

APPLYING THE PRODUCTION'S OPERATIONAL MANAGEMENT WITH THE HELP OF THE VALUE STREAM MAPPING METHOD

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Abstract:

The purpose of applying the value flux method is increasing the value creation and reducing the waste.

This method has been applied for the first time by Toyota. It is also called "The presentation of the material and information flux" and it is used in order to present the real planned stages along the development of the plans' implementation. A particular consideration is given to the introduction of the continuous production fluxes (value creator) as well as the waste reduction.

Keywords: production; flux; added value.

JEL classification: M₁₀; G₂₁; G₂₄; P₄₇; D₂₄; D₅₁

1. Defining elements for the value stream mapping method

As it is highlighted by several authors, „Several studies have successfully investigated the relations between the production's quantity and the quality. A popular opinion confirmed by Dr. Deming and Dr. Juran is that, according to which, any quantity decrease caused by a greater attention given to quality will be more than balanced by the waste reduction. A documentation analysis suggests there is no simple relation between these two factors. For the routine, repetitive tasks like typing, banking services or spell check, the workers have the tendency to accentuate one or the other. If the quality improves, the quantity decreases; if the quantity increases, the quality decreases. For the tasks that involve complex and diverse physical and mental requirements, the relation between quality and quantity is no longer that clear". (Adam, E.E., Ebert, R.J., 1992, p. 601).

In production there are three types of fluxes: the material flux, the information flux and – at the level of the process – the personal/process type. The value flux method covers the first two fluxes and it is based upon the presentation of the material and information fluxes. (Pânzaru, S., 2005, p. 83).

It is important that the producers can orient their thinking upon fluxes, and not on each production process, and to be able to implement production systems, not only provide singular process improvements. The method aims at providing the enterprise with a help in producing long term systematic improvements, which not only reduce the wastes but also identify their causes as well, in order for them not to reappear.

By value flux we refer to all the activities (both the ones generating value, as well as the ones not producing value) that are necessary for a product to go through all the main fluxes that are decisive for any product: (1) the production flux starting from the raw material and ending with the final product that reaches the client and (2) the development flux starting from the concept and ending with the beginning of production. We analyze the production flux from the client's requirements back to the raw material (Rother, M., Shook, J., 2000, p. 13).

Having a value flux perspective refers to working on the general perspective, not only on singular production processes. This means that everything should be improved, not just single parts. In order to obtain a general view, and it is desirable to supervise the entire way from the raw material to the product that reaches the client, one must follow the value flux of a product going through several companies and several production sites.

The value flux has a great importance from several points of view, namely:

- It allows the flux recognition, not only the production processes;
- It helps recognizing the waste causes within the value flux;
- It creates a foundation for the implementation plan. As a help in accomplishing a complex flux – element that is lacking from many improvement projects – projecting the value flux becomes a construction plan in order to implement several new production systems;
- It shows the connection between the material flux and the information one.

2. Stages in projecting the value flux

According to some specialists (Rother, M., Shook, J., 2000, p. 14), projecting the value flux begins with choosing a product family upon which we apply the following stages.

We identify the client's product family – respectively the end as a leading point for the value flux. A family of products is a group of products that undergo similar production stages and machines at the end of the downstream progression of the value flux. In this segment of the value flux the products are being finishes for the external client.

Adding several improvements in the value flux aims several persons and all the participants should develop the understanding capability for the way in which projecting the value flux functions. But, the implementing team must be led by someone who can see beyond the limits within the value flux is being performed and who can dictate changes where they are needed.

Improving the value flux – sometimes called “Kaizen flux” or “System Kaizen” – is a difficult task of management. As we can see in Figure no. 1, there are two types of Kaizen: flux kaizen and process kaizen.

