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# THE LEVELING

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## 1. Introduction

The goal of a company is the effort to adapt to the customers needs. The customer's orders are not any time regular and the ordered quantities fluctuate. The result of the changes id orders are: capacity problems or the problems with capacity utilization on the other hand and connected high costs. The aim of the leveled production is the ability to produce every day almost the whole spectrum of the products produced on a defined line. We have to bear in mind that we cannot produce the same parts one after another. These concerns the main product types (produced and delivered in higher quantities and frequencies). The products with little sales are placed in a production plan according to the up-to-date need.

By means of the leveling the company attempt to set up the standardized processes, smooth product line utilization, better personal utilization and transparent planning of the product spectrum and quantity. Leveling contributes to the build-up of the daily plan, which aim is the smooth utilization.

## 2. The leveling principles

The leveling supports the principles standardization, continuous improvement, flexibility and transparency.

Standardization

The processes have to be documented, it is necessary to prepare unique instructions for all logistical activities. All activities have to be done according to the directions. The instructions are to be checked regularly, each deviation is to be evaluated and the measurements are to implement. The directions are to up-to-date according to the new factors influencing the logistical processes.

Continuous improvement

Every process underlie to the continuous improvement. The effectiveness of the processes is regularly checked, the value added examined and the loss-making activities are minimized. The news in the logistic area is monitored and after careful analysis is implemented.

Flexibility

This principle focuses on the important activities. The company attempt to reduce the time of the partial activities, the time of the line change over, the replenishment lead time (through the increase of transport effectiveness, the upload and unload times, minimization or elimination of the warehousing). The process is continuously evaluated and the improvements are designed. All activities are to be in conformity with the process of a customer. The method and frequency of deliveries is subordinated to the customer.

Transparency

All processes are to be transparent. External subject have to recognize what is done on the defined work place and what are the main activities. It serves not only to the direct workers but also to other employees of a company. It helps to the orientation in processes. The visual management has to be enough flexible, in the case of a change it has to be easily adaptable.

## 3. The relation leveling and other processes in a company

Leveling is a part of the processes improvement and its function is the linking them and improving them as a whole. Leveling detects the problems in the material flow that are to be solved immediately in order to reach positive effects of the leveling. The process of the change from the batch production to one piece flow touch almost all activities needed to the production management. The leveling relate to:

- Consumption managed inventory – linking of the following processes
- Quick change over – batch reduction
- Internal Milkrun - transport of small batches
- External Milkrun – high frequent transport of small quantities from suppliers

**Why leveling?**

Problems caused by orders fluctuation:

- Too much waste due to production instability
    - Overproduction
    - Lack of parts
    - High stock
    - Long lead times
    - Accidental plan changes
- Order changes to suppliers
- It is not possible to build-up standardized processes

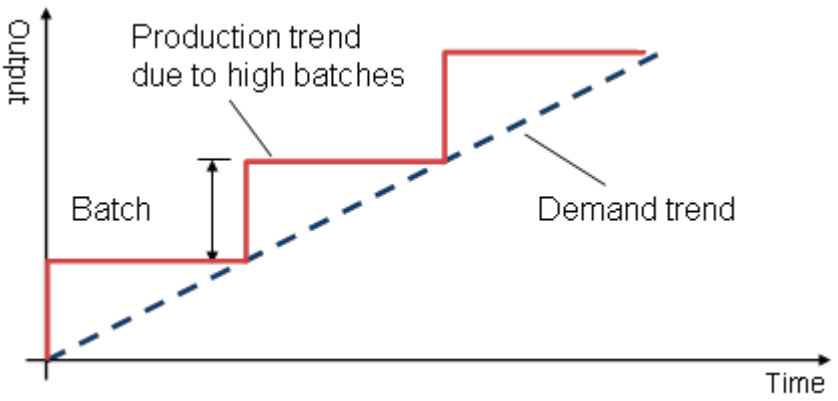


***Fig. 1** Production trend due to high batches*

High batches lead to long lead times and to delayed information transfer. If a company finds out late the increase of the demand for the defined products, it has only a limited possibility to adapt the production plan. The delivery performance is jeopardized and the company is in a delay with the deliveries. It is necessary to increase the production capacity to satisfy the customer demand. A reduction of the orders leads to opposite effect – increase of the stock.

