

PLANNING STARTING FROM COMPUTER AIDED PRODUCTION MANAGEMENT

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Abstract. The issue of a director production plan allows getting a global idea concerning what it is feasible in an organization taking into account predictable requirements and available capacities. On the issue of this stage, the organization has a plan which must be applied in order to define precise fabrication and purchase orders. It is the net necessities calculation. Net necessities calculation or Material Requirement Planning (MRP) is an assembly of techniques using nomenclatures, supplies condition in order to generate fabrication and purchase proposals for the set of articles at all the nomenclatures levels starting from director production plan. Moreover, if there is the case, it supplies priorities among fabrication orders to be launched. It is a means of managing supplies. Today it is considered a planning instrument. Taking into account the volume of data and their numerous interactions, it is necessary to be used IT MRP soft in order to perform these calculations: this is a management pro soft for computer aided production management. In this work let's illustrate the principle of necessary components through an example, an organization which assembles an industrial product and manages its production starting from a computer aided production management system based on MRP principles.

Keywords: management, material requirement planning

1. Introduction

The first applications to calculate net necessities were performed in the USA by Orlicky. In 1965, Joseph Orlicky noticed that the necessities, expressed to the management of a company are the following two types:

- Independent necessities coming from external sources: sources which are not dependant on the company's will. Independent necessities are usually end products or spare parts necessities.
- Dependant necessities are calculated starting from independent ones. The simple decision to manufacture a subassembly will generate necessities for each of the subassembly's parts. Subassemblies production induces necessities which depend on these parts. Reported to dependant necessities, independent ones represent a more irregular consumption profile and they need the use of statistic methods.

The issue of a director production plan allows getting a global idea concerning what it is feasible in an organization taking into account predictable requirements and available capacities. On the issue of this stage, the organization has a plan which must be applied in order to define precise fabrication and purchase orders. It is the net necessities calculation.

Net necessities calculation or Material Requirement Planning (MRP) is an assembly of techniques using nomenclatures, supplies condition in order to generate fabrication and purchase proposals for the set of articles at all the nomenclatures levels starting from director production plan. Moreover, if there is the case, it supplies priorities among fabrication orders to be launched. It is a means of managing supplies.

Today it is considered a planning instrument: *What is there ordered? How much is there ordered? When is there ordered? When is delivering programmed?*

The demand must be predicted (articles from Director Production Plan) managed through provisions) and the dependant demand can be calculated (articles from Material Requirement Planning).

Taking into account the volume of data and their numerous interactions, it is necessary to be used IT MRP soft in order to perform these calculations: this is a management pro soft for Computer Aided Production Management (CAPM).

Starting from physical data (available supplies, expected deliveries, production capacities) and financial ones (production costs, purchase costs, interruption costs), these tools thus

establish a production plan which determines for each period the amounts which must be produced, the amounts manufactured for each charge post, the level of the supply in semi finite and finite products and the use of resources (work force and machines). Computer Aided Production Management allows thus the automation of a difficult series of calculations respecting data which concern the product and the fabrication range (nomenclature, charge post...). CAPM pro soft has a unique database and interface

possibilities with other IT systems of the organization (predictions, orders, accountability) (figure 1.). This pro soft is organized nowadays as a system of totally integrated production management. They work from the top with more information and with their validation. This is called MRP closed loop. Thus, one reaches a planning method of the assembly of resources of an industrial organization, supplying an operational planning of the quantity, a financial planning allowing simulation.