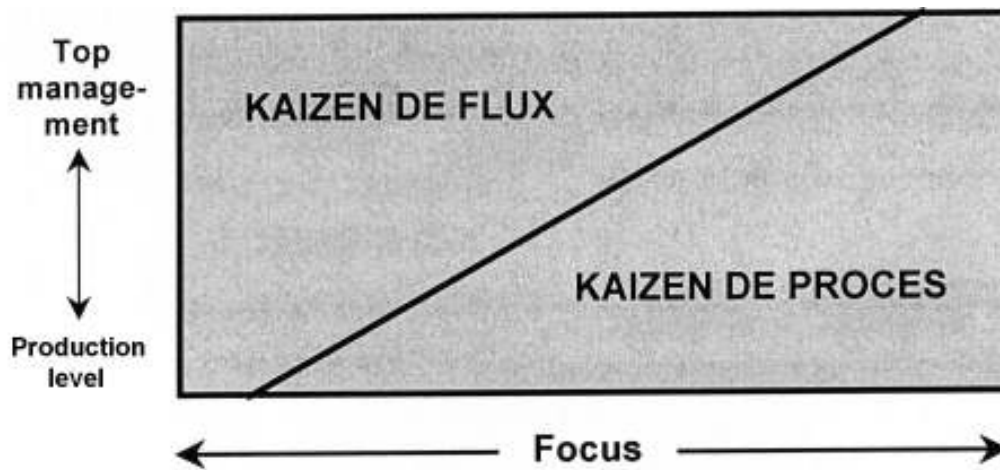


Figure no. 1. Types of Kaizen

Source: Rother, M., Shook, J., 2000, p. 128

Both the flux Kaizen (improving the value flux) and the process Kaizen (eliminating the wastes at each process) are necessary to any company: improving one of the fluxes favors the improvement of the other one. At flux Kaizen we have, in the center, the material and information fluxes (that can be recognized only taking a general look), whereas at the process Kaizen we have, in the center, the personnel/process flux, respectively the interaction between the employees and their specific production processes.

3. The characteristics of an efficient value flux oriented towards the client

At new production systems we are talking about the fact that a process produces only what is necessary for the next one and only when it is necessary. It is recommendable to look at the processes as a bunch – from the final client back to the raw material, in a uniform flux, with no sideways, that produces, within the shortest amount of time, the highest quality and the lowest costs.

A very important element that helps synchronizing the assembly rhythm with the sales is identifying the correct amount of time, having as a result a production rate for the assembly, based upon the sales rate. (Pânzaru, S., 2007. p. 338);

$$\text{Tact time} = \frac{\text{Total working time available on one shift}}{\text{The producing quantity per shift necessary for the client}} \quad (1)$$

“The tact time” indicates the period of time in which a product must be accomplished according to the sales figures, in order to correspond to the client’s needs.

With the help of the tact time (Rother, M., Shook, J., 2000, p. 53), we can synchronize the assembly rhythm to the sales one, especially in the case of the “leading process”. This reference figure must indicate the speed at which the assembly should be made.

In an ideal situation, the continuous production flux represents the fact that a reference product is made and it goes directly to the next stage without any delay between stages (and without causing any other wastes). The continuous flux production is the most efficient form of production and we should be as creative as possible in order to reach or get close to this stage. (Pânzaru, S., 2003, p. 20).

A good starting point in order to begin the representation would be a combination between the continuous flux production and the “pull” systems like the supermarkets or FIFO principles (First-in-first-out).

It is recommendable to use the “pull” system in order to direct the production, in the cases where the continuous flux production does not reach the independent processes.

In the value flux we can find several stages where the continuous flux production is not possible and therefore the lot production is required. There can be various reasons for it, like:

✓ Several processes are structured in such a way that they must work and machines must be set with a very fast or very slow cyclic rhythm as to be able to deliver several product

families (eg. stamping or molding by injection);

- ✓ Several processes, like the ones coming from the deliverers, are taking place way too far and a piece by piece delivery would be unrealistic;
- ✓ Several processes require too large periods of time and are not too efficient as to be able to be combined in the continuous flux production.

More easily said, a “pull” system must be installed in the places where the production in continuous flux is interrupted, and the previous process must further produce lots of products.

4. The “pull” system of a supermarket

The aim of this system is to direct the production to the delivery process without a production plan. As a scheme this system can be seen in Figure no. 2.

“Production” Kanban solves the production of an icon, but when we talk about “takeover” Kanban, on the contrary, we are dealing with a buying list indicated by the supplying department that allows it to do acquire and move the icons. (Plumb, I., Nicolescu, O., ș.a., 2003, p. 379).

