The International Journal of
TRANSPORT &*LOGISTICS*
Medzinárodný časopis
DOPRAVA A LOGISTIKA

ISSN 1451-107X

APPLICATION OF THE SCM PRINCIPLE AMONG OBJECTS OF THE ONE COMPANY FROM THE POINT OF CAPACITY PRODUCTION PLANNING

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Abstract: *If the object of SCM is from the one company, the SCM has similar relations as in KANBAN. SCM integrates advantages both basic production strategies PULL and PUSH. The paper describes the capacity production model creation in the conditions, when the company is object of SCM-KANBAN.*

Key words: *SCM, Push and Pull strategy, capacity planning model.*

1 INTRODUCTION

Basic production strategies – PULL and PUSH have advantages and disadvantages too. Production strategy choice, connected on the many factors: [4]

- position on the market,
- position in SCM,
- the volume of orders and level of capacity utilization of the technologies and workers
- type of product.

In the market economy it is dominant PULL strategy – production to orders, which is apply in the production management through capacity production planning. [7]

Advantages PULL strategy are:

- manufacturing the products in on orders – small risk for sale of this products,
- lean manufacturing (small stock).

Disadvantages PULL strategy:

- longer production cycle (materials, components are ordered in the moment acceptance orders),
- longer delivery time,
- uneven production capacity utilization,
- small production batches, less productivity, opposite to the PUSH.
- higher cost for wages. [4]

Advantages of PUSH strategy:
- uniform capacity utilization,
- higher production batches and productivity,
- short delivery time,
- higher flexibility to market.

Disadvantages of PUSH strategy:
- uncertainty of product sale,
- bigger stock. [8]

When comparing advantages and disadvantages booth production strategies, they are almost inversed, i.e., what is the advantage in one strategy in the second is disadvantage.
The theory of management and logistics try to create the methods which apply advantages both strategies. One of these methods is SINCRO-MRP. Production process is divided to two parts PP1 and PP2. In the PP1 is apply PUSH system and in part PP2 is apply PULL strategy. (Fig. 1)

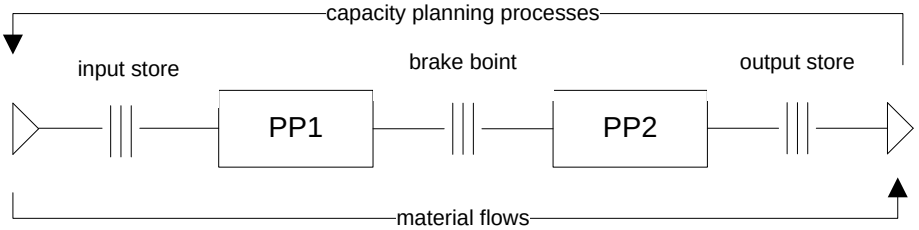


Fig.1*SYNCRO MRP concept*

Another option of combination advantages PULL and PUSH strategy is SCM. In SCM, at the information exchange EDI, object of chain i.e. N3 (Fig.2) sends for object N2 manufacturing forecast of few weeks ahead. Object N2 can take this information, with big probability, as "future orders". In this case, on the next planning period (week), its production capacity are not utilized on the asked level, this orders can be manufactured in the store S2. In this case that the objects of the company create the SCM, and dominant company of the S2 – in Push strategy [7]. CM is "mother company" i.e. N3 and "daughter company" is object N 2 relations between this objects is an in KANBAN, processes in object N2 is indicated from object N3.[1]

2 APPLIED METHODS AND METHODOLOGY FOR CPP MODEL DESIGN

2.1 STRATEGIES OF CPP

Very often, a manufacturing process is realized in some production departments. By the optimization of criteria and technological, economic, environmental constrains, there can be selected two basic strategies. [8, 9, 11]

A)The open system of CPP – open system means that product in one planning period (week) pass through some production department. Capacity planning in this case has to coordinate operation amount this production department to keep DDI. The creation CPP model on this strategy is very complicated.

B)The closed system of CPP – this strategy define that operations on some product is realized in one planning period (week) only in one production department.

