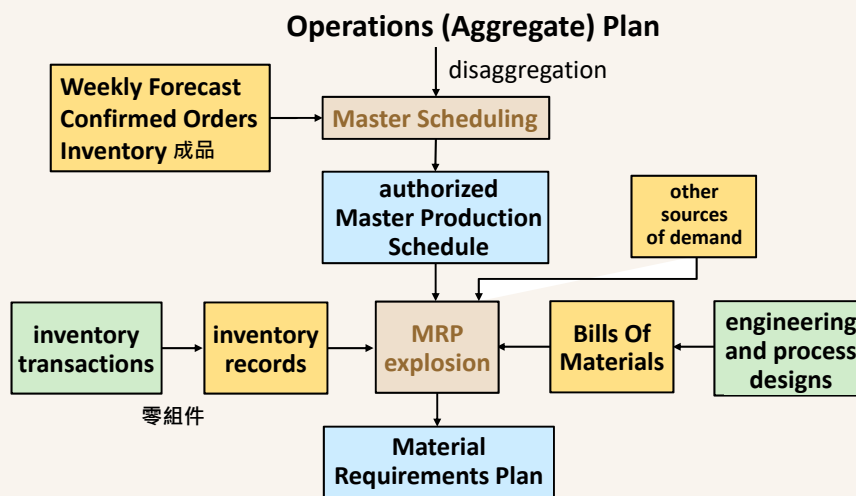


Chapter 11: Resource Planning

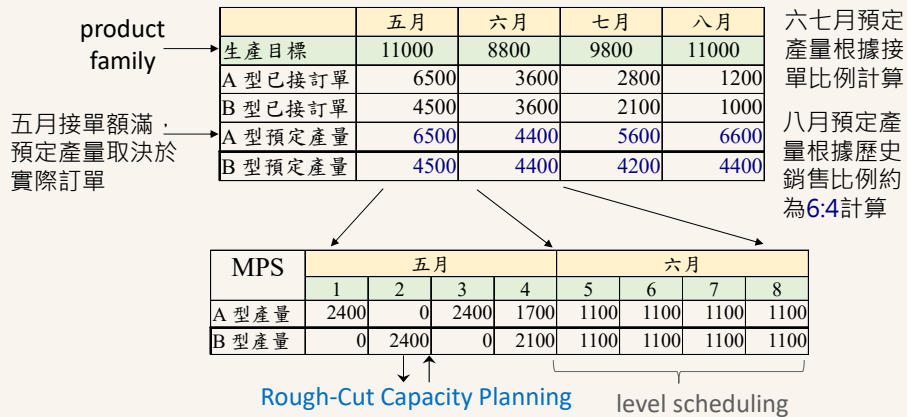
- Master Production Schedule
- Material Requirements Planning
- Enterprise Resource Planning

From Operations Planning to MRP



Master Production Scheduling

- A part of the production plan that details how many **end items** will be produced within specified periods of time (通常以週為單位)



3

Developing a Master Production Schedule 1/4

- The sums of the quantities in the MPS must equal those in the aggregate plan.
- MPS production quantities must be allocated efficiently over time.
- Capacity limitations and bottlenecks, such as machine or labor capacity..., may determine the timing and size of MPS quantities.

Step 1: Calculate projected on-hand inventories

$$\left(\begin{array}{c} \text{Projected on-hand} \\ \text{inventory at end} \\ \text{of this week} \end{array} \right) = \left(\begin{array}{c} \text{期初庫存} \\ \text{On-hand} \\ \text{inventory at} \\ \text{end of last week} \end{array} \right) + \left(\begin{array}{c} \text{本期產出量} \\ \text{MPS quantity} \\ \text{due at start} \\ \text{of this week} \end{array} \right) - \left(\begin{array}{c} \text{預估需求} \\ \text{Projected} \\ \text{requirements} \\ \text{this week} \end{array} \right)$$

where: **Projected requirements** = Max(Forecast, Customer Orders Booked)

Developing a Master Production Schedule 2/4

Item: Ladder-back chair			
Quantity on Hand: 55	April		
	1	2	
Forecast	30	30	
Customer orders (booked)	38	27	
Projected on-hand inventory	17	-13	
MPS quantity	0		
MPS start			

Forecast is less than booked orders in week 1; projected on-hand inventory balance = $55 + 0 - 38 = 17$.

Forecast exceeds booked orders in week 2; projected on-hand inventory = $17 + 0 - 30 = -13$.