The main purpose in installing a “pull” system between two segments of the value flux is of having a means of clearly directing the previous process, without needing to try to predict the necessary stocks for the next one and to plan it. The “pull” systems of supermarkets are a means of directing the production between fluxes.

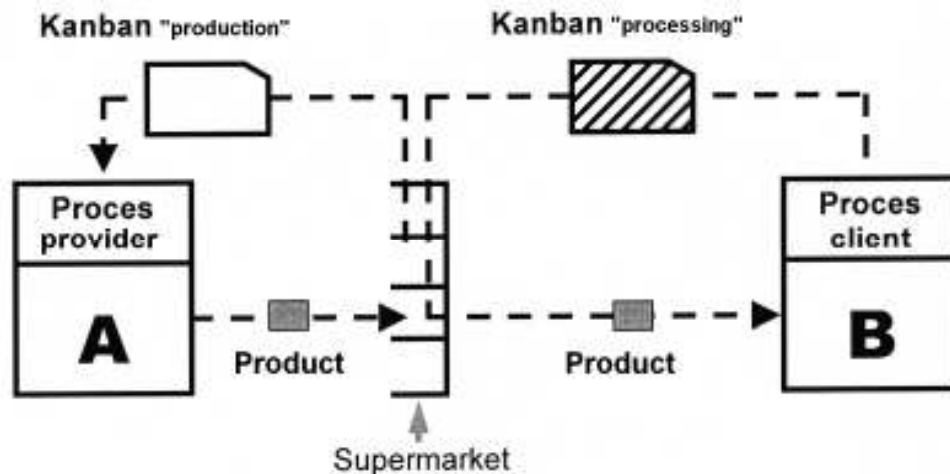


Figure no. 2. The “pull” system of a supermarket

Source: Plumb, I., Nicolescu, O., ș.a., 2003, p. 379

Resupplying the client process with material comes back to the deliverer's supermarket and takes what is needed. This takeover starts moving the pre-typed Kanban labels (normally as tags) from the supermarket to the deliverer, where they serve as unique production directions in this process.

The "pull" systems are a better method to direct the production between the two processes that cannot be included in a continuous production flux. In some cases there is no point in building up a stock with all the product's variants in a "pull" system of a supermarket's type.

In some of these cases a FIFO system can be used ("first in, first out" used in the order they arrived) between two separated processes, instead of a supermarket, in order to maintain the flux between the two processes. The FIFO system can be considered as a slope that can only takeover a certain quantity of stocks, the delivering process being at the entrance, and the client process at the exit of the slope. If the FIFO slope is full, the delivering process must stop the production until the client has taken a part of the stock.

If we introduce a "pull" system, normally we would have to plan the production only in a single spot of the value flux, ramp to ramp. This planning point marks the beginning of the "leader process". The fluctuations within the production volume or the lot production of a certain type of product in the process that establishes the rhythm influences the capability necessary of the previous supermarkets. Once choosing this point, we also establish which elements of the value flux become a component part of the time needed from the client's order until the finite product.

The leading process cannot have supermarkets or previous "pull" systems, except for a finite product supermarket. That is why the leading process finds itself, for most of the times, at the beginning (close to the external client) of a continuous flux within the value flux. In the planned stage, the leading process is the production process that is directed by the external client's orders.

5. Choosing the leading process

Balancing the production mix (Rother, M., Shook, J., 2000, p. 59) makes reference to evenly distributing the various products' production along a certain period of time, especially in the leading process (Figure no. 3). For instance, instead of producing all the "type A" products in the morning and the "type B" products in the afternoon, "balancing" them would mean to shift the frequency between small lots of both types of products.