The selection of the strategy is influenced from the production cycle, delivery cycle and from type of dominant optimization criterion. When it is dominant technological optimization criterion, in this case, it is better to apply close strategy. Opposite: when it is dominant economic and trade optimization criterions, in this case, there are recommended open system. [13]

2.2 PUSH AND PUSH STRATEGY

The application of the push system is not simply in production to storage. The push system can involves forecasting to meet customer demand. Companies must predict, which products will customers purchase along with determining, what quantity of goods will be purchased. The company will turn to produce enough products to meet the forecast demand and sell, or push, the goods to a consumer. Disadvantages of the push system are that forecasts are often inaccurate as sales can be unpredictable and vary from one year to the next. This increases the company's costs for storing these goods. An advantage to the push system is that the company is fairly assured it will have enough products on hand to complete customer orders, preventing the inability to meet customer demand for the product. [14]

The pull system begins with a customer's order. With this strategy, companies only make enough products to fulfill customer's orders. One advantage to the system is that there will be no excess of inventory that needs to be stored, thus reducing inventory levels and the cost of carrying and storing goods. However, one major disadvantage to the pull system is that it is highly possible to run into ordering dilemmas, such as a supplier not being able to get a shipment out on time. This leaves the company unable to fulfill the order and contributes to customer dissatisfaction. An example of a pull inventory control system is the just-in-time, or JIT system. The goal is to keep inventory levels to a minimum by only having enough inventories, not more or less, to meet customer demand. The JIT system eliminates waste by reducing the amount of storage space needed for inventory and the costs of storing goods. [1]

2.3 SCM - KANBAN CPP

KANBAN is one of the Lean tools designed to reduce the idle time in a production process. The main idea behind the KANBAN system is to deliver what the process needs exactly when it needs it.
In Japanese, the word “Kan” means "visual" and "ban" means "card," so Kanban refers to visual cards. Lean uses visual cards as a signaling system that triggers an action to supply the process with its needs either from an external supplier or from a warehouse.

Kanban was originally invented as a part of the famous Toyota Production System. It is associated with the design of pull systems and the concept of delivering just-in-time goods [3].

The concept is that each process manufactures each component in line with another department to build a final part to the exact expectation of delivery from the customer. Because your production process is designed to produce only what is deliverable, your

business becomes leaner as a result of not holding excessive stock levels of raw, partly-finished, or finished materials.

Just-in-time is a "pull" system of production, so actual orders provide a signal for when a product should be manufactured. Demand-pull enables a firm to produce only what is required in the correct quantity and at the correct time. This means that stock levels of raw materials, components, work in progress and finished goods can be kept to a minimum. This requires a carefully planned scheduling and flow of resources through the production process.

Modern manufacturing firms use sophisticated production scheduling software to plan production for each period of time, which includes ordering the correct stock. Information is exchanged with suppliers and customers through an Electronic Data Interchange (EDI) to help ensure that every detail is correct.

There can be defined tree basic SCM system (7):

A) The SCM established of exchange of information (EDI) about forecast or manufacturing plan among the member of the SCM agreement. The forecast is the only information for supplier is not binding, it has only information character.

B) Enterprise N1 receives or gains the manufacturing plan forecast of enterprise N2 and N2 enterprise will specify, how big the stock produced by N1 should be e.g. in T_1, T_2 .....T_N period in the exit warehouse of N1 company. The same will apply for N3 enterprise, which will specify the volume of inventory for the same T_1, T_2 .....T_N period as in N_2 enterprise etc. (see the Fig. 2). This will enable to manage these enterprises in the long run and to increase the uniformity of production, to create optimum production batches, and to generate internal orders by accumulation of a larger number of orders for a longer period of time. However, this all is just a forecast. As a part of this forecast business is carried out on the basis of particular orders. The supply chain is mostly initiated by the companies with the strongest position in the chain or based on the agreement of all companies becoming a part of this chain.