The shortage signals a need to schedule an MPS quantity in week 2.

Developing a Master Production Schedule 3/4

Step 2: Determine the timing and size of MPS quantities (EPQ)

- The goal is to maintain a nonnegative projected on-hand inventory balance at the end of each period.
- As shortages in inventory are detected, MPS quantities should be scheduled to cover them. (避免缺貨而影響客戶)
- At the end of week 2:

$$\begin{aligned} \text{Projected Inventory} &= \left(\begin{array}{l} 17 \text{ chairs in} \\ \text{inventory at the} \\ \text{end of week 1} \end{array} \right) + \left(\begin{array}{l} \text{MPS quantity} \\ \text{of 150 chairs} \end{array} \right) - \left(\begin{array}{l} \text{Forecast of} \\ 30 \text{ chairs} \end{array} \right) \\ &= 137 \text{ chairs} \end{aligned}$$

Developing a Master Production Schedule 4/4

Item: Ladder-back chair					Order Policy: 150 units Lead Time: 1 week			
Quantity on Hand: 55	April				May			
	1	2	3	4	5	6	7	8
Forecast	30	30	30	30	35	35	35	35
Customer orders booked	38	27	24	8	0	0	0	0
Projected on-hand inventory	17	137	107	77	42	7	122	87
MPS quantity	0	150	0	0	0	0	150	0
MPS start	150	0	0	0	0	150	0	0

The time needed to assemble 150 chairs is 1 week. The assembly department must start assembling chairs in week 1 to have them ready by week 2.

1. The MPS quantity is needed to avoid a shortage of $17 - 30 = -13$ chairs in week 2.
2. On-hand inventory balance = $17 + 150 - 30 = 137$.

MPS and Available-to-Promise

Available-to-Promise (ATP) Quantities 可允諾訂購量

- The quantity of end items that **marketing can promise** to deliver on specific dates
 - $ATP = \text{Initial Inventory} - \text{customer orders until 1st production}$.
 - $ATP = \text{MPS quantity} - \text{customer orders until next production}$.
 - $ATP \neq \text{projected on-hand inventory}$. 不等於庫存量
- Freezing the MPS
Disallow changes to the near-term portion of the MPS.
 - Reconciling the MPS with Aggregate Plans
Capacity is limited and forecasts may change.

Available-to-Promise

Item: Ladder-back chair					Order Policy: 150 units Lead Time: 1 week			
Quantity on Hand: 55	April				May			
	1	2	3	4	5	6	7	8
Forecast	30	30	30	30	35	35	35	35
Customer orders booked	38	27	24	8	0	0	0	0
Projected on-hand inventory	17	137	107	77	42	7	122	87
MPS quantity	0	150	0	0	0	0	150	0
MPS start	150	0	0	0	0	150	0	0

ATP 17 91 ?

ATP=55+0-38=17 ATP=150-(27+24+8+0)=91

MRP 物料需求計畫



油蔥蝦米飯、帶骨里肌排、季節蔬菜、海帶結、辣炒酸菜絲、滷蛋、麻油醬瓜



菜飯、滷雞腿、滷蛋、季節蔬菜、辣炒酸菜絲、麻油醬瓜

Materials Requirements Planning

與零售業庫存管理不同

A computerized system developed to help manage dependent demand inventory and schedule replenishment orders.

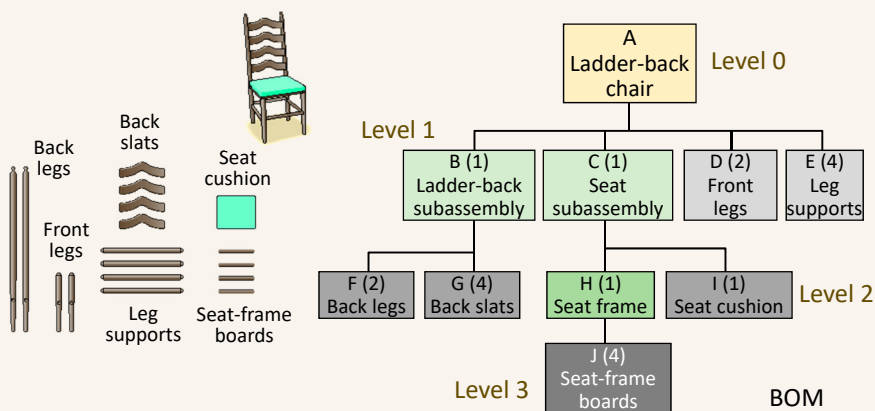
Dependent demand: The demand for an item that occurs because the quantity required varies with the production plans for other items.