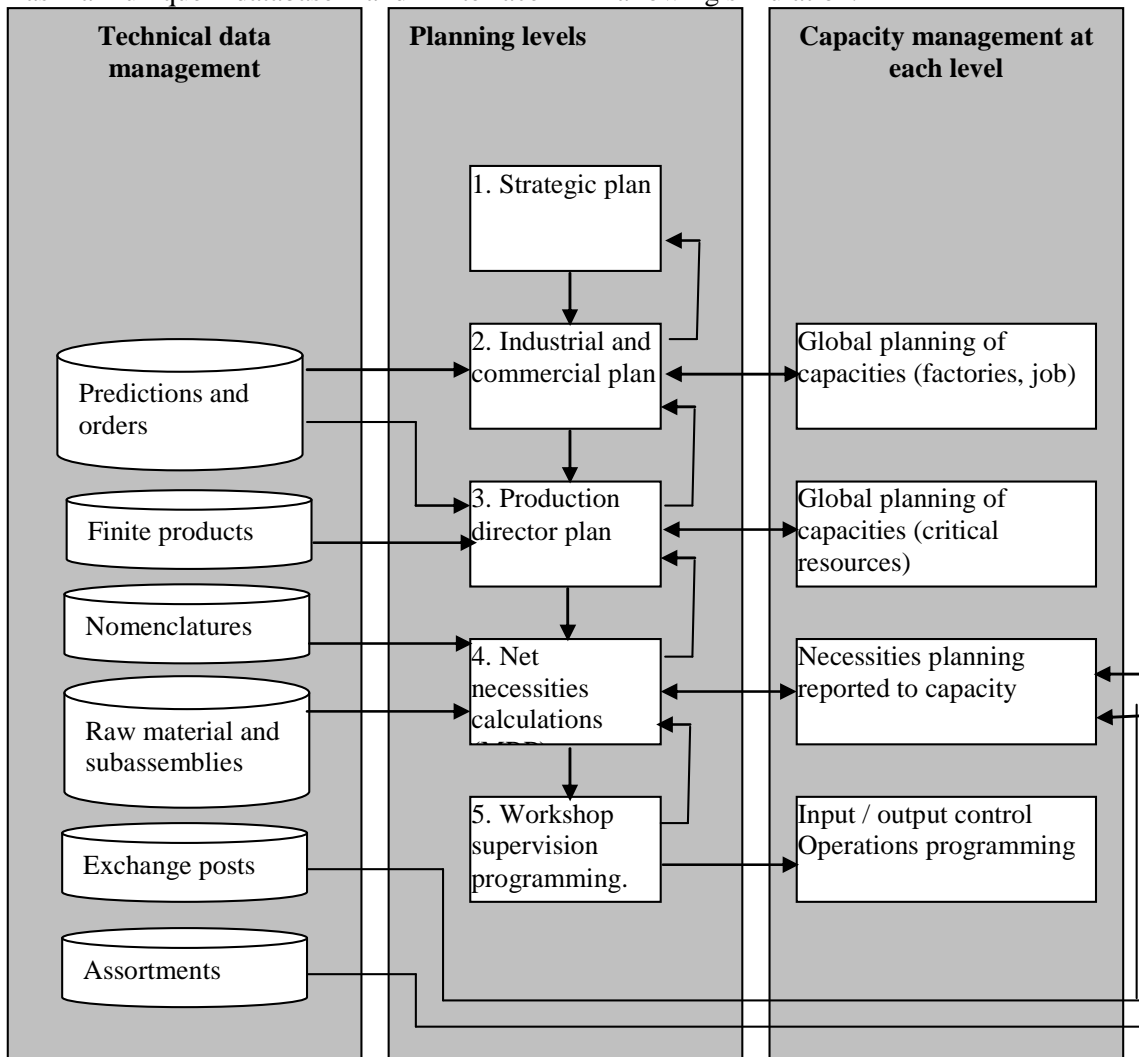


Figure 1. Global demarche of an MRP

The method MRP2 [1, 2, 3] consists of a high number of interconnected functions: strategic plan, industrial and commercial plan, managing production plan, planning necessities reported to capacity and monitoring plans execution. Data coming from this method are integrated in the activity plan, orders engagement, expedition budget, predictable supplies valorisation.

2. Planning necessary components

Let's illustrate the principle of necessary components through an example: let's consider an organization which assembles an industrial product and manages its production starting from a Computer Aided Production Management (CAPM) system based on Material requirement planning (MRP) principles.

