Chapter 4: Pick Preparation

- most costly activity in the warehouse:
  picking 50%, receiving 15%, shipping 15%, storage 20%

- just in time, the growth in online shopping … smaller order quantities and more frequent deliveries (p.77)

- labour intensive, challenging to automate, difficult to plan

- prone to error, has direct impact on customer service
  1. omitting items from the order 品項遺漏
  2. sending the wrong item 品項不同
  3. sending the wrong number of items 數量不符

- trade-off : speed, cost and accuracy

1

Key Performance Measures for Picking Operations

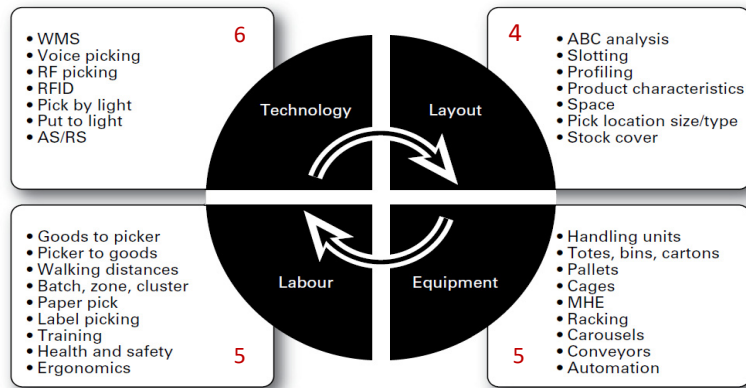**TABLE 4.1**   Best in class: picking (WERC)   2012 (2017)

	Best in class	Median	Laggards
Percentage of orders picked accurately	≥ 99.9%	99.5%	≤ 98.0%
Percentage of orders shipped on time and complete to customer request; or on time, in full (OTIF)	≥ 99.05% (99.59%)	95.0% (96.53%)	≤ 84.1%

2

1

Picking Interrelated Decisions

FIGURE 4.1 Picking interrelationships

- WMS
- Voice picking
- RF picking
- RFID
- Pick by light
- Put to light
- AS/RS

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- ABC analysis
- Slotting
- Profiling
- Product characteristics
- Space
- Pick location size/type
- Stock cover

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Technology | Layout

Labour | Equipment

- Goods to picker
- Picker to goods
- Walking distances
- Batch, zone, cluster
- Paper pick
- Label picking
- Training
- Health and safety
- Ergonomics

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- Handling units
- Totes, bins, cartons
- Pallets
- Cages
- MHE
- Racking
- Carousels
- Conveyors
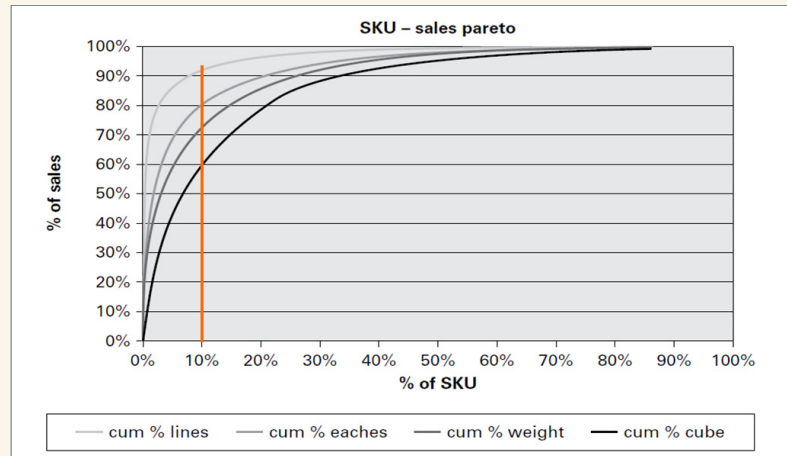- Automation

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3

Preparation: ABC classification

- 規劃揀貨作業前，了解產品與訂單特性

- Pareto's Law or the 80/20 rule. (P.79)

- roughly 80% of effects come from 20% of causes.