- **Parent:** An product that is manufactured from one or more components
- **Component:** An item that is transformed into part of one or more parents

MRP Explosion: A process that converts the requirements of final products into **a time plan that specifies the replenishment schedules** of all the subassemblies, components, and raw materials needed to produce final products

MRP Inputs: Bill of Materials

A record of all the components of a final product, the parent-component relationships, and the usage quantities.



MRP Input: Inventory Records

A record that shows an item's lot-size policy, lead time, and various time-phased data.

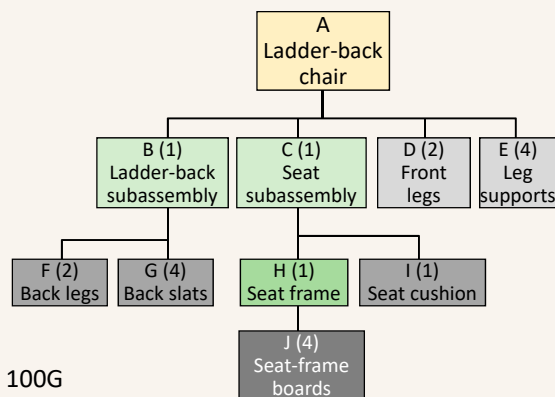
Item master data segment	Part no.	Description	Lead time	Std. cost	Safety stock						
	Order quantity	Setup	Cycle	Last year's usage	Class						
	Scrap allowance	Cutting data	Pointers	Etc.							
Inventory status segment	Allocated	Control balance	Period								Totals
			1	2	3	4	5	6	7	8	
	Gross requirements										
	Scheduled receipts										
	Projected available balance										
Planned order releases											

MRP Explosion

MPS lot size = 25 chairs

Inventory on hand
20D, 20F, 10H

25B ⇒ 50F, 100G ⇒ 30F, 100G
 25C ⇒ 25H, 25I ⇒ 15H, 25I ⇒ 60J, 25I
 50D ⇒ 30D
 100E



MRP Terminology

- Gross requirements: total demand of an item from all parents.
- Scheduled receipts: order that has been placed but not yet received or completed. 先前已發出的訂單或工單 · 期初預定收到的數量
- Projected on-hand inventory (期末庫存)

$$\left(\begin{array}{c} \text{Projected on-hand} \\ \text{inventory balance} \\ \text{at end of week } t \end{array} \right) = \left(\begin{array}{c} \text{Inventory on} \\ \text{hand at end of} \\ \text{week } t-1 \end{array} \right) + \left(\begin{array}{c} \text{Scheduled or} \\ \text{planned receipts} \\ \text{in week } t \end{array} \right) - \left(\begin{array}{c} \text{Gross} \\ \text{requirements} \\ \text{in week } t \end{array} \right)$$

- Planned receipts: order that should be received from the shop or the supplier. 需要設定在該期期初進貨或完工的數量
- Planned order releases: order for a specified quantity of an item is to be issued to the shop or the supplier. 需要在該期下單或開工的數量

Explosion

part commonality

	April				May			
MPS Start	1	2	3	4	5	6	7	8
Ladder-back chair	150					150		
Kitchen chair				120			120	

Item: C (Seat subassembly)

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory	37 ↑ 117	117	117	-3	-3	-153	-273	-273
Planned receipts								
Planned order releases								

$$37 + 230 - 150 = 117 \text{ units.}$$

MRP Explosion

Lot-sizing rule: Fixed Order Quantity

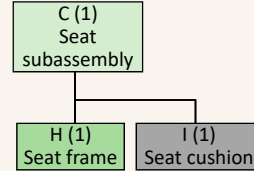
Item: C (Seat subassembly)		Week							
		1	2	3	4	5	6	7	8
Gross requirements		150	0	0	120	0	150	120	0
Scheduled receipts		230	0	0	0	0	0	0	0
Projected on-hand inventory 37		117	117	117	227	227	77	187	187
Planned receipts					230			230	
Planned order releases			230			230			

Lot-sizing Rule: Lot-for-Lot (L4L)

Item: C (Seat subassembly)		Week							
		1	2	3	4	5	6	7	8
Gross requirements		150			120		150	120	
Scheduled receipts		230							
Projected on-hand inventory 37		117	117	117					
Planned receipts					3		150	120	
Planned order releases			3		150	120			

