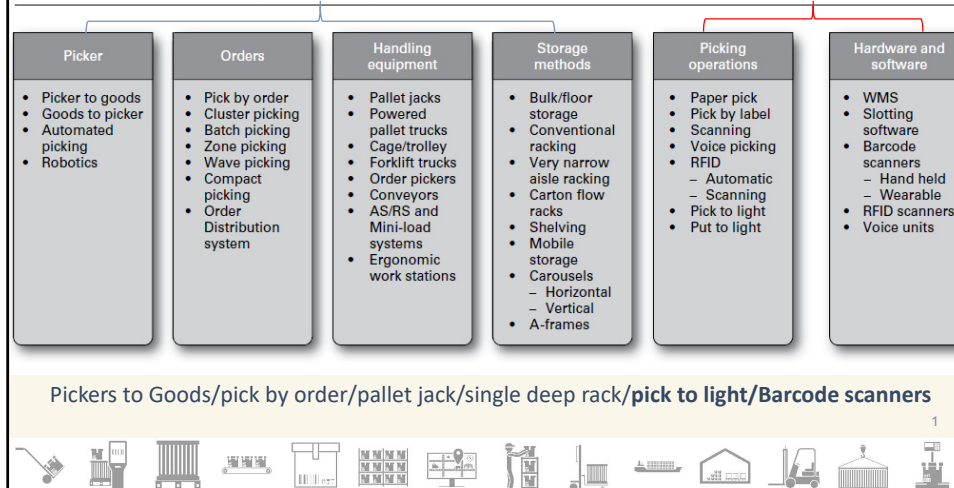


## Chapter 6 Order-Picking Methods

FIGURE 5.1 Picking strategies and equipment



1

## Order-Picking Operations

- ❖ paper pick lists 揀貨單
- ❖ pick by label 貼標揀貨
- ❖ pick by voice 聲控揀貨
- ❖ barcode scanning 條碼掃描
- ❖ radio frequency identification 無線射頻識別 (電子標籤)
- ❖ pick by light / pick to light 摘取式揀貨
- ❖ put to light / pack to light 播種式揀貨
- ❖ automated picking (第五章)

accuracy, productivity, return on investment

2



## 1. Paper Pick Lists

- ❖ Pick by List: 由客戶訂單轉換，至少應包含訂單號碼、產品碼、產品資訊、儲位、揀貨數量。
- ❖ Any discrepancies are written onto the pick list. When the pick list is returned... if there are shortages. (p.139)

優點：實施容易、成本低

缺點：

- ❖ 人工輸入揀貨紀錄，容易出錯
- ❖ 資訊非即時傳遞

以WMS與儲位規劃輔助的優點：可根據訂單內容安排最佳揀貨次序，減少行走時間，使最後一個揀貨儲位靠近出貨區。

3



## Orders ⇒ Picking Lists

### Picking Slip for #N11087

Customer: ██████████

Date Required: ██████████

Printed by Neto Support, 30/10/2017 11:53

██████████  
SOUTH BRISBANE  
QLD 4101, AU  
Shipping With: Flat Rate  
Estimated Shipping Weight: 0KG  
Customer Instructions: delivery instruction

Image	QTY	SKU	Location	Item	QTY picked	Pick Task	Unit	Picked	Pick Bin	Checked
	1	18	Stock: -4	Premium Intense Beans (card: abc;)	1	0		<input type="checkbox"/>		<input type="checkbox"/>
	1	18	Stock: -4	Premium Intense Beans (card: zxy;)	1	0		<input type="checkbox"/>		<input type="checkbox"/>
	1	56	Stock: -1	Goals (Gift Message: Test message;)	1	0		<input type="checkbox"/>		<input type="checkbox"/>

No. Cartons	Length	Width	Height	Weight	Shipping Method

Picked By: \_\_\_\_\_

Checked By: \_\_\_\_\_

## 2. Pick by Label

- ❖ 依據客戶訂單的訂購種類或數量印出等量的標籤。
- ❖ 標籤上已載明相關的揀貨訊息與客戶資訊，揀貨人員以此取代揀貨單進行揀貨，揀取一件貨品即貼上對應的標籤。

### 優點

- ❖ 省去在出貨區貼運送地址的作業步驟
- ❖ It's also more accurate than paper picking as you can soon tell if there has been a mis-pick in terms of quantity. 準確率較高

### 缺點

- ❖ 高度依賴人工作業
- ❖ These manual forms of operation and low levels of productivity ... use of technology within the warehouse.

