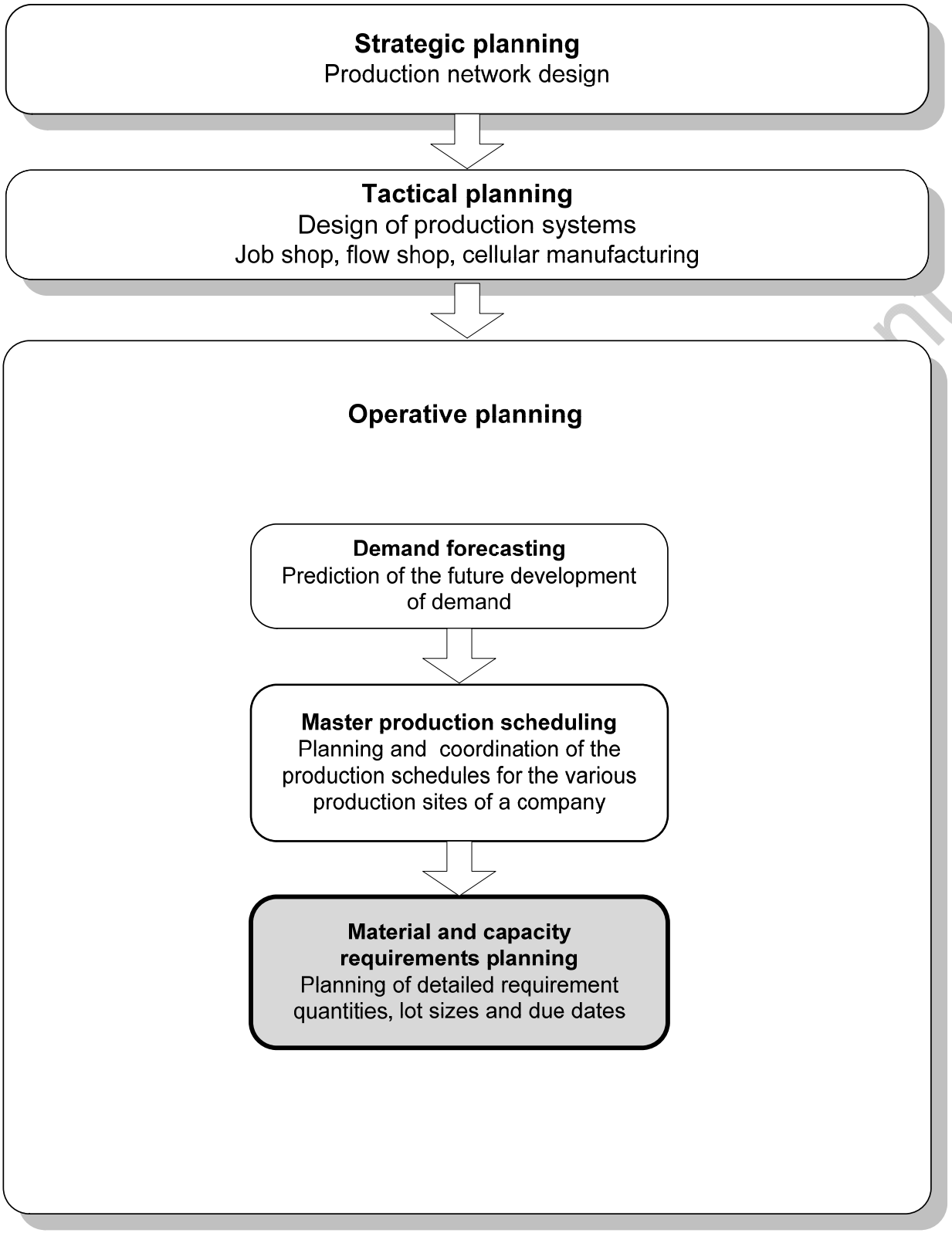
6. Material requirements planning


Strategic planning
Production network design
Tactical planning
Design of production systems
Job shop, flow shop, cellular manufacturing
Operative planning
Demand forecasting
Prediction of the future development of demand
Master production scheduling
Planning and coordination of the production schedules for the various production sites of a company
Material and capacity requirements planning
Planning of detailed requirement quantities, lot sizes and due dates

6. Material requirements planning

Modes of material requirements planning (MRP)