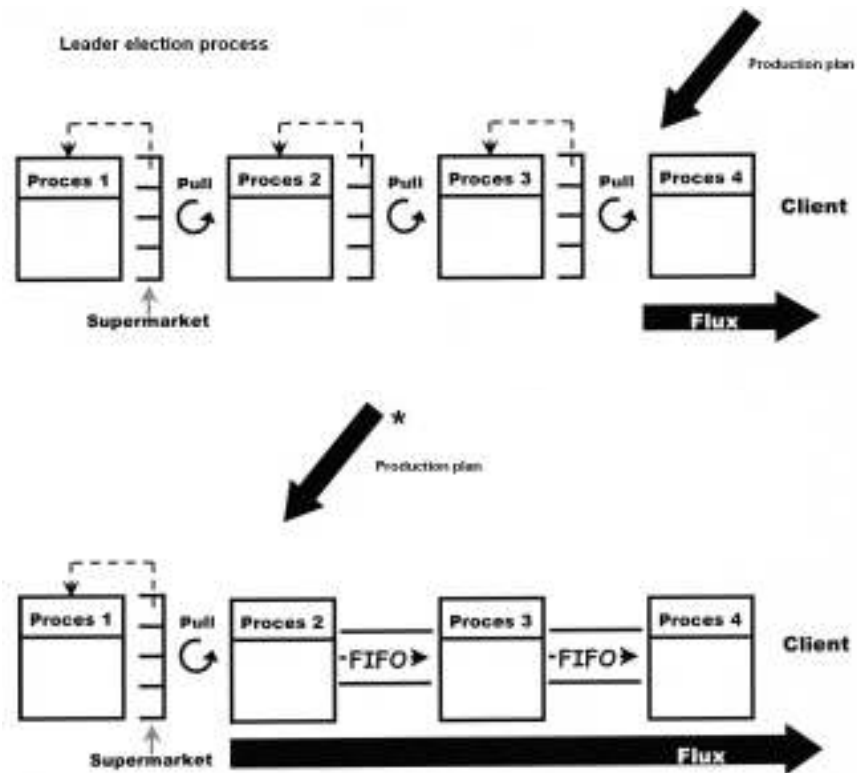


Figure no. 3. Choosing the leading process

Source: Rother, M., Shook, J., 2000, p. 59

The more we balance the mix in the leading process, the quicker one can react in a short amount of time to various clients' requirements also owning smaller stocks of finite products. In such a way we get to keep the previous smaller supermarkets.

It is also possible for a production mix balancing at the leading process to bring along several changes, like a most frequent setup for the machines and also trying to always have various production components at our disposal (in order to eliminate the time required for the machines' setup). In exchange, a reward would be the elimination of several large quantities of wastes within the value flux.

Structuring a balanced production level creates a predictable production flux, indicating the problems in due time and providing the possibility of quickly taking measures. A good starting point is the approval of several small and frequent planning increments towards the leading process (within the serial production, for most of the times,

an increment between 6 and 60 minutes) and also taking the proper quantity of finite products. We call this procedure “tact connected takeover” (Pânzaru, S., 2003, p. 41).

This balanced working increment is called “Pitch” and it is calculated, when possible, upon the container’s dimensions (the number of pieces that can fit into a container of finite products), or it represents a multiple or a fraction of this quantity.

This is how the “pitch” represents a multiple of the tact time, calculated for the quantity of transferred finite products from the leading process. Then it becomes the basic unit for the production planning for the entire family products.

The production balancing can be made according to the pattern in Figure no. 4.