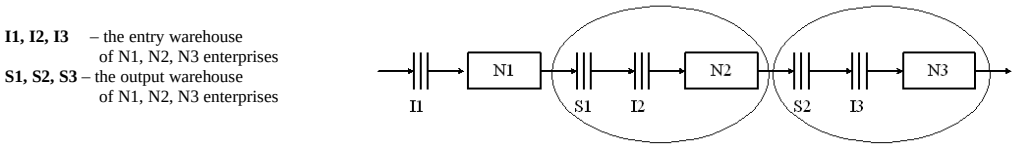


Fig.2 *The principle of SCM-KANBAN*

C) Demand chain. This philosophy has recently let mainly bigger pressure from chain dominant enterprises that specify, for their sub-suppliers, the volume of products and the period (T_1, T_2 .....T_N), in which the given volume should be either in a warehouse close to their premises or directly in entry i.e. disposition warehouses. The above-mentioned goods will be owned by the supplier up to the moment of their release from the disposition warehouse. Once released the following will take place: deal – order – invoice – payment to the sub-supplier. We would like to emphasize once more, that the goods in disposition warehouses are owned by sub-suppliers, which forces each enterprise in the chain to make its sub-suppliers create I0, I1, I2 dispatch stocks in their warehouses (see the Fig. 3).

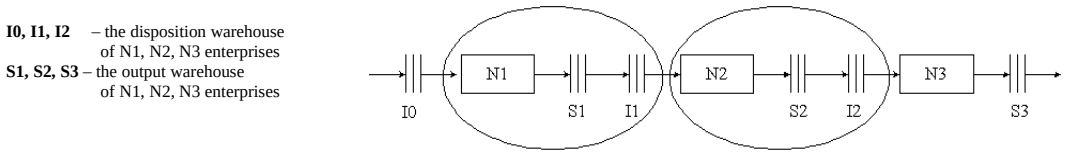


Fig.3*The principle of demand chain application*

If subject of SCM N1 and N2 are member of one company (N1 is daughter, N2 is mother company) in this case SCM is KANBAN.

Now we take a case, if the N1 and N2 are in second type of SCM, i.e. N2 define the level of storage products in the KANBAN (output buffer) for N1 and levels of product are define to the end of planning period (month).

The model of capacity planning company N1 must respect this information – regulation – limitation. The model of CPP utilized this KANBAN buffer as regulation element it means: in the case, when it is not enough order capacity possibilities of the machine workshop utilization information about level of the product in the KANBAN buffer as virtual order which is assignment to capacity plan ($CP_J > CN_J$).

In the case, when ($CP_J < CN_J$) in the beginning of the planning period we utilized product from the KANBAN buffer for fulfilling the orders of the customer and by this way are decreased CN_J on the planning period.

Disadvantage to create the KANBAN buffer and its maintenance become advantage when model of CPP has assemble the regulation element, it is described in Fig.4.