Explosion of Seat Subassembly

Item C: Seat subassembly								
Lot size: 230								
Lead time: 2 weeks	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Planned receipts				230			230	
Planned order releases		230			230			



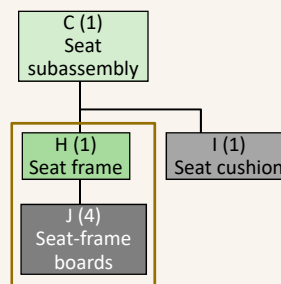
Item H: Seat frames								
Lot size: 300								
Lead time: 2 weeks	Week							
	1	2	3	4	5	6	7	8
Gross requirements		230			230			
Scheduled receipts		300						
Projected inventory	40	40	110	110	110	180	180	180
Planned receipts					300			
Planned order releases			300					

Item I: Seat cushion								
Lot size: 141								
Lead time: 1 week	Week							
	1	2	3	4	5	6	7	8
Gross requirements		230			230			
Scheduled receipts								
Projected inventory	0	0	0	0	0	0	0	0
Planned receipts		230			230			
Planned order releases	230			230				

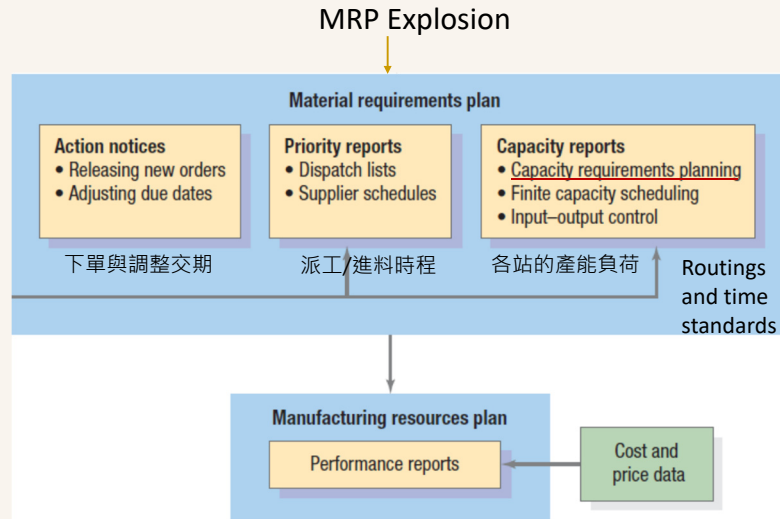
Explosion of Seat Frames

Item H: Seat Frames								
Lot size: 300								
Lead time: 1 week	Week							
	1	2	3	4	5	6	7	8
Gross requirements			230			230		
Planned receipts						300		
Planned order releases			300					

Item J: Seat frames board								
Lot size: 1500								
Lead time: 1 week	Week							
	1	2	3	4	5	6	7	8
Gross requirements				1200				
Scheduled receipts								
Projected inventory	200	200	200	500	500	500	500	500
Planned receipts				1500				
Planned order releases			1500					