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## 3. Pick by Voice

- ❖ 電腦語音以無線傳輸指示揀貨作業，人員揀貨後回報確認
- ❖ 可應用在揀貨作業、循環盤點、補貨作業、入庫
- ❖ 可將聲控系統與AGV 結合運用 (Figure 6.3)
- ❖ This system has become prevalent in the food service and grocery retail sector. It is ... advantages over paper pick lists, labels and barcode scanning. (p.140-141)

**FIGURE 6.3** Laser-guided AGV with voice (courtesy of Toyota)



<https://www.youtube.com/watch?v=bMLakL35Vus>

[https://www.youtube.com/watch?v=mS\\_J3vRE3EI](https://www.youtube.com/watch?v=mS_J3vRE3EI) AR Glasses

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## Voice Picking

- ❖ increased accuracy
- ❖ increased productivity
- ❖ reduction in paper usage
- ❖ reduction in errors through elimination of re-keying data 不用手指鍵入·減少錯誤
- ❖ improved safety through hands- and eyes-free operation 雙手可用·眼睛不分神
- ❖ reduction in damage
- ❖ real-time stock updates leading to fast and accurate replenishment 即時更新庫存
- ❖ real-time updates regarding potential shortages 即時回報避免缺貨
- ❖ increased operator time on the warehouse floor 效率
- ❖ reduced training times
- ❖ multilingual, accommodating a diverse workforce 多國語言
- ❖ potential reduction in employee turnover 降低員工流動率
- ❖ normally a quick ROI.

Figure 6.1

缺點？

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## 4. Barcode Scanning

- Barcode可用來辨識商品、儲位、容器類別、數字資訊
- There is no conformity and thus no universal barcode. ... The main barcode standards include EAN-8, EAN-13 and Code 128. (Appendix 2)
- 由WMS指揮揀貨作業，無線傳輸揀貨指示至手持裝置的螢幕，人員揀貨後將確認的資訊傳回系統
- Barcode scanning, utilizing hand-held scanners with real-time data transmission has made data collection faster and more accurate ... (p.147)

**FIGURE 6.4** One-dimensional and two-dimensional barcodes



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## Bar Codes 物流與資訊流的ID

UPC-A含有12個數字，常用於美國零售業，是最早大規模應用的條碼



- 起始字元：閱讀器確認此字元存在後開始處理掃描。
- 資料字元標示一組數值，其結構不同於起始字元，可允許雙向掃描。
- 校驗字元檢驗條碼讀取是否正確。掃描器讀入條碼時，進行規定的運算，如運算結果與校驗字元相同，則讀取有效。
- 終止字元：掃描器確認此字元號後停止處理。

How Barcodes Work <http://www.youtube.com/watch?v=e6aR1k-ympo>

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## EAN and Code 128

EAN-13是由UPC衍生出的國際條碼，前三個數字為地區碼(471)

左護碼+左資料碼(7碼=地區碼+廠商碼)



中護碼+右資料碼(5碼=產品碼)+檢查碼(1碼)+右護碼



Code 128 是一維類別中最複雜、用途最廣泛的條碼。它能將 128 個 ASCII 字元編碼，包括字母與數字、標點符號、符號等。最常用於物流業。



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## Barcode Readers

1. hand-held 手持型 · 附有螢幕、相機
  - ❖ 讀取多種類型的barcode · 可無線傳輸
  - ❖ 缺點：取放花時間 · 揀貨不方便
2. wearable 穿戴式
  - ❖ 主機戴在手腕上 · 掃描器戴在手指上
  - ❖ 方便雙手揀貨 · 提高效率 · 減少失誤



[https://www.youtube.com/watch?v=sqds\\_epkpgc](https://www.youtube.com/watch?v=sqds_epkpgc)

360° scanner



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## 條碼在物流的運用



- 條碼可用於產品辨識、儲位辨識、容器辨識、設備辨識、文件辨識、人員身分辨識

- 過多的條碼應用會延緩流程、降低生產力

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## 5. Radio Frequency Identification