- concentrate time and resources on the important 20% or the 'vital few'. 重要不等於暢銷

- ABC classification can produce an effective warehouse layout. 儲區規畫

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Pareto's Law (Sales) — Figure 4.2

SKU – sales pareto
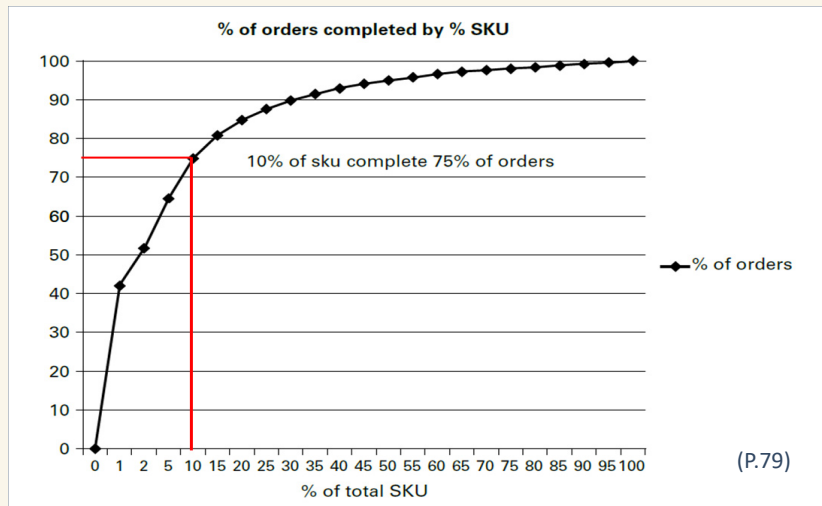
受訂次數　　　出貨總數　　　出貨總重　　　出貨總體積

根據出貨量或出貨金額的ABC classification 雖然可以輔助倉庫的設施佈置，但是從倉儲作業績效考量，還須納入其他考慮因素，如：揀貨次數、產品體積與重量與特殊情形(如：高價值商品)。

TABLE 4.2　ABC comparison

	Sales	Number of orders
Product A	10,000 units	4
Product B	1,000 units	200

Pareto Analysis of Orders and SKU Figure 4.3

% of orders completed by % SKU

10% of sku complete 75% of orders

◆ % of orders

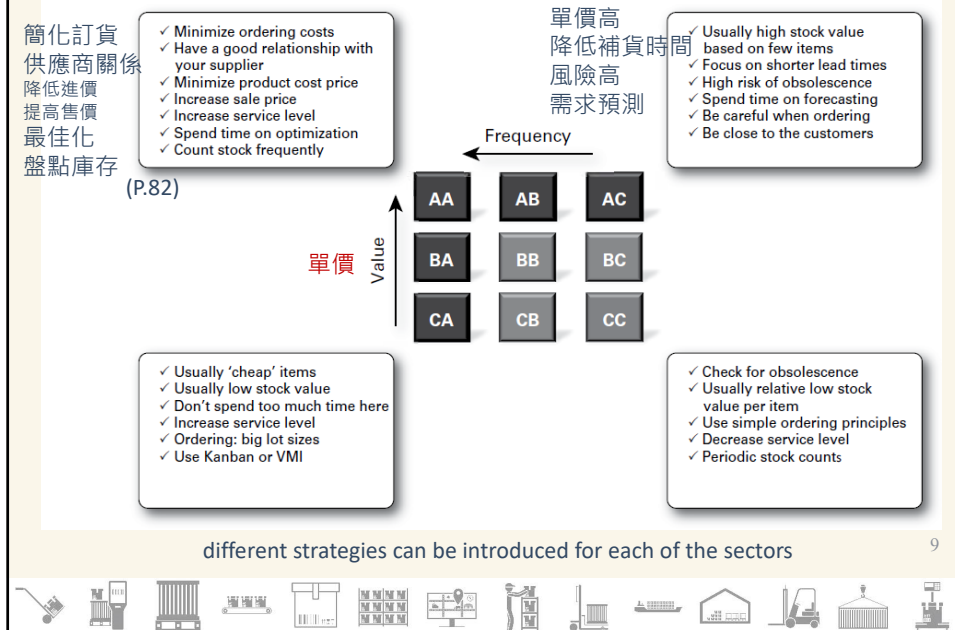% of total SKU

(P.79)