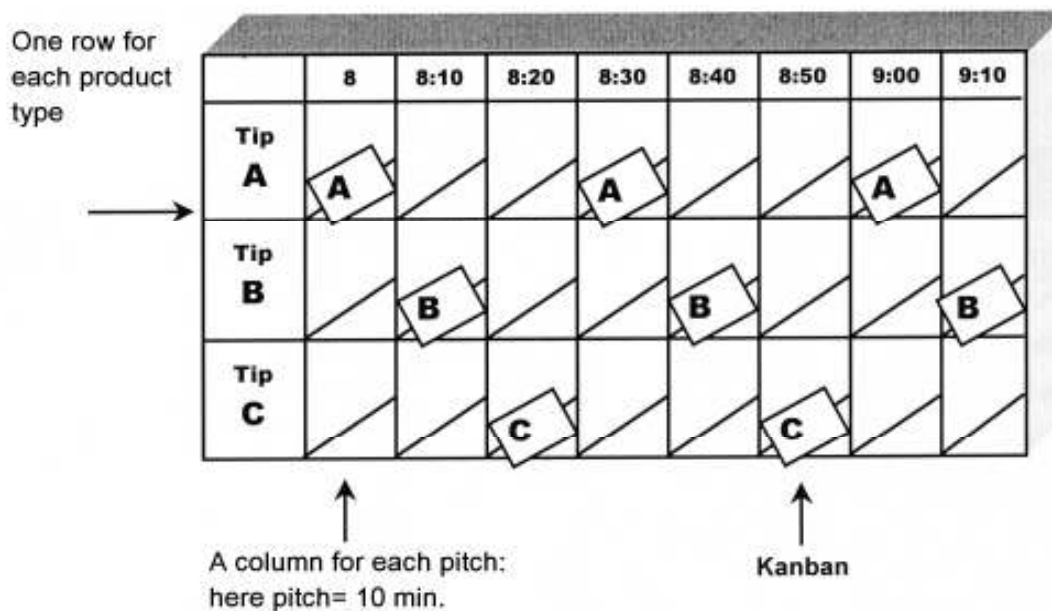


Figure no. 4. Balancing the production (balancing box)

Source: Rother, M., Shook, J., 2000, p. 64

There are several methods of practicing a takeover connect to tact for some small and equal working increments. A possible help for balancing the volume of the production mix and of the product is the “balancing box” or „Heijunka-Box" (Rother, M., Shook, J., 2000, p. 64).

This box can be used when the leading process can work on its own and according to the tact. The box has a column with Kanban labels for every pitch and a set of Kanban labels for

every product. At this system, kanban does not only express the quantity that must be produced but also the necessary period of time for producing that quantity (based upon the tact time).

The Kanban label can be introduced in the balancing box in the desired order of the mix, on types of products (see the figure below). Moreover, the Kanban labels will be taken by the material's manipulators and will be introduced into the leading process – one after another at pitch intervals.

By reducing the time needed to adjust the machines and by introducing several smaller lots within the previous production processes, they can react faster to the stock modifications in the following processes. These processes will therefore keep only small stocks within their supermarkets.

In order to enable a more frequent shift of the adjustments, all the necessary devices and components will have to be close to the cell operators. But, if all the components remain on the production line, several safety measures must be taken (the so called “Poka-Yoke”) in order to avoid the faulty assembly of the patterns.

The production systems' specialists support the implementing team and are subordinate to the superior management (Figure no. 5). The specialists support the implementing team and are subordinate to the superior managers.

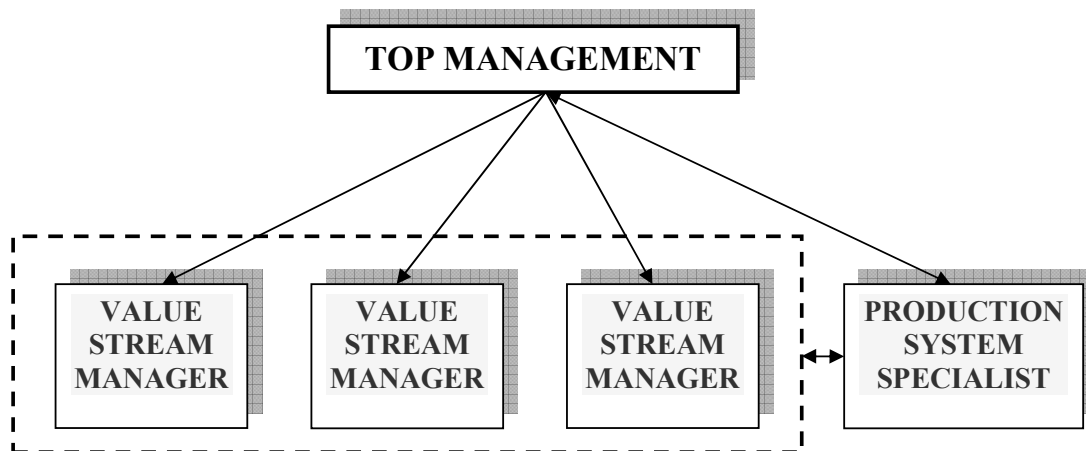


Figure no. 5. The relation between the value flux's manager and the superior management

After finishing the identification actions for the macro loses, it is necessary to perform actions within the working cells, applying the Kaizen strategies. One of these actions is called “Kaizen on paper”, and I will briefly present it further on.