- ❖ RFID is a means of uniquely identifying an item using radio waves. Data is exchanged ... may or may not require line of sight. (p.151)
- ❖ 可在單一位置存取多處資訊。
- ❖ 由於barcodes成本低、讀取準確，故RFID尚未完全取代barcodes。
- ❖ 傳輸距離與速度受所用的無線電頻率影響，而各國使用的無線頻率不同，造成供應鏈使用上的問題。

	主動式電子標籤 (Active tag)	被動式電子標籤 (Passive tag)
發送/接受	可發送/接受資料	只可被讀取資料
電源裝置	內建電池	無內建電池
使用年限	5~10年	無使用年限
讀取距離	較遠	較近
儲存容量	較多	較少



IBM RFID

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## RFID Picking

- ❖ 即時登錄揀貨資料與更新庫存
- ❖ Individual-item-level tracking for the majority of products is unlikely to happen. (貴重品除外)
- ❖ The tracking of roll cages, pallets and returnable packaging such as totes, kegs, ... cost effective through the use of RFID.

### RFID缺點：

- ❖ reading issues when in close proximity to liquids and metal 易受干擾
- ❖ intermittent data capture, with the possibility of some tags not being read. 讀取中斷
- ❖ dead areas in the warehouse where signals are weak 信號死角
- ❖ can be damaged by liquids, static discharges and magnetic surges 容易受損

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

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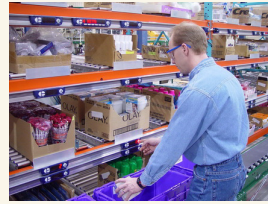


## 6. Pick by light / Pick to light

- ❖ 先掃描容器的訂單條碼，資訊系統根據訂單內容控制揀貨區貨架上對應的LED燈號亮起，負責人員揀取顯示的數量，放入該訂單的物流箱內，按下貨架上的按鈕以示確認。(摘取式揀貨)
- ❖ 可與zone picking(分區揀貨)結合，揀貨人員各自負責單一區域的揀貨，再由輸送帶送到下一區，直到整張訂單完成。(pick and pass)

優點：

- ❖ 降低不必要的尋找時間，提高生產力
- ❖ 訓練容易，方便尖離峰的臨時人員調度



Diginfo <http://www.youtube.com/watch?v=g6E7K-3NYpA>

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## 7. Put to light / Pack-to-light

- Prevalent in retail store replenishment operations 連鎖零售業
  - ❖ Individual product lines required by the stores will be picked in bulk and transferred to ... Each store will have a tote or totes assigned to it.
  - ❖ 以商品為基準，針對有訂購該商品的訂單，所屬貨箱的電子標籤將亮起，負責人員將顯示的數量，放入訂單的貨箱內，再進行下一種商品的揀貨。(播種式揀貨)
- put-to-light technology requires **order consolidation** and a batch pick of products. Part pallets or cases will need to be returned ...
- 適用在cross-docking

Put To Light System

<https://www.youtube.com/watch?v=CFcH8Dm15aE&t=120s>



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## Deciding on Type of Picking System

- Pickers to Goods/pick by order/pallet jack/voice,
  - ✓ The return on investment and payback periods 3~5年回收最佳
  - ✓ Ergonomic and green issues 人體工學、環保節能
  - ✓ The long-term strategy 配合長期策略
  - ✓ High volume due to **seasonal peaks** 考量旺季需求
  - ✓ The availability of labour 人力供給
  
- **Flexibility** and **automation** tend not to go hand in hand and .... a discussion regarding future operations are paramount.
  
- ❖ Most companies will use a combination of pick technologies to further increase accuracy and productivity.

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## Return On Investment

- ❖ A warehouse that picks 36,000 cases per day with a 98.68 % accuracy level incurs 475 errors per day.
- ❖ **Increasing accuracy** to 98.88 %, for example, will reduce errors by 72 per day, or 26,280 per year.
- ❖ Assume that the cost of a picking error is £ 25, this can be an overall saving of £ 657,000.
  