The organization is based on a unique

product with high VAT, reference A. The planning of the necessary components requires the existence of more elements:

- A complete nomenclature: this means a codification of all the components under a tree like structure. In the example, in order to do a unit of the product A, there are necessary two units of the component B, which is made of three components C and five components D (figure 2), [2];

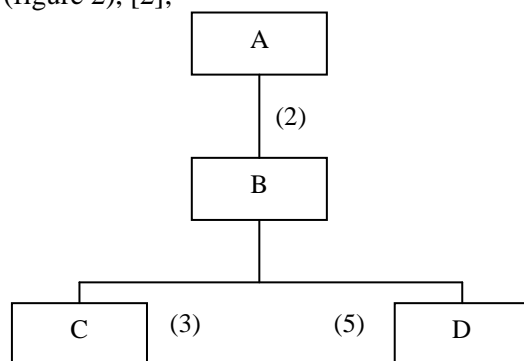


Figure 2. Splitting up components

- A production director plan: the production director plan is the plan which makes available end products. It can also contain the plan of making available subassemblies or components sold as spare parts. Production director plan it predicts only the availability of end products (table 1);

Table 1. Production director plan

Week	Demand A	Spare parts		
		B	C	D
1	200	0	0	0
2	200	0	0	0
3	250	0	0	0
4	150	0	0	0
5	200	0	0	0
6	250	0	0	0
7	150	0	0	0
8	250	0	0	0
9	200	0	0	0
10	200	0	0	0
11	250	0	0	0
12	250	0	0	0

- An information system about supplies, which allows the knowledge of the initial supply condition and of the intermediate stages of each component at the beginning of each period. The supplies available at the end of each period t (symbolized AS_t) are given in the table 2;

Table 2. Articles file

Reference	A	B	C	D
Initial supply	0	500	500	500
Intermediate processed parts	200	400	1000	2000
Intermediate processed parts delivery week	1	2	2	2
Purchase strategy	Q-variable	Q-fix 400	Q-fix 1000	Q-fix 3000
Purchase term during the week	1	2	3	4

- A file of expected deliveries: This means one giving the number of parts resulting from previous orders which have not been delivered yet. Expected deliveries during each period t , in this case of intermediate parts processed, as well as purchase strategy given in the table 2;
- A file concerning purchase term: purchase term is the sum of operational times, of production launching and of expectancy between two productions. Purchase terms are given in table 2;
- A file concerning production centres capacity for each period of the planning interval;
- A file concerning fabrication assortments consolidated through the work post (table 3).

Table 3. Fabrication assortments

Reference	Work post WP	Adjustment time per batch	Processing time per component
A	WP1	30	2.5
B	WP2	10	0.75
	WP1	15	0.5
C	WP3	15	0.3
	WP2	15	0.25
D	WP2	25	0.75
	WP3	30	0.15
	WP1	75	0.5
	WP3	30	0.75

3. Main MRP principles

MRP calculation logic consists in the tandem use:

- To establish a component net necessities;
- The way to cover these necessities.

The calculation starts with the remark that the necessities of inferior levels of nomenclatures are directly connected to the necessities of superior levels (attached or dependant needs), [3].

The calculation takes into account the existent supplies at all the levels and the fabrication cycles of each part, in marking the necessities. MRP also supposes the availability of the required

capacity. NNC has, in general, the same planning interval and the same frequency as DPP.

3.1. Establishing net necessities of a component

Starting from the director program which is considered feasible, you can calculate the needs to plan fabrication orders. It will be noted:

- BN_t : brute needs on time;
- ER_t : expected receptions of intermediate parts, time t ;
- AS_t : Available supplies on time t ;
- NN_t : Net needs on time t ;
- LPO : launching proposed order.