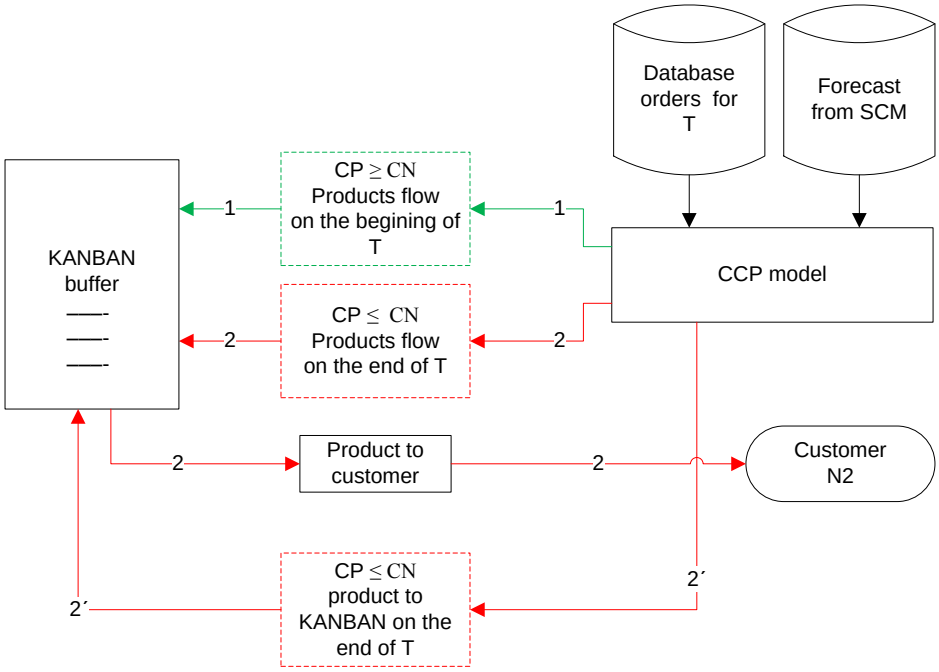


Fig.4 *Utilization of KANBAN- buffer for capacity regulation*

2.4 THE HEURISTIC APPROACH IN DESIGN OF CPP MODEL

Heuristic approach of the synthesis LS assumes modelling of process principles as processing of information carried out by a man on various phases of his activities and while solving various tasks. This approach then bases on a principle of heuristic model creation. In the next, is described the example of the heuristic model synthesis for the operative planning and production scheduling model.

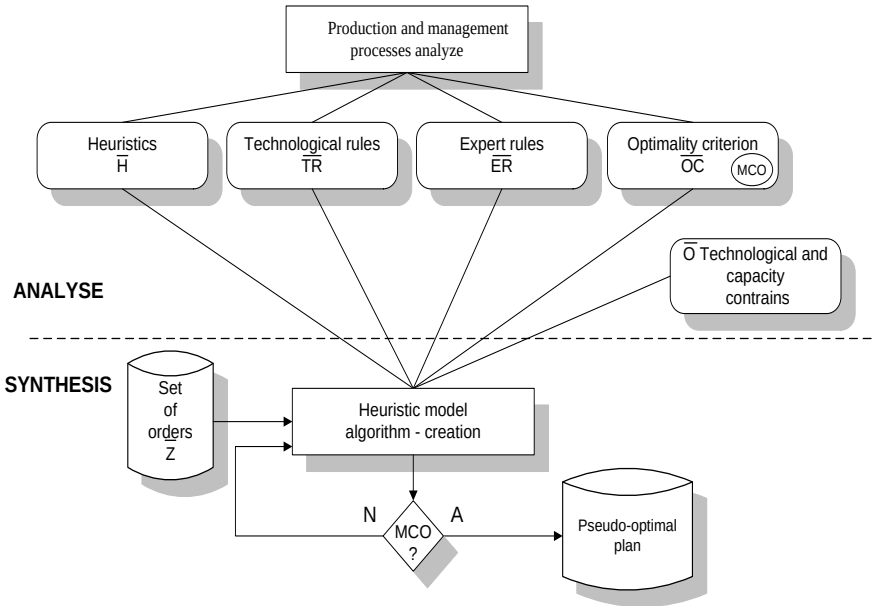
Sequences of steps during creation of such heuristic model:

a) Definition of initial situation (problem definition).
b) Creation of possible variants for further situations (possible solutions).
c) Rule creation.
d) Heuristic model synthesis.
e) Heuristic model verification.

The sequences of steps for creation of such heuristic model are illustrated on a fig. 3. Definition of rule set is performed as the result of analysis, technological processes, machines, equipment, organization and manufacturing process management, economy, capacity and optimality criterion.

Particular process, e.g. planning, has particular entry file of orders and by its analysis the rules were defined, which need to be fulfilled by the planning process.

The synthesis objective is to create an algorithm or model from these rules and from the



definition of entry files structure.

Fig.5 *The schema of the creation heuristic model [4]*

Set of rules $\{\overline{R}\} \in \{\overline{H}, \overline{TR}, \overline{ER}, \overline{O}, \overline{CO}\}$ comprise of following groups:

- Heuristic - $\overline{H}$
- Technological rules - $\overline{TR}$
- Expert rules - $\overline{ER}$
- Constraints - $\overline{O}$
- Optimality criteria - $\overline{OC}$

3 PROPOSAL OF CAPACITY PLANNING MODEL IF COMPANY IS OBJECT SCM-KANBAN SYSTEM

The CPP model is designed on the heuristic approach. [1, 12,] Source of input information is the file of all orders. Each order has the certain quantity of ordered assortment and due dates. Present capacity planning consists of planning of all orders backwards from due date to first operation. There are calculated latest times of beginning of production and capacity need of each machine by this way, supposed that all income orders are put into production. Next, there is calculated in-process production and purchasing of semi-products, which can relieve capacity need at PP 1. In each production company, including R.S. s.r.o., the capacity calculation have to include unexpected influences (lost times) i.e. breakdowns, increased time of setting etc., which is 10 – 15% of all times. That is why the machines are planned at about between 85 – 90% of their capacity, so this created a kind of time reserve. [10]
The capacity planning comes out from known workload – orders to certain planning period. Its aim is to choose orders from the aggregated orders (file of incoming orders) and to put them into a production plan, into a certain planning period by keeping the following:

- to fulfil required ordered quantities and due-dates for customers,
- to give in balance capacity demands to machines, equipments, workplaces with their capacity possibilities,
- to keep the prescribed store level limits of products in KANBAN warehouse,
- to purchase material, semi-products or sub-deliveries based on capacity plan of production,
- to have the capacity plan as a basis for creation production scheduling, in which there is no need to take care about capacity.

3.1 PARAMETERS AND CRITERIA FOR CAPACITY PLANNING

1. The capacity plan is created for all company and it is divided to:

U1 – cutting, welding, riveting,

U2 – casting and production of aluminium (Al) alloys,

U3 – surfacing, finishing and other finalising.

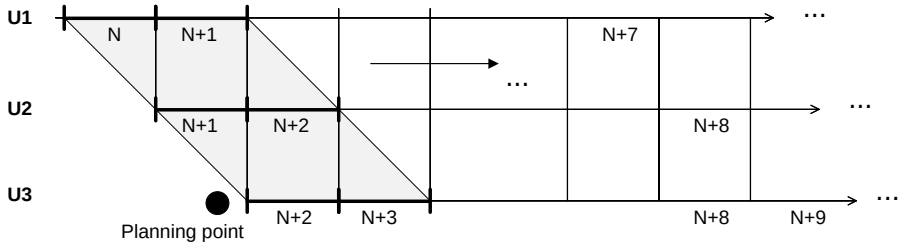


Fig.5 *Planning periods of defined divisions (U1 - U3)*

2. Planning period will be at minimum 8 weeks. Planning point is between 10:00am – 12:00pm on Thursday.

3. There is used the principle of sliding planning, which is performed each Thursday at noon (12.00 o'clock).

4. There is a different obligation in weeks (1st week is definite, 2nd week is preliminary – set at approx. 80%, 3rd week – 8th week is forecasted). The exact authorisation of doing changes have to be defined, e.g. changes for 1st week – only general director can provide changes, for 2nd week – only delegated production supervisors or planner can provide changes, other weeks planner and other entitled persons can provide changes.

5. Planning by PULL system – it means from the end to beginning.

6. The products will have priorities "B" – ordinary, "S" – urgent, "SS" – super urgent.

7. Closed system of capacity planning (phase production) besides the products with priority "S" and "SS" (defined by general director) will be kept, i.e. what is produced at U1 in week N will be processed at U2 in week N+1 and at U3 in week N+2. It results to defined production time, which for "B" products is three weeks, for "S" products two weeks and for "SS" products is one week or orders are completed from KANBAN.