6. The added value flux for the modern companies

As we highlighted at the beginning, the purpose of applying the value flux method is to reduce the material flux to a possible minimum. At the same time, we are taking into consideration the accomplishment of a complex informational flux, diminishing the number of operations that do not provide added value.

6.1. The stages of projecting the value flux for the modern companies

1. Choosing a family of products

It is identified as a family of try outs.

2. The value flux management

The top management names as a project leader the chief quality engineer who chooses the support team (Năstase, M., 2008, p. 86, Năstase, M., 2010, p. 458). This team is made up of members belonging to the following departments (Ștefănescu, Dragomir, C., 2008, p.80):

- quality;
- production planning and logistics;
- maintenance;
- financial;
- production (process engineers/ team manager/ line manager);
- human resources.

The team is divided into two sub-teams:

- the team focused on obtaining the information regarding the material’s flux;
- the other one focused on obtaining the information regarding the informational flux.

6.2. The material flux and the informational flux

With the help of the information gathered by the two sub-teams the actual stage of the material flux is being established.

When gathering information about the material and the informational flux, the starting point is represented by the client following all the way to the deliverers.

This way, the managerial team, upon the gathered information, will establish the optimal path for the materials and the efficient shift for the operations.

7. Applying the just in time concept

With the help of the gathered information one can notice that between several processes there is a “Push” system that contravenes the Just in Time concept, having as a basis the use of the “PULL” system.

Moreover, it has been noticed that between the storage areas and the production line there is a discontinuity of the material flux, event that launches the idea that the production capacity should be augmented in order to be able to face, without any problems, the client’s delivery requirements.

Therefore, out of these analyses we obtain the possibility to reduce both the material and the informational flux by diminishing the wastes found in certain production areas.

In the patten storage we found stocks that are larger than the safety ones established upon the large distances between the providers and the beneficiaries, fact that led to the need of having an external warehouse. This generates extra shipping and manipulations with an extremely high number of indirect operators that imply higher costs.

After this analysis we can notice the presence of the “PUSH” system on certain sub-processes. This leads to requiring a replacement of the “PUSH” system with a “PULL” one that presents a higher flexibility.

We also notice that all along the production chain the FIFO system (“First-in-first-out”) is well applied.

In the value flux we can notice that lot production is not necessary due to the fact that the adjustment times for the machines and the order switching times (C/O-change over) are not high.

From the informational flux we draw the conclusion that, in order to plan the production, it is necessary to develop a production plan. For a higher flexibility the implementation of the Heijunka system would be necessary.

8. Applying the kanban system

Resupplying the client process with material is found in the provider's supermarket and takes over what is needed. This takeover starts moving the Kanban labels pre-typed by the supermarket towards the delivering process, where they serve as production directions for this process.

The present working system is efficient when dealing with production lines that have small quantities of products, or the same type of product, as well as when dealing with producing spare parts.

The main advantages of the Kanban system are (Merli, G., 1992, pp. 145-156):

- production accomplished in due time (in English Just-In-Time, J.I.T.);
- eliminating the stocks;
- eliminating the waste, thanks to using the necessary materials, space, working time in order to add value to the product;
- dynamic responsibility;
- increasing the quality because it provides feed-back immediately when the flaw appears, not after several days, as in lot production.

The production must work or organize its activity in such a way as to produce only when there are free areas in the supermarket's storage, fact that supports the need for new finite products (Petrescu, I., Dragomir, C., Pânzaru, S. ș.a., 2003, p. 98).

In order to be able to face the diverse requirements of the client in any moment (different quantities and types of finite products) it is necessary to apply the production mix balance.

Taking into consideration the fact that an order change is made in about 12 minutes, we can notice that it is more effective that the changes in orders should be made in a number of times equal to the types of finite products required by the client.