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Double ABC Analysis

- Picking area layout should be based on the number of pick-face visits … such as high security items. P.81

- combine two factors : <u>volume</u> and <u>frequency</u>

  出貨總數　　　揀貨(受訂)次數

FIGURE 4.4　ABC analysis: quantity and frequency of sales (courtesy of ABC Softwork)

	High frequency ←		Low frequency
Higher sales	AA	AB	AC
總金額 ↑	BA	BB	BC
Lower sales	CA	CB	CC

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Slide 1

FIGURE 4.5 ABC analysis: product value and frequency of sales

簡化訂貨
供應商關係
降低進價
提高售價
最佳化
盤點庫存
(P.82)

- ✓ Minimize ordering costs
- ✓ Have a good relationship with your supplier
- ✓ Minimize product cost price
- ✓ Increase sale price
- ✓ Increase service level
- ✓ Spend time on optimization
- ✓ Count stock frequently

單價高
降低補貨時間
風險高
需求預測

- ✓ Usually high stock value based on few items
- ✓ Focus on shorter lead times
- ✓ High risk of obsolescence
- ✓ Spend time on forecasting
- ✓ Be careful when ordering
- ✓ Be close to the customers

Frequency ←

單價 | Value ↑

AA	AB	AC
BA	BB	BC
CA	CB	CC

- ✓ Usually 'cheap' items
- ✓ Usually low stock value
- ✓ Don't spend too much time here
- ✓ Increase service level
- ✓ Ordering: big lot sizes
- ✓ Use Kanban or VMI

- ✓ Check for obsolescence
- ✓ Usually relative low stock value per item
- ✓ Use simple ordering principles
- ✓ Decrease service level
- ✓ Periodic stock counts

different strategies can be introduced for each of the sectors

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Slide 2

ABC+VED Analysis for Pharmacy

ABC Analysis	No. of Items	% of items	Annual Value
A	160	11.08	413K
B	338	22.16	118K
C	1054	66.75	59K

VED Analysis	No. of Items	% of items	Annual Value
Vital	167	10.76	137K
Essential	706	45.49	329K
Desirable	679	43.75	123K

No. of Items	% of items	No. of Items	% of items	No. of Items	% of items
AV 57	3.7	AE 63	4.1	AD 40	2.6
BV 58	3.7	BE 167	10.8	BD 113	7.3
CV 52	3.4	CE 476	30.7	CD 526	33.9

	No. of Items	Annual Value
Category I	270	444K
Category II	756	131K
Category III	526	15K

Ceylan, Z., Bulkan, S., (2017). Drug Inventory Management of a Pharmacy using ABC and VED Analysis, Eurasian Journal of Health Technology Assessment, Vol. 2, No. 1, 13-18