Establishing a net need, this means those which will need new production launching orders taking into account two cases:

Case 1: What is available is enough to cover brute needs. In this case, the net need, noted NN in the time interval is zero and the final supply of the period, noted AS_t , is calculated as supply at the end of the previous period, increased with the expected deliveries in the time t , noted ED_t and subtracted from the period demand (brute needs, noted BN_t):

$$AS_{t-1} + ER_t \geq BN_t \Rightarrow NN_t = 0$$

$$AS_t = AS_{t-1} + ER_t - BN_t \tag{1}$$

Case 2: On the contrary, there are net needs to cover through new fabrication orders. Net needs in the period t , noted BN_t , are calculated as the difference between brute needs and the sum of expected deliveries and of the initial level of the period supply (table 4).

$$BN_t \geq AS_{t-1} + ER_t$$

$$\Rightarrow NN_t = BN_t - ER_t - AS_{t-1} \tag{2}$$

$$AS_t = 0$$

Table 4. Net needs of the component

Week	BN	ED	AS	NN	Production launching
0	0		0	0	0
1	200	200	0	0	200
2	200		0	200	250
3	250		0	250	150
4	150		0	150	200
5	200		0	200	250
6	250		0	250	150
7	150		0	150	250
8	250		0	250	200
9	200		0	200	200
10	200		0	200	250
11	250		0	250	250
12	250		0	250	

3.2. Establishing net needs coverage

In the production planning, it is supposed that net needs are well known before in order to avoid any interruption. Establishing the amount to be delivered in order to satisfy net needs is thus based on an arbitrage between production launching costs and possession costs.

In order to determine production launching, it was taken into account the purchase term supposed here 1, 2, 3 and 4 weeks, respectively for A, B, C and D. Taking into account a purchase term of one week for the component A, launching 200 during period 1 comes from an expected delivery during period 2 in order to satisfy the net need of this period. For the other periods the logic is the same. In order to determine launching time (for the products manufactured) and of the order (for products purchased), one must take into account the delay or time difference necessary to purchase the products. For the products bought, there is the supplier delivery delay. For products manufactured there is the time necessary to perform all the operations to elaborate a products batch. It depends on the fabrication range (table 5).

Table 5. Launching component A into production

Week	NN	Production launching
0	0	0
1	0	200
2	200	250
3	250	150
4	150	200
5	200	250
6	250	150
7	150	250
8	250	200
9	200	200
10	200	250
11	250	200
12	250	

Logically, you will need to take into account production capacities. If these capacities are updated, you will proceed to adjust charge - discharge.

A. Using calculation logic in tandem. Now when the possibility to launch production is determined for the component A, it will serve to calculate the possibility of brute requirements of inferior level components (B). Thus, component A is made of two units of component B (Reference B(2xA) – table 7 and similar, Reference C (3xB) and Reference D (5xB). Will be resulted production launching purpose (table 6). It is applied then the calculation procedure which you have seen, in

tandem, for all the references and levels.

B. Charge adjustment – capacity and global planning of capacities, [4]. When production launching is determined, you can calculate the result for different workshops. In order to obtain a feasible production plan, the resultant charge must respect the production capacity. If there is not the case, an adjustment “charge – discharge” is performed.

Table 6. Production launching purpose

Week	BN	ED	AS	NN	Production launching
0	0		500	0	0
1	400		100	0	300
2	500	400	0	0	400
3	300		0	300	500
4	400		0	400	300
5	500		0	500	500
6	300		0	300	400
7	500		0	500	400
8	400		0	400	500
9	400		0	400	500
10	500		0	500	
11	500		0	500	
12			0		

Table 7. Reference B (2xA)

Week	A	B	C	D
0	0	0	2000	0
1	200	300	1000	3000
2	250	400	2000	3000
3	150	500	1000	3000
4	200	300	2000	3000
5	250	500	1000	3000
6	150	400	2000	
7	250	400		
8	200	500		
9	200	500		
10	250			
11	250			
12				

3.3. Example

Let’s take the available capacity of each work post performing intermediate assembling and the final one 2000 minutes / week. The global charge calculation allows PDD feasibility. This activity can as well be performed before the necessities calculation, starting from DPP. In our example we suppose that the A reference batch size will be the average of 200 units. On this purpose you will calculate the total time of each operation performed per product manufactured. Then you will calculate the time spent at each

work post for each file realized using the assortments file. You can try for example to adjust the charge of different posts per period, reporting or advancing a part of the requirements. This means to check the workshop condition, the resources availability, especially human ones, and to accept these exchanges from the commercial point of view. In order to simplify, we suppose that Director Production Planning (DPP) proposed is feasible.