In order to efficiently balance the production mix, it is necessary to use an efficient system of changing the order and to perform the actions necessary for the change before the change itself. It is also important to change the patterns. This has to be performed outside the process because the machines' adjustment to the actual working mode requires time that cannot be removed. The complete removal of the adjustment would be too expensive, but one can try reducing it.

Such a structure of the production creates a predictable production flux that indicates, in

due time, the main problems, thus creating the possibility to intervene with corrective measures in the shortest possible time.

Taking into consideration the ideas mentioned above, as to sum up, I would like to propose certain time reducing measures regarding the material flux, as well as accomplishing a more efficient informational flux that is closer to the client's requirements (Tables no. 1 and 2).

Table no. 1

Proposals for improving the material flux (o short term)

Nr. Crt.	Description of the potential point of improving	Proposed solution
1	There isn't enough available information about the providers' ability to deliver, in due time, the	Creating an informational system that provides data regarding the size of the existing stock at the client
2	We notice, in certain production areas, discontinuities of the activities	Applying the adjusting concept for the production with the help of the Heijunka system
3	The level of the pattern stock within the production line is increased	Establishing an optimal level of resupplying the line
4	The maximum cyclic time given to the production line	Following the predetermined cyclic pattern
5	A larger quantity of patterns than necessary	Establishing a maximal and minimal level of the pattern stock in the storage.
6	There is no complex information regarding the providers' performances	Creating a data base for the products' performance for several producers of the same pattern

Table no. 2

Proposals for improving the informational flux (o short term)

Nr.crt	Description of the potential point of improving	Proposed solution
1	Time wasted for the conformity declaration	The conformity declaration should be automatically given when giving the invoice thus producing a time reduction of 30 minutes
2	The customs is made in an external location	Studying the possibility of performing the custom on the spot thus reducing the documents' processing time. The informational flux might be reduced with
3	Time wasted for the development of the production plan	Using the Heijunka system as a production plan. Possibility to reduce the time with about 15 minutes.

After performing the proposed stages of the material and informational flux we can notice a significant improvement in the working time.

9. Conclusions

The study performed upon the quantitative and qualitative aspects of production within a company highlighted the fact that there is a possibility of continually improving the production processes by applying the modern operational management methods by the managerial teams of the company that deal with the material goods' production.

In order to diminish the pattern stock from the company's warehouse, implicitly diminish the capital stock, it is desirable to also apply the *KANBAN system in the relation with the providers*. This action requires a long period of time needed for implementation, especially when dealing with a large number of suppliers. It would be preferable for these providers to work with the same informational system in order for the information regarding the pattern necessary to be able to reach them in the shortest time possible, and for the data processing to be made in an optimal time, thus creating the possibility of delivering the patterns in the shortest amount of time. In the present system in the relation with the providers we apply the clear order principle

that can extend from one week to a month and orders for periods larger than a month. Therefore, when facing certain changes within the process or misunderstandings, there is the possibility or the risk for certain patterns to be delivered by the provider (according to the clear order) in quantities that are smaller or larger than the necessary in that moment. Applying the KANBAN system with the providers could stop this system deficiency.

Due to the fact that many pattern providers are external we face the following losses:

- high acquisition prices, because in these countries the labor force is highly paid as compared to Romania;
- large distances increase the shipping time, denying an optimal reaction ability if dealing with changes;
- the transportation is also very expensive, being accomplished by external transportation companies.

All these losses could be stopped by the existence of certain suppliers in Romania and by extending the company's functions, so that it also performs the transportation.

Moreover, we can notice the dependence between certain providers, a fact that, when dealing with problems on the supplier's side, can generate dysfunctions within the production process. In order to overcome this, we recommend the existence of alternative suppliers.

Another opportunity that can be easily used within the production area is the implementation of the "one-piece-flow" process. Taking into consideration the fact that the performed modifications upon the machines led to a balance in the times required by the operations, the "one-piece-flow" method can represent a solution for a minimal reduction for the flow and also the existence of the possibility to detect, in real times, the eventual differences as regarding the quality of the product.

After implementing these measures it is recommendable that within the added value flux analysis to continue until the level of the production cells, removing all the losses and increasing the operations that bring added value. We must also insist upon the required time for the specific working elements, through which the product is brought to a final stage, a form that the client is ready to pay for.

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