One of the reasons of the long information flows is high batches. As a result of batch assembly the delay in information transfer about consumed material to the following process occurs. This effect is multiplied in the case we have a synchronization in the order moment in the supply chain – all consumption points order by their suppliers at the same time.

The planning process in the case of non-leveled production is following:

1. Comparison of the up-to-date customer demand or the prognosis with the up-to-date stock
2. Decision about the quantity to be produced and the production order, taking the delivery dates into consideration
3. Reaction to the order changes

Due to this planning manner and the existence of more planning levels in the material flow following situations occur:

- Different plans in different periods
- Different ways of information flow
- Non-planned changes of production plan
- Decision due to up-to-date situation and not due to the standardized rules

The variability of the order quantity grows with the distance of the supplier from the end customer:

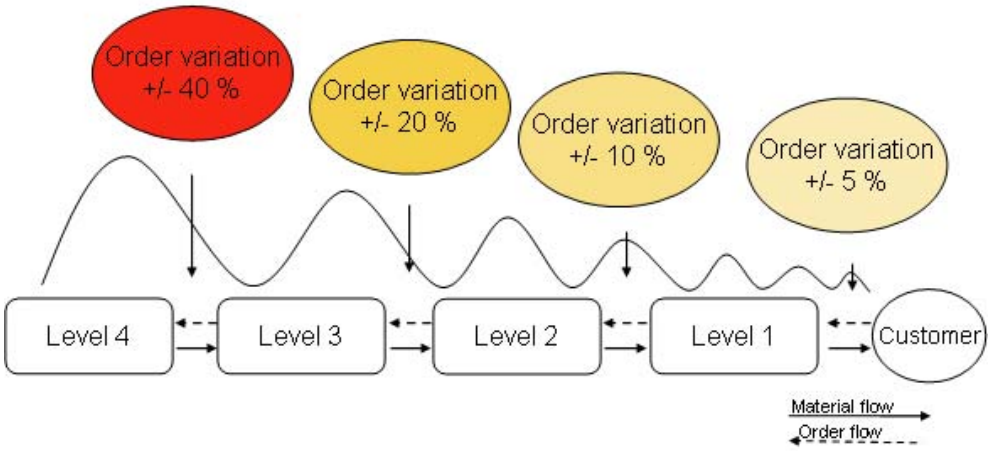


***Fig. 2** Development of the orders in different levels*

## 4. Leveling in use

Leveling contributes to provide the constant flow and rhythm in the whole value stream and to:

- Standardized work
- Highlight the deviations from the standard

- Reduction of lead times and stock
- Increase of flexibility with respect to failures and order changes from the customer

Before the start of leveling it is necessary to set the leveling period. In this fixed period the same quantity of the same products is planned. This plan lead the previous process, for example orders to the suppliers or kanban loops.

We have to distinguish the runners (main types) and low sales parts. For this splitting the analysis of customer orders and its fluctuation is to be provided. We evaluate these parameters:

- Quantity orders
- Delivery frequency
- Variation of order quantity
- Fluctuation in delivery dates
- Forecasting reliability

The runners are produced regularly and the low sales parts according to the need.

Example: We have 5 working days and production capacity 1000 pc a day. A customer orders: Part A 1500 pc, part B 1000 pc, part C 1000 pc and 1500 pc of 12 different low sales parts.