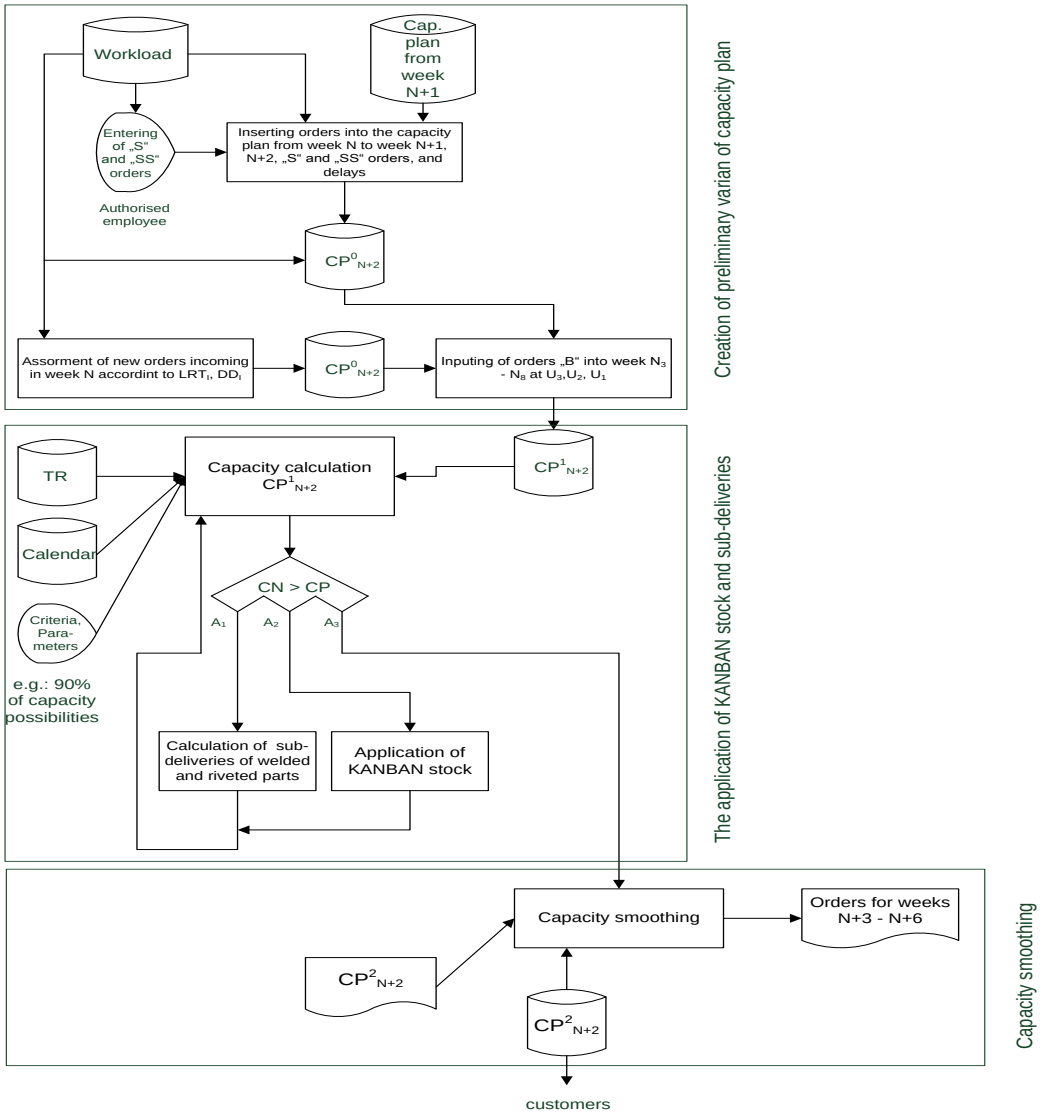


Fig.5 *Algorithm of the capacity planning model*

8. The capacity plan will be created at 90% of maximum capacity (10% is left for unexpected, unaware changes and interactions).

9. Initial variant of plan is created in the way that:

   a) Inputting "S" and "SS" orders into weeks according to DD_I to division U3.

   b) New "B" orders are assorted by: LRT – Longest Remaining Time, i.e. maximum time to their production is:

$$\sum_J MN_I * t_{I,J} = \max$$, respectively according to DD_I to division U3.(1)

   c) Orders are inserted to certain weeks from the end of U3 through U2 up to U1.

d) The capacity calculation is provided and there are calculated CN_J (capacity needs) in certain periods of weeks N+1 - N+8, but planning dead times, compulsory maintenance and in-process production have to be taken into calculation.

10. Calculation of bottle-neck.

11. Solution of bottle-neck through KANBAN stock levels, and point 10 is again repeated.

12. Calculation of sub-deliveries of welded and riveted parts and point 10 is again repeated.

13. The capacity smoothing is possible to reach:

a) By using KANBAN.
b) By moving forward.

By dividing one big order to 2, 3 smaller batches (internal work orders) and moving two, three batches a period back.

4 CONCLUSION

CPP model in manufacturing company is a key element of production logistic of the company. In the condition that company is a subject SCM-KANBAN, can to utilize the SCM-store as a buffer for regulation of the capacity utilization in the company. This paper presented theory and application this idea to CPP model in real company – R.S. s.r.o.

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