Data Analysis for Warehouse Layout
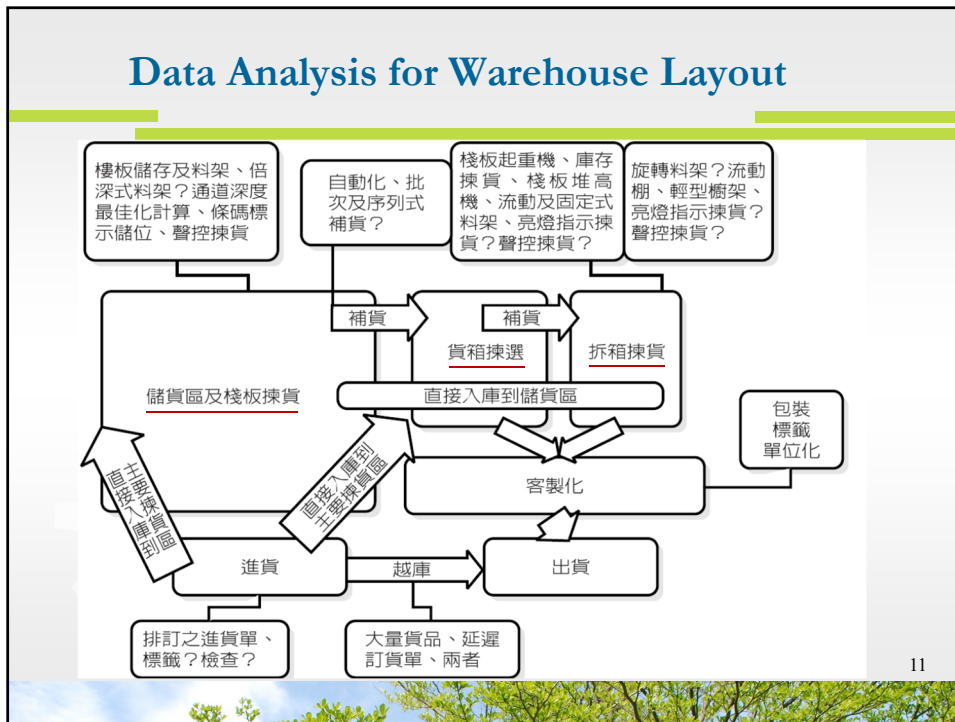
11

TABLE 4.3 ABC analysis using Excel — total demand × picking frequency

Product code	Annual demand 000	Pick list frequency	Weighted volume	Weighted percentage	Cumulative weighted percentage	ABC category
85058	200	20,000	4,000,000	41.2	41.2	A
79001	250	15,000	3,750,000	38.6	79.9	A
67553	400	2,000	800,000	8.2	88.1	B
12865	600	1,000	600,000	6.2	94.3	B
13866	800	500	400,000	4.1	98.4	C
13700	1,000	100	100,000	1.0	99.4	C
85866	1,000	40	40,000	0.4	99.9	C
72333	100	80	8,000	0.1	99.9	C
77577	500	10	5,000	0.1	100.0	C
77212	1,000	1	1,000	0.0	100.0	C
	5,850		9,704,000			

total demand
picking frequency

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TABLE 4.5 Order analysis: FMCG manufacturer

	No of orders	No of units	No of SKUs	Units per order	Units per SKU	SKU per order
Family group 1	4,783	65,552	29,501	13.7	2.2	6.2
Family group 2	6,955	81,857	34,386	11.8	2.4	4.9
Family group 3	1,892	25,596	12,165	13.5	2.1	6.4
Family group 4	52	817	110	15.7	7.4	2.1
Family group 5	2,555	13,654	4,287	5.3	3.2	1.7
Family group 6	12,974	667,558	189,898	51.5	3.5	14.6
Family group 7	6,067	112,218	55,704	18.5	2.0	9.2
Family group 8	949	1,590,870	40,135	1,676.4	39.6	42.3
Family group 9	62	23,459	643	378.4	36.5	10.4
Overall	36,289	2,581,581	366,829	71.1	7.0	10.1

(P.86)

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Cube per order index (COI)

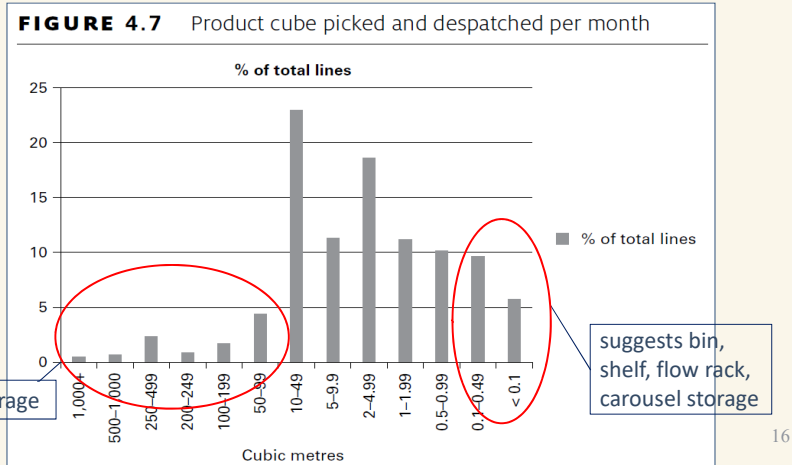- the ratio of a product line's space requirement at the pick face to the number of picks per day. 出貨量體積/揀貨次數

- The lower the COI, the better the space utilization of the product. It should be placed nearer to the despatch bay.