Order suggested. Director Production Planning (DPP) and Net Necessities Calculation (NNC) don’t generate but orders suggested coherently with other firm or suggested orders. In general it is stored in the memory of the system. If it is not confirmed, it is reminded again at the moment of the new necessities calculation.

Firm order. It is created by an action of the responsible person, starting from the suggested order. Once the order created, it is considered by the system an order which must be necessarily achieved on the occasion of the next calculation of the necessities. The firm order will be taken into account with the orders already launched to be programmed. In order to ease the coordinator’s tasks, with order emission, a listing is edited, containing only the orders which need action. When an order is issued, but it is not launched, the system will examine on each calculation the necessities, if some re-planning actions are necessary, there are generated messages in order to advance or to cancel an order and the coordinator must take it into account.

The order launched. An order launching takes place at the moment of fabrication starting or when the order is approved by the supplier. In the case of a fabrication order, the condition of launched order has as effect:

- a. To provoke components reservation;
- b. To provoke an input into supply of the product manufactured, of the amount concerned, so that the necessities calculation won’t be applied anymore for the components of this product (because they are already attributed).

4. Taking into account random aspects

In the planning by Material Requirement Planning (MRP) method in which launching is positioned since the delivery date and the supplies are optimized, any random aspect for requirements (increasing) or incidents causing rebuts or fabrication delay can trigger lacks and can prevent the assembly of the end product. A small piece

lacking can delay the assembling and the delivery of an end product. In order to face such random aspects production managers will tend to create safety areas. Besides, production managers will protect themselves against these random aspects, implementing safety systems in the management system. Random aspects related to predictions:

Lack of predictions precision and requirements variations can stimulate the maintenance of safety supplies:

- a. A safety supply creating a complementary fictive need launching higher amounts;
- b. An overestimation of units necessary for a product component. It concerns the components which are very old or whose fabrication is not strictly controlled.

Random aspects can as well affect the delay in purchasing a component (longer time of adjustment than it was established, a batch fabrication time, interruption, delivery delay), which will have as consequence the delay of the availability date of the end product. Overcharge at the level of the workshop, waiting rows in front of the machines or priorities logics between batches can as well delay the term of purchasing a part. Production manager will take into account these risks, anticipating the launching of certain fabrication orders or purchase, with a higher delay than the technical necessary time to respect its

terms. Consequently, you can notice that components enter the supply before the real need date and they remain there until their consumption by launched orders.

5. Conclusion

A Computer Aided Production Management pro soft offers the possibility to introduce a waiting time before each operation in the range. The fabrication cycle is thus increased. This allows production managers a certain margin to organize their activity and to remedy possible delays.

References

1. Fota, A., Sârbu, F.A.: *Modelling and simulating techniques of manufacturing and logistic planning systems. Part I.* Bulletin of Iasi Polytechnic Institute. "Gh. Asachi", "Tehnică" University of Iasi, vol. LII (LVI), no.5A, may 2006, p. 355-358, ISSN 1011-2855, Iași, Romania
2. Boncoi, Gh., Calefariu, G., Fota, A.: *Manufacturing Systems. Vol. II,* "Transilvania" University of Brașov Publishing House, 2001, ISBN 973-9474-89-6, Brașov, Romania (in Romanian)
3. Fota, A., Sârbu, F.A.: *Modelling and simulating techniques of manufacturing and logistic planning systems. Part II.* Bulletin of Iasi Polytechnic Institute. "Gh. Asachi", "Tehnică" University of Iasi, vol. LII (LVI), no.5A, may 2006, p. 359-362, ISSN 1011-2855, Iași, Romania
4. Tarondeau, J.: *Industrial strategy (Strategie industrielle).* Paris, Vuibert, 1998 (in French)