Parts A, B a C are runners. Their production plan is following: part A 300 pc a day, part B 200 pc a day and part C 200 pc a day. For low sales parts is reserved the capacity of 300 pc a day. Production plan example shows the fig. 3:

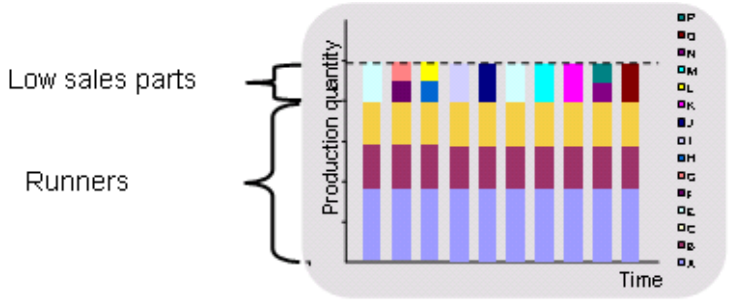


***Fig. 3** Leveled plan*

In reality the customer orders fluctuate. It hinders the regular utilization of work places. In order to separate the production from fluctuation f orders, we use in leveling the exactly defined stock. This prevents the direct influence of fluctuations on the

production in the fixed planning period. Due to the leveled constant and regular production the stock is reduced.

Example: security stock is set - 200 pc

| | Mo | Tu | We | Th | Fr |
|---|---|---|---|---|---|
| Leveled plan in pc | 1000 | 1000 | 1000 | 1000 | 1000 |
| Customer orders in pc | 900 | 1100 | 1200 | 800 | 1000 |
| Development of security stock in pc | 300 | 200 | 0 | 200 | 200 |

***Fig. 4*** *Development of security stock*

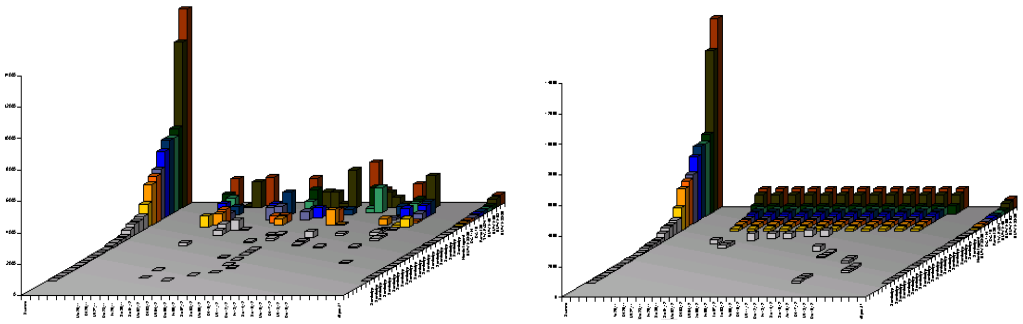

***Fig. 5*** *Comparison of classic and leveled plan*

During implementation of leveling we have to focus on following:

Unrepeated (during implementation):

- Definition of responsibility for leveling
- Definition of leveling periods
- Description of standards for planning and monitoring
- Definition of strategy in the case of deviations

Regularly:

- Monitoring of leveling on the basis of defined indicators
- Evaluation of indicators and set up of measurements in the case of deviations from the standard

- Continuous improvement
- Implementation of IT tool

We need to prepare also the visual management. In the process of leveling we talk maily about the use of “heijunka” tables (from japanesse, planning table). Heijunka is not only a tool for visualization of the leveled plan, but also the real tool of planning. We put production kanbans into a heijunka and when the final products are produced we take he card of the heijunka and stick them to the packaging unit of the final product. When a final product is sold, the kanban card is returned to heijunka.

## 5. Conclusion

When implementing the leveling in a company the careful analysis and documentation of the starting situation is to be provided (after implementation a comparison is proceed) If the leveling is correctly implemented, the benefits not only for the production are indisputable – the fluctuation of customers orders do not influence the production in the large extent, the utilization is regular and the stock in the whole value stream is reduced and delivery performance increases.

*Lectured by: doc. Ing. Jozef Strišš, CSc.*

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### Resumé

### NIVELIZACE

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V současnosti musí společnosti obstát v tvrdé konkurenci. Aby posílila své postavení na trhu, musí přijmout moderní metody v managementu výroby, skladovém managementu, nové procesy, opírající se logistiké přesuny, atd. V managementu výroby existují různé nové metody, jednou z nich je nivelizace.