- B2C: small cube orders ⇒ roll cage or trolley 以推車批次揀貨

- B2B: larger cube orders ⇒ pallet trucks or pallet jacks. 以棧板為單位揀貨

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Cube Movement Distribution

- Decide on the most appropriate storage mode.

FIGURE 4.7 Product cube picked and despatched per month

Pallet storage

suggests bin, shelf, flow rack, carousel storage

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Data Analysis for Slotting

- Calculates the optimum location for products.
- Take into account value, cube, weight, crushability, and seasonality.
- Placing fast moving products close to despatch.
- Very fast-moving lines will require multiple faces to avoid a bottleneck at a single location   pick face 排面
- Place items that frequently ship together next to each other. (bolts and nuts)
- Goal is to reduce travel time.

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TABLE 4.6 Example of pick-face analysis

Product code	Units picked per day	Equivalent carton pick	Average number of visits to pick face per day	Cartons per flow rack location	Minimum number of locations
989533	886.1	11.1	13.3	6	2
989133	942.3	10.5	16.2	6	2
881043	522.2	8.7	6.4	6	2
978003	5,804.3	7.3	14.4	6	2
989333	309.8	6.2	13.4	6	2
881033	405.7	5.8	4.3	6	2
881053	141.8	4.7	3.7	6	1
989122	554.1	3.7	12.0	6	1
812833	158.8	3.5	11.6	6	1
989144	194.6	3.2	8.8	6	1
989322	277.7	3.1	9.1	6	1

the idea … limit the number of replenishments that take place during a day.

Demand Correlation Analysis

品項編號	品項編號	成對訂購次數
189-2-4	189-2-1	58
493-2-1	493-2-8	45
007-3-3	007-3-2	36
119-2-1	119-2-7	30
999-1-8	999-1-6	22
207-4-2	207-4-24	15
662-1-9	662-1-1	12
339-7-4	879-2-8	9
112-3-8	112-3-4	6

衣服的款式　顏色
品項的尺寸

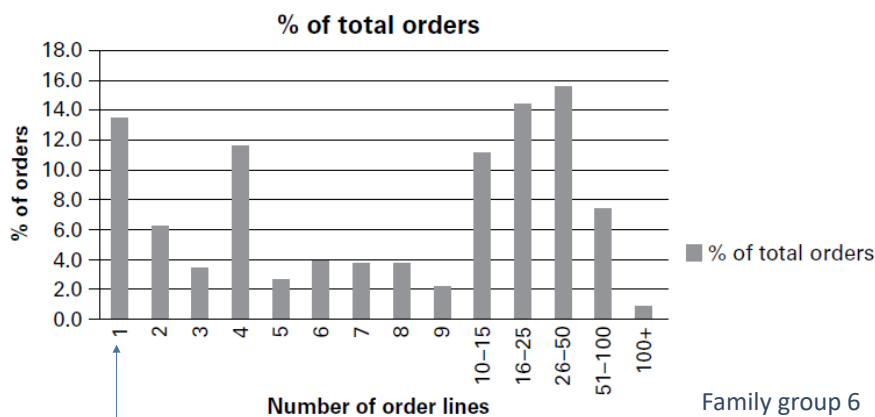Table 4.4

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Preparation: Order Analysis

- How many different product codes make up an order? (B2B vs. B2C) 了解你的客戶

- How many pick locations we will visit for each order?

- Which pick method to use ?

- How much space to allocate ?

- Where and how to store the product?