1. Independent demand

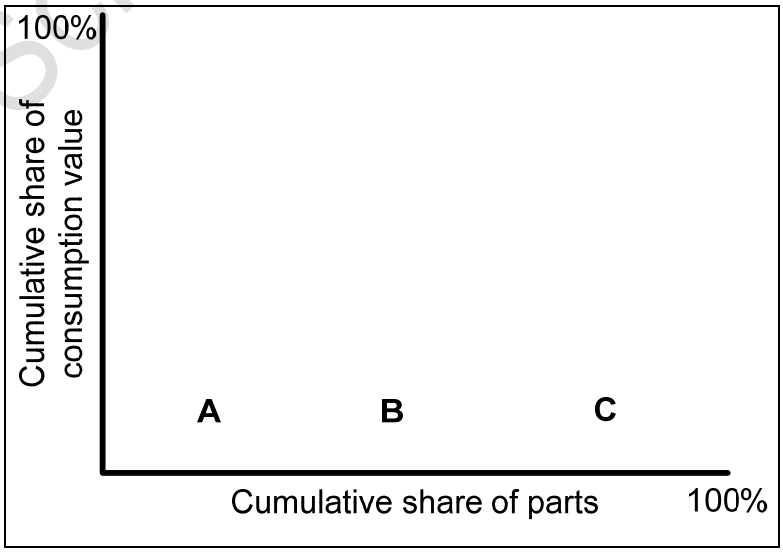
2. Dependent demand

- **ABC classification of parts**

Supports the choice between independent and dependent MRP calculations

Part	Consumption value per year
1	50
2	150
3	5
4	400
5	20
6	100
7	250
8	25
Total	1000

Part	Consumption value per year	Cumulative share of parts	Cumulative share of consumption value
Total	1000		



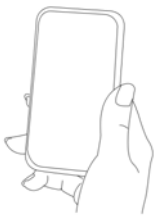
Dependent demand

- **Product structures**

Example

The composition of a product can be described as follows. Final product 1 consists of two units of sub-assembly 2 and one unit of sub-assembly 3. The requirements per unit of sub-assembly 2 are two units of raw material 5 and three units of raw material 6. The requirements per unit of sub-assembly 3 are one unit of sub-assembly 2 and one unit of raw material 4. Final product 7 consists of one unit each of sub-assemblies 3 und 8 and six units of raw material 5. Sub-assembly 8 is made from five units of raw material 6.

- **Complete product structures (according to manufacturing level)**



(1) How many manufacturing levels are required for product 7?

a. 1
b. 3
c. 4
d. 6

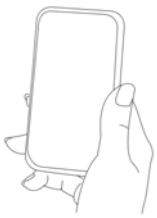
- **Part usage – where used list**

Part	1	2	3	4	5	6	7	8
Used for (quantity)								

- **Complete product structures (according to low-level codes)**

  Low-level code = lowest manufacturing level at which a part occurs

Low-level code	Part
0	
1	
2	
3	



(2) The total number of levels used for low-level coding is always

a. smaller or equal to the number of manufacturing levels
b. larger or equal to the number of manufacturing levels
c. equal to the number of manufacturing levels
d. 4

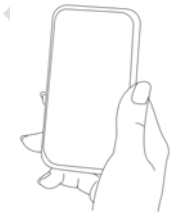
- **Single-level bill of material (BOM)**

- **Gozinto graph**

- **Full bill of materials (BOM)**

Final product 1	
Part	**Quantity**
2	
3	
4	
5	
6	

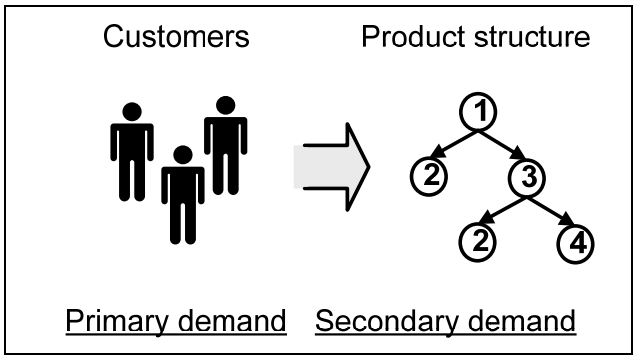
Final product 7	
Part	**Quantity**
2	
3	
4	
5	
6	
8	



(3) How many units of the products 2-6 and 8 are needed to produce one unit of product 7?

a. 1,1,1,7,8,1
b. 1,1,1,8,6,1
c. 1,1,1,7,6,1
d. 1,1,1,8,8,1

- **Calculation of requirements**



  - Primary demand

  - Secondary demand

  - **Procedure**

For all low level codes $s = 0,...,S$

For all products $k \in K(s)$ within the level

For all periods $t = 1,...,T$

.....

  - **Gross requirement (k,t)**

- **Projected available inventory (*k*,t)**

  = Physical inventory (*k*, at the beginning of *t*)
  + Scheduled receipts (*k*,*t*)
  – Reserved inventory (*k*,*t*)
  – Safety stock (*k*,*t*)

Example

Determine the projected available inventory of some product *k* at the beginning of period *t*, if 100 units are physically available, receipts of 200 units are scheduled resulting from a previous production order, 30 units are reserved for special orders and safety stock is 10 units?

