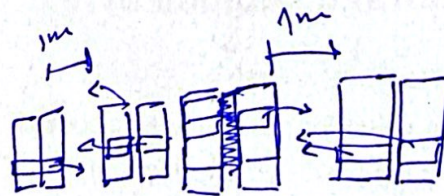


first in - first out ✓
very high density ✓
low frequency ✓

Storage Equipment

Double Deep Rack

- High Density Storage medium
- Must use reach truck only with extendable forks
- Requires multiple pallets of Single SKUs



lower frequency

first in first out X

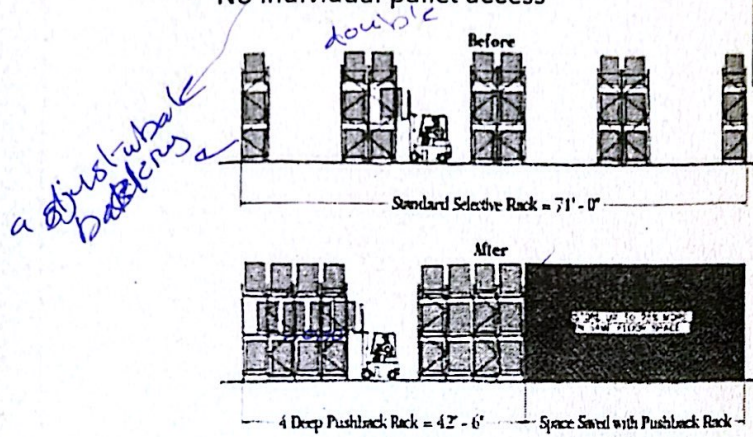
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قصة

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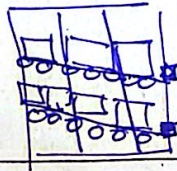
Storage Equipment

Push back racking

- Supports slow moving product
- Needs same product in the line
- LIFO
- No individual pallet access



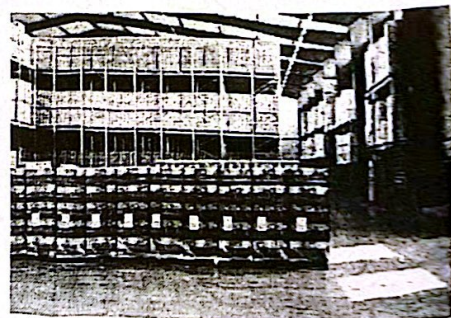
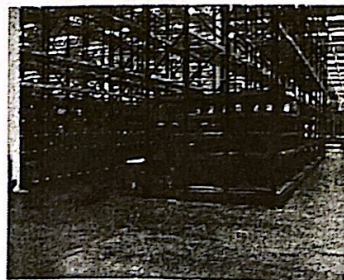
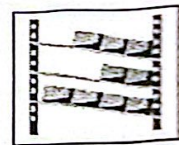
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Storage Equipment

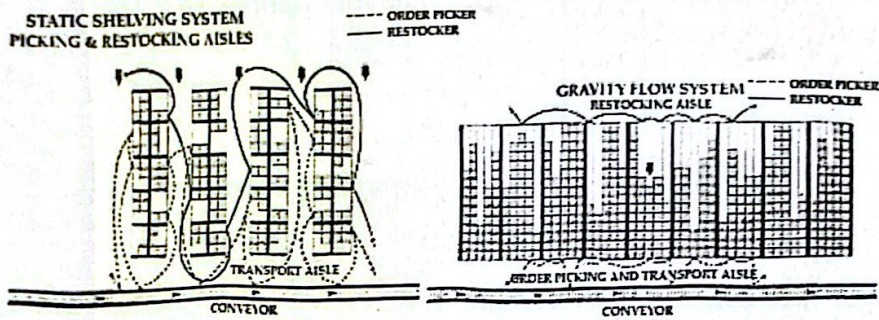
Flow or Live Rack

- Great for carton flow or piece pick
- Many SKU's in small footprint
- Supports high speed and slow moving product
- Designed for High speed picking



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Gravity flow versus static shelving



Courtesy of Cisco Eagle

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Storage Equipment

Satellite/Shuttle racking

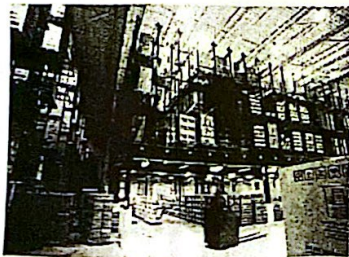
- No aisles
- Many pallets in small footprint
- Supports high speed and slow moving product
- Good utilisation of space at the loading bay
- Continuous flow

نہی سکتے ہیں پالٹ (Pallet) (50) وینٹی (Pork Left) پر فوری

very high density

first in - first out X

Low frequency X



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