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FIGURE 4.6 FMCG manufacturer: order analysis (p.87)

% of total orders

Number of order lines

Family group 6

With such a large number of single-line orders we also need to determine whether these are standard orders or possibly back orders.

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訂單之產品線與COI分佈範例

每張訂單的產品線	0-1	1-2	2-5 每張訂單立方呎	5-10	10-20	20+	總計	佔訂單比率	產品線總數	佔總產品線之比率
1	176	15	16	7	3	3	220	49%	220	17%
2-5	100	24	27	15	10	2	178	40%	623	47%
6-9	8	6	6	6	4	3	33	7%	248	19%
10+	2	1	1	6	4	1	15	3%	225	17%
總計	286	46	50	34	21	9	446	100%	1,316	100%
佔訂單比率	64%	10%	11%	8%	5%	2%	100%			
總體積	143	69	175	255	315	270	1,227			

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EIQ analysis for e-Retailing

E (訂單 order Entry), I (品項 Item), Q (數量 Quantity)
常用統計包括平均值、最大與最小值、次數分佈、Pareto分析

訂單量(EQ)分析：瞭解單張訂單總訂購量的分佈情況(≈COI)，
　　可用於決定訂單分批或個別處理的原則、揀貨系統的規劃，
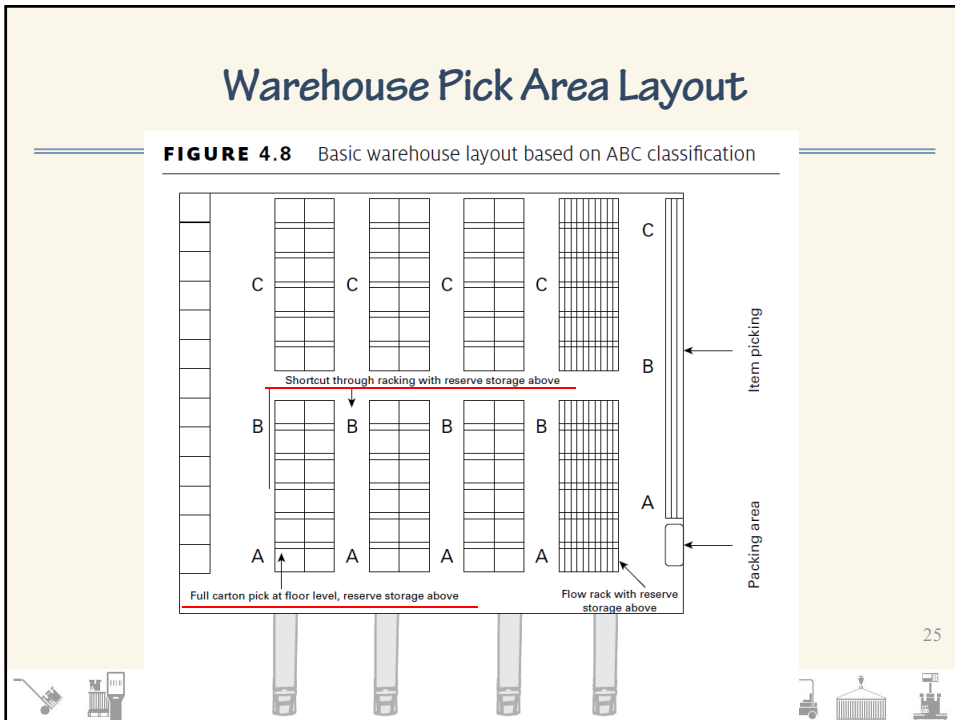　　並影響出貨方式及出貨區規劃

訂單品類數(EN)分析：單張訂單訂購品項數的分析

品類數量(IQ)分析：瞭解各品項出貨量的分佈情況，分析品項
　　的重要程度與庫存規模，用於倉儲設備的選用、儲存空間
　　的估算，並將影響揀貨方式及揀貨區的規劃

品項受訂次數(IK)分析：單一品項出貨次數的分析

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		Line Items						EN	EQ
		I1	I2	I3	I4	I5	I6		
Order	E1	3	5	0	1	2	3	5	14
	E2	2	0	4	6	7	0	4	19
	E3	4	0	0	0	0	8	2	12
	E4	2	8	0	3	5	2	5	20
	IK	4	2	1	3	3	3		
	IQ	11	13	4	10	14	13		

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Warehouse Pick Area Layout

FIGURE 4.8 Basic warehouse layout based on ABC classification

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Preparation: Picking Route

- Pick sequence as per the most effective route beginning at the front of the racking nearest the despatch bays.