- **Net requirement (*k*,*t*)**

  = max {gross requirement (*k*,*t*) – projected available inventory (*k*,*t*); 0}

Example

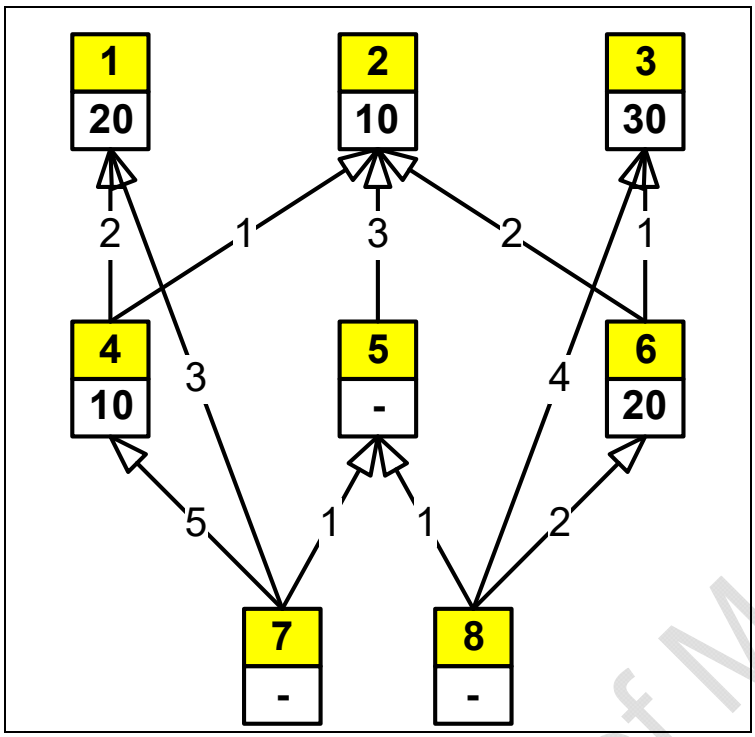
Determine the net requirement of some product *k* for period *t*, if gross requirement is 500 units and the projected available inventory is 260 units. Do the same for a gross requirement of 200 units.

- **Lead time adjustment**

- **Production or procurement order**

Calculation of net requirements (multiple product level, single-period demand)

Demand for final products 1, 2 and 3 and parts 4-8 is given in the following Gozinto graph. Determine the net requirements

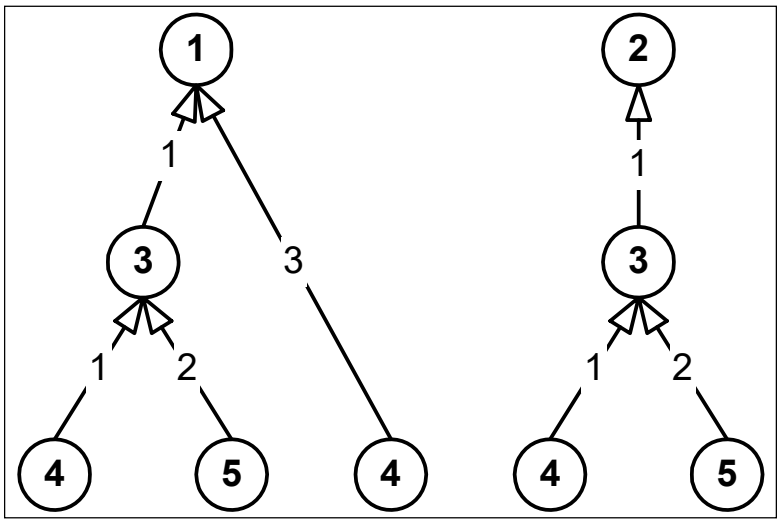


(4) What is the net requirement for products 6, 7 and 8?
a. 60, 65, 100
b. 0, 65, 100
c. 40, 65, 50
d. 0, 65,50

Product	Primary demand	Secondary demand	Gross requirement	Initial inventory	Net requirement
1	20			5	
2	10			-	
3	30			10	
4	10			70	
5	0			10	
6	20			80	
7	0			-	
8	0			50	

Exercise: multi-period material requirements planning

For the manufacture of final products 1 and 2, sub-assembly 3 and raw materials 4 and 5 are needed. Product structures are given as follows.



Future production orders are 10 and 40 units for final product 1 in periods 3 and 5 and 40 and 140 units for final product 2 in periods 1 and 4. Sub-assembly 3 has primary demand of 30 and 20 units in periods 3 and 5.

Assume that lot sizes correspond to period requirements. In addition, the following data are given.

Product	3	4	5
Initial inventory	200	100	180
Safety stock (sst)	30	-	-
Lead time (z)	2	2	3

Which production orders have to be released for products 3, 4 and 5 in the course of the next six weeks?

Low level	Pro-duct		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
0	**1**	Production orders			**10**		**40**	
0	**2**	Production orders	**40**			**140**		
1	**3**	Primary demand			**30**		**20**	
		+ Secondary demand						
		Gross requirement						
		Physical inventory	**200**					
	sst=30	Available inventory						
		Net requirement						
	z=2	Production orders						
2	**4**	Gross requirement						
		Physical inventory	**100**					
	sst=0	Available inventory						
		Net requirement						
	z=2	Production orders						
2	**5**	Gross requirement						
		Physical inventory	**180**					
	sst=0	Available inventory						
		Net requirement						
	z=3	Production orders						

How would your solution change if a receipt for product 5 of 50 units at the beginning of week 3 could be scheduled?

Low level	Pro-duct		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
2	**5**	Gross requirement		**100**	**120**			
		Physical inventory						
		Scheduled receipt			**50**			
	sst=0	Available inventory						
		Net requirement						
	z=3	Production orders						