Outputs from MRP



Improvements in the MRP System

缺點1：細部產能規劃不周全

早期MRP未考慮瓶頸工作站的產能限制

對策：**Capacity Requirement Planning**確認各站是否有足夠產能達成MRP的要求，並考慮替代作業路徑、加班、外包等補救措施。

缺點2：容易受不確定因素干擾

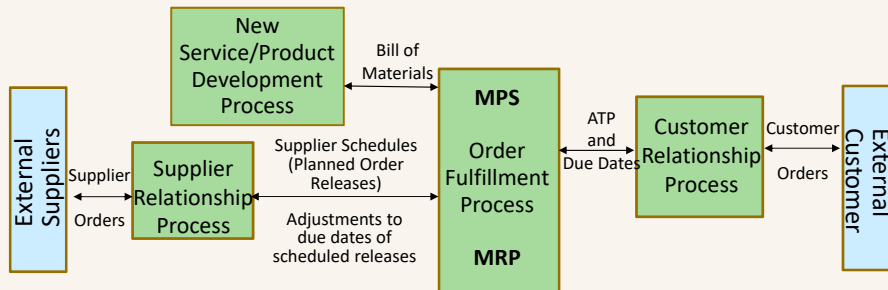
不良率、設備故障、供應商交貨延誤

對策：增加safety stock以防不良品過多、低估產能以防故障、加入採購的安全前置時間。

Regenerative system: Updates MRP records periodically

Net-change system: Updates MPR records continuously

MRP, Core Processes, & Supply Chain Linkages



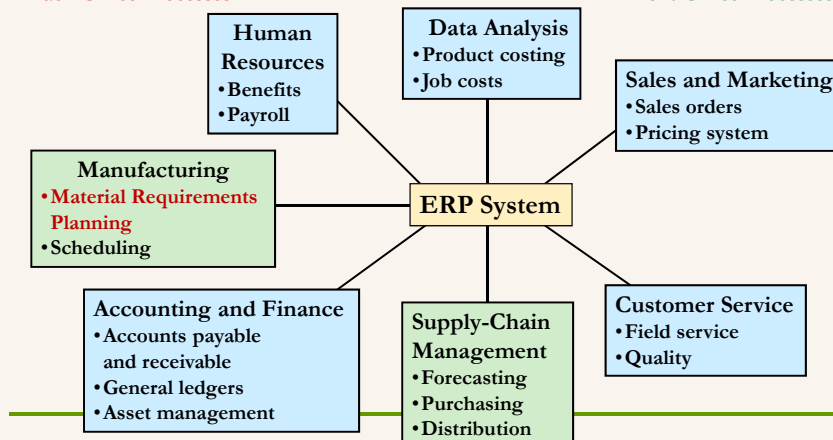
Objectives: 有效控制物料需求、確保MPS可行、協助供應商提前計畫

Closed Loop: 若因產能不足或供料延誤，使實際進度與計劃有出入，當執行上有嚴重差距時，則需往上修改MPS，再重新產生MRP

Enterprise Resource Planning

A companywide process that cuts across functional areas, business units, geographic regions, product lines, suppliers, and customers

Back-Office Processes ← → Front-Office Processes

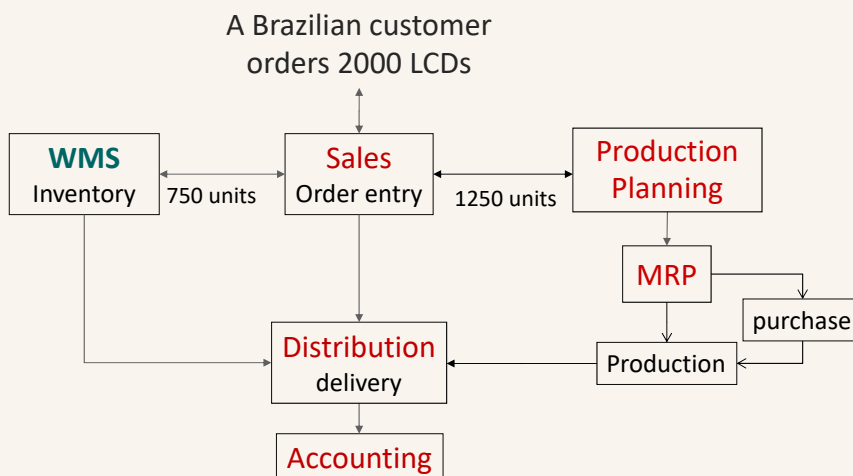


How ERP Systems Are Designed

- ERP revolves around a single comprehensive **database**. The database collects data and feeds them into the various modular applications (or suites) of the software system.
- As new information is entered as a **transaction** in one application, related information is **automatically updated** in the other applications, including the firm's financial and accounting databases, its human resource and payroll databases, sales, supplier and customer databases...
- Designing an ERP system requires that a company carefully analyze its major processes... Sometimes, a company's processes ... must be **completely reengineered** before the firm can enjoy the benefits of an integrated information system.

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An ERP Example



26

One Nestle, One System



- 1997年，雀巢美國分公司發現所屬各單位的香草料號不同，向同一供應商採購的香草有29種不同的價格！
- 1997年10月，雀巢美國分公司召開ERP誓師大會，由50名高層經理和10名IT專家組成實施小組，制定一套對各單位都適用的資訊系統，所有製造、採購、會計、銷售等功能，都必須拋棄過去的作業方式，接受新思維。
- 雀巢宣布實施ERP之後，恆生銀行對雀巢股票做了降級處理，從長遠意義來看，ERP會給雀巢帶來好處，但就中短期影響而言，因為“ERP實行**集權化管理**，將觸及原來分散式的企業文化，一旦觸及公司文化的深層，風險就會不期而至。”

ERP系統當機可能癱瘓企業的運作