- Heaviest items are picked first.

- able to pick from both sides. (Fig. 4.9)

- Shortcuts are programmed into the system to minimize travel. (Fig. 4.8)

- The picker ends up as close to the despatch area as possible.

- The most popular items need to be set up to avoid congestion at the pick bays. 避免過度集中A類

Supermarket Psychology: Supermarket Layout
https://www.youtube.com/watch?v=g3IwOgA3Ngw

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FIGURE 4.9 Rack and shelf layout (adapted from and reproduced by kind permission of J B van den Berg)

the aisles are numbered, not the rows of racking
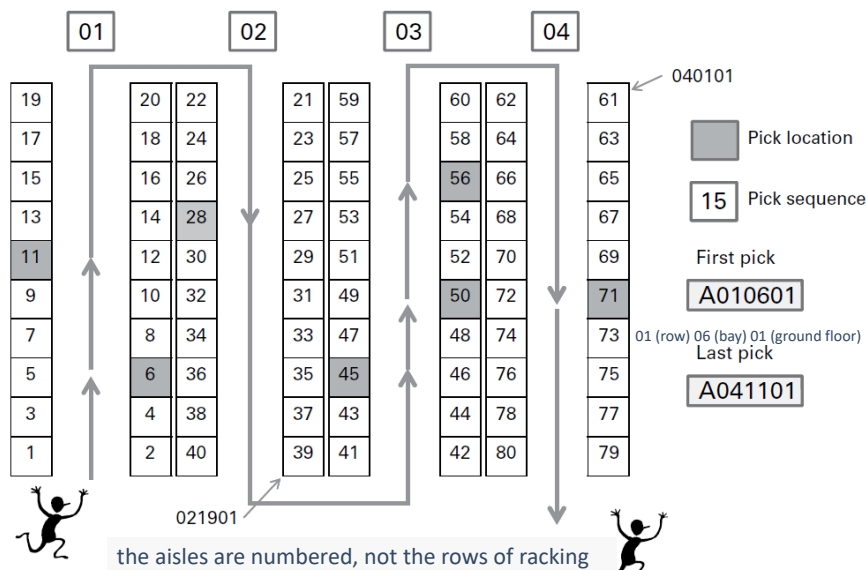
27

Preparation: Information

Information required to determine the most effective picking system :
- dimensions and weight of the product
- product group (hazardous, temperature sensitive, high value, etc.)
- total number of SKUs by category (ABC)
- total number of orders in a period 訂單量尖離峰變化
- mode and average number of lines per order (EN)
- mode and average number of units per line (IQ)
- pick-face visits per SKU (IK)
- item, case or full-pallet picks by SKU 品項的出貨單位
- typical family groupings (飲料區再分類)
- items sold together frequently.

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Make Picking Easy and Comfortable

- good lighting (>200 lux, <5000K)

- ergonomic equipment

- equipment aids (scanners, voice, RFID)

- assistance with heavy items

- easy-to-reach shelf locations

- clear and unambiguous labels

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Ten Commandments of Picking

1. Design for flexibility and scalability.

2. Keep pickers picking.

3 Minimize travel.

4. Minimize product touches. 需要接觸產品的次數

5. Never let pickers arrive at an empty location. 揀貨時不缺貨

6. Measure, measure, measure.

7. Pick logically, slot intelligently. 儲位安排、揀貨順序

8. Pick accurately.

9. Continue to learn and explore.

10. Advocate continuous improvement.

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