Objednávky zákazníka často kolísají a tyto výkyvy jsou stochastické. Změny v těchto objednávkách mají negativní vliv na výrobní plán. Využití výrobní linky není pravidelné, tyto okolnosti linku zastaví, nastává nadvýroba nebo naopak nedostatek kapacity. Za účelem zmírnění těchto negativních účinků stochastických změn, může společnost zavést nivelizaci jako nástroj výrobního plánu.

Nivelizace souvisí s dalšími nástroji pružného systému – zásoby řízené spotřebou, rychlá změna, vnitřní a vnější tok materiálu. Pracovní nástroje je třeba představit souběžně.

Jestliže se společnost rozhodne zavést nivelizaci, doporučuje se akční plán. Na počátku se musí roztřídit výrobky, zda se jedná o polotovary, nebo maloodbytové součástí. Musí se definovat nivelizační období (období, kdy je celé výrobní spektrum plánováno vyrovit). Pro nivelizaci a organizaci procesu musí být definovány zodpovědné osoby. Všechny členy nivelizačního procesu je třeba proškolit.

Pokud vytváříme nivelizační plán, objednávky zákazníka rozdělujeme do celého nivelizačního období, které je pevně dané. Vyrábíme polotovary každý nivelizační interval ve stejném pořadí. Využívámevhodné okamžiky k výrobě maloodbytových součástí (podle aktuálních potřeb zákazníka).

Vizuální management má být připraven - hovoříme o nástroji heijunka. Podáváme výrobní kanbany do heijunky a po výrobě je karta heijunky odebrána a přilepena na balicí jednotku konečného výrobku. Až je konečný výrobek prodán, karta kanbanu je vrácena do heijunky.

Využití výrobní linky je po zavedení nivelizace pravidelné a výrobní proces je stabilní. Můžeme přijmout normalizovanou práci na všech pracovních místech a výrobní doby jsou zkráceny. Kladný účinek se neprojeví jen ve výrobním procesu.

Tento účinek pozorujeme také v logistice - hlavně ve snížení stavu zásob, pravidelných objednávkách dodavatelům a tím lepším využití dopravních prostředků. Flexibilita směrem k zákazníkovi je zvýšená.


**Summary**

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Nowadays a company has to face up a tough competition. In order to strenghten its position in the market, it has to adopt modern methods in the production management, stock management, new lean processes in logistic transfers, etc. There are various new methods in the production management, one of them is leveling.

The orders from the customer often fluctuate and these variations are stochastic. The changes in the orders have negative influence on the production planning. The production line utilization is not regular, the situations on line stop, overproduction or lack of capacity occur. In order to soften the negative effects of stochastic changes, a company can implement leveling as a tool of a production planning.

Leveling relate to other tools of lean system – consumption managed inventory, quick change over, internal and external milkrun. The tool are to be introduced paralel.

There is recommended action plan when a company decides to implement leveling. At the beginning it has to clasify the products whether they are runners or low sales parts. It has to define what is our leveling period (a period where all the production spectrum is planned to be produced). The responsible persons for the leveling and organization of the process have to be defined. All members of the leveling process are to be trained.

When creating the leveled plan we split the customer orders regularly in the whole leveling period, which is fixed. We produce the runners every leveling interval in the same order. We use the empty windows to produce low sales parts (according to up-to-date customer needs).

The visual management is to be prepared – we talk about heijunka tool. We put production kanbans into a heijunka and after the production a card of the heijunka is taken and stuck to the packaging unit of the final product. When a final product is sold, the kanban card is returned to heijunka.

The production line utilization after leveling implementation is regular and the production process is stable. We can adopt standardized work in all work places and the production lead times are shortened. The positive effects occur not only in the production process.

We see the effect also in the logistics – mainly in the reduction of stock, regular orders to the suppliers and so better utilization of the transport means. The flexibility towards the customer is increased.


**Zusammenfassung**

**NIVELLIERUNG**

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Der Artikel beschäftigt sich mit dem neuen System der Produktionsplannung – Nivellierung. Nach Implementation der Nivellierungsplannung die Ergebnisse erscheinen – stabile Auslastung der Fertigungslinien, regelmässige Materialflusse und besser Auslastung der Transportmittel. Sehr wichtiges Efekt ist auch die Reduktion des Bestandes.