- ❖  $36,000 \text{ cases} \div 7.5 \text{ hours /day} \div 35 \text{ operators} = 137 \text{ cases per hour.}$
- ❖ A 10 % **productivity gain** would raise the cases per hour to 151.
- ❖  $\times = 36,000 \text{ cases per day} \div 7.5 \text{ hours per day} \div 151 \text{ cases} = 32 \text{ operators}$
  
- ❖ Further savings can be made in terms of .... (p.145)

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**TABLE 6.1** Pick method comparison (adapted from CILT Warehouse Management course)

	Method	Equipment	Speed	Accuracy	Order size (lines)	Cost
Bulk pre-pick (batch)	Pallet to picker followed by picker to tote/pallet	By RT/CBT	Medium-fast	Paper: medium RTDs: high Voice: high	Low-medium	Low Medium Medium
	Put to light	Cart, pallet truck or conveyor	Medium-fast	High	Medium-high	Medium
Mainly automated	Goods to picker	Carousel	Medium-fast	High	Low-medium	High
	Picker to goods or goods to picker	Conveyor or sorter (A-frame)	Fast	High	Medium-high	High
	Goods to picker	AS/RS to pick station	Medium-fast	High	High	High

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## Cost of Picking Errors

- ❖ cost of recovering and in-handling the item 回收錯送品項
- ❖ cost of picking the replacement item, re-packing, and re-delivery 重新揀貨、重新包裝、重新配送
- ❖ administration costs of handling credit claims 客戶求償
- ❖ cash flow with reference to non-payment of invoice 發票處理
- ❖ potential loss of sale for the product incorrectly despatched 銷售損失
- ❖ cost of re-training staff 加強員工訓練
- ❖ possible stock write-off if the returned product is outside an acceptable shelf life or has been damaged in transit 回收品損壞或過期
- ❖ If the error is an under-pick then it could result in a lost sale and the associated margin. 數量短缺導致銷售損失
- ❖ If it's an over-pick and is reported, there is the cost of transport to collect the item ... If not reported, the cost ... 出貨過多需回收或承受損失

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**TABLE 6.2** Pick system advantages and disadvantages

Applications and pick rate	Benefits	Drawbacks
<p>Paper picking</p> <ul style="list-style-type: none"> <li>• Most operations</li> <li>• Where there is very little systems support</li> <li>• Low-cost areas</li> <li>• <u>&lt; 100 lines per hour</u></li> </ul>	<ul style="list-style-type: none"> <li>• <u>Low cost</u></li> <li>• Single stage picking operation although two stage update operation</li> <li>• Flexible</li> <li>• <u>Quick implementation</u></li> <li>• Ability to use in other areas of the warehouse such as receiving</li> <li>• Ability to isolate urgent orders</li> <li>• Picker able to decide pick path</li> <li>• Low maintenance</li> <li>• Suitable as part of a contingency plan</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Low pick rate</u></li> <li>• Not hands free</li> <li>• <u>Low accuracy</u></li> <li>• Duplicated tasks</li> <li>• Not real time</li> <li>• Training can take some time</li> <li>• Requires manual update of system from written instructions</li> <li>• Requires return to desk for further instructions</li> </ul>
<p>Pick by label</p> <ul style="list-style-type: none"> <li>• Most operations</li> <li>• Where there is very little systems support</li> <li>• Low-cost areas</li> <li>• <u>&lt; 100 lines per hour</u></li> </ul>	<ul style="list-style-type: none"> <li>• <u>Low cost</u></li> <li>• <u>Reasonably accurate</u></li> <li>• Single stage picking operation although two stage update operation</li> <li>• Flexible</li> <li>• <u>Quick implementation</u></li> <li>• Low maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Low pick rate</u></li> <li>• Not hands free</li> <li>• Duplicated tasks</li> <li>• Need to print labels</li> <li>• Not real time</li> <li>• Training can take some time</li> <li>• Label information may be difficult to read</li> <li>• Can <u>damage product</u></li> <li>• Requires return to desk for further instructions</li> </ul>

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Applications and pick rate	Benefits	Drawbacks
<p>Barcode scanning with gun</p> <ul style="list-style-type: none"> <li>• Most operations</li> <li>• <u>&lt; 100 lines per hour</u></li> </ul>	<ul style="list-style-type: none"> <li>• <u>Improved accuracy</u></li> <li>• <u>Paperless</u></li> <li>• Flexible</li> <li>• <u>Real time stock update**</u></li> <li>• Ability to deal with multi-sku locations</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Low/medium pick rate</u></li> <li>• Not hands free</li> <li>• Can take longer than paper picking</li> <li>• <u>Cost of hardware</u></li> <li>• Requires barcode on product</li> <li>• Issues with international standards</li> <li>• Requires system interface</li> <li>• Requires maintenance</li> </ul>
<p>Wearable scanners</p> <ul style="list-style-type: none"> <li>• Most operations</li> <li>• <u>&lt; 150 lines per hour</u></li> </ul>	<ul style="list-style-type: none"> <li>• <u>Paperless</u></li> <li>• Flexible</li> <li>• Improved accuracy</li> <li>• Improved productivity</li> <li>• <u>Hands free</u></li> <li>• Less strain on operators</li> <li>• Damage reduction</li> <li>• <u>Real time stock update</u></li> <li>• Ability to deal with multi-sku locations</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Cost of hardware</u></li> <li>• Requires barcodes on product</li> <li>• Issues with international standards</li> <li>• Requires system interface</li> <li>• Requires maintenance</li> </ul>
<p>Voice picking plus finger scanning</p> <ul style="list-style-type: none"> <li>• Most operations</li> <li>• Ideal for temperature-controlled areas</li> <li>• <u>125–250 lines per hour</u></li> </ul>	<ul style="list-style-type: none"> <li>• <u>Paperless</u></li> <li>• <u>High accuracy</u></li> <li>• Good productivity</li> <li>• <u>Hands free</u></li> <li>• Less strain on operators</li> <li>• Damage reduction</li> <li>• <u>Real time stock update</u></li> <li>• Ability to deal with multi-sku location</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Cost of hardware and software</u></li> <li>• Requires barcode</li> <li>• Requires system interface</li> <li>• Requires international standards</li> <li>• Unsure of long term health issues</li> </ul>

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TABLE 6.2 Continued

Applications and pick rate	Benefits	Drawbacks
<ul style="list-style-type: none"> <li>Low/medium no. skus high volumes per individual item</li> <li>mail order/e-commerce</li> <li>(approx. 250–450 lines per hour)</li> </ul>	<ul style="list-style-type: none"> <li>High accuracy*</li> <li>High productivity</li> <li>High pick rate</li> <li>Easy to train staff</li> <li>Staff can choose pick sequence</li> <li>Real time stock update</li> <li>Hands free</li> <li>Improved safety</li> <li>Damage reduction</li> <li>Simultaneous or sequential picking</li> <li>Can be used for goods-to-person and person-to-goods picking (zone)</li> </ul>	<ul style="list-style-type: none"> <li>Cost of hardware</li> <li>Requires system interface</li> <li>System failure</li> <li>Cost of maintenance</li> <li>Low flexibility</li> <li>Long implementation time</li> <li>Limited in terms of product types</li> <li>Problem with multi-sku locations</li> <li>Difficulty with batched or clustered orders</li> </ul>
<ul style="list-style-type: none"> <li>Retail store operations</li> <li>Cluster picking</li> </ul>	<ul style="list-style-type: none"> <li>High accuracy</li> <li>High productivity</li> <li>Damage reduction</li> <li>High pick rate</li> <li>Easy to train</li> <li>Real time stock update</li> <li>Can be used for goods-to-person and person-to-goods picking (zone)</li> </ul>	<ul style="list-style-type: none"> <li>Cost of hardware</li> <li>System failure</li> <li>Limited in terms of product types</li> <li>Cost of maintenance</li> <li>Two stage operation</li> </ul>
RFID	<ul style="list-style-type: none"> <li>Very high accuracy</li> <li>Real time stock update</li> </ul>	<ul style="list-style-type: none"> <li>Cost of hardware</li> <li>Read distances very short</li> <li>Requires international standards</li> <li>Requires system interface</li> <li>Cost of maintenance</li> </ul>

\* High accuracy is dependent on accurate put-away. Can be supplemented by reading out last four digits of barcode.

\*\* Scanning can be real time or information can be downloaded once the tasks are completed.

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## Summary and Conclusion

- ❖ You should not under any circumstances automate a bad or broken process.
- ❖ Processes need to be as streamlined as possible. Any unnecessary steps need to be eliminated. 作業精簡化
- ❖ Take advantage of technology to further enhance the operation. 善用科技
- ❖ Staff resistance to change is a potential barrier to the successful implementation of any new system. 降低員工抗拒

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