ORGANIZATION OF THE PERFORMANCE PRODUCTION FLOW

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Abstract: This article is devoted to some consideration - in a discussion, analytical manner - of the features of lean flow management. We formulated that the lean flow is a wide-range management concept with an aim to achieve the maximum possible level of efficiency of business processes by optimizing and eliminating all categories of losses, irrational costs and expenses. A lean production flow is characterized by a high level of added value. Managing the lean production flow of an organization is a systematic activity aimed at minimizing all forms of losses that arise during the production processes. It was noted that the lean production flow management of the organization was determined by optimization of the technical and technological component: machine tools, equipment, volumes and structure of production areas. There is some set of measures at the enterprise, based on the improvement of the operational characteristics, the implementation of which contributes to a consistent increase in the level of product competitiveness.

Key words: lean flow, pull production, critical chain, innovative transformations, production costs, optimization of technical and technological components.

1 Introduction

The relevance of the specified thematic field is determined by the fact that the very concept of "lean production" itself is some kind of innovation. As a starting point, let us note that the concept of Lean Manufacturing/ Lean Production/ Lean Enterprise, as the well-known scientist Asaul M.A. interprets, can be certified as a broad content management concept, the purpose of which is to achieve the maximum possible level of efficiency of business processes due to their optimization and elimination of all categories of losses, irrational costs and expenses (Asaul et al, 2012).

Practice allows saying that the Lean Production is a system practice, determined, firstly, by the identification of irrationally organized processes; secondly, by the search and implementation of effective methods for their optimization. The activity result is the time lag reduction from the process of placing an order by the client to receiving the finished products. (*Kodolova, 2016*).

Let us describe the lean production flow management process, noting the following aspects.

- Firstly, this flow is characterized by a high level of added value.
- Secondly, there is a systematic activity aimed at minimizing all forms of losses that arise during the production processes.

In order to have the required level of efficiency, all components of the production system should be implemented as efficiently as possible: the speed of all business processes should be maximum, while the quality of these processes, their performance should be at least at the level of the base period indicators, and ideally - exceed them.

A lean flow reveals the following types of combination of the operations involved:

- consistent;
- parallel;
- parallel-consistent (mixed) (Eliya,2013).

It is very effective - due to the volume of capital expenditures, the degree of responsibility in the organization of production processes - the consistent form of combination of operations determined by the fact that there is a certain process at each operation part, the result of which is the basis for the beginning of the next process. The beginning of the next process is carried out not earlier than the set of all previous operations will be completed.

The lean flow management is determined, among other things, by the procedure of flow value mapping - the formation of a relatively simple and highly visual graphical scheme reflecting the diversity of material and information flows.

The flow value map enables to immediately see the bottlenecks of the flow and, based on its analysis, to identify all non-productive costs and processes and to develop an improvement plan.

The flow value mapping includes the following steps:

- Documentation of the current state map.
- Analysis of the production flow.
- Creation of the future state map.
- Development of the improvement plan.

There is some *discussion point of view* according to which one of the mechanisms for implementation of the lean flow management of the organization is the introduction of the critical chain method, which, ultimately, can maximize the effectiveness of the whole variety of production, marketing and logistics processes.

Justifying this point of view, and this question, we will take the liberty to note the following. The purpose of using the methodology in question is to calculate the dependencies of resources, risks, uncertainties.

Let us characterize the main aspects that determine the effectiveness of implementation of the critical chain method within the complex of industrial logistics of the rocket and space industry, noting the following aspects.

- Firstly, to carry out the unambiguous definition of some "critical term" as a date to which all production processes should be completed, and the finished products (or parts, nodes, etc.) should pass all the relevant "tests", acceptance processes, as well as approval and agreement.
- Secondly, it is expedient to make an unambiguous determination of the range of processes that can be implemented in a parallel mode, the achievement of which can be carried out in parallel. In addition, it is important to implement a system of additional "resource links" for each relevant type of limited resource.
- Thirdly, it is necessary to form some critical chain as a critical path (with exact differentiation of processes and the dates of their implementation (completion)), determined by the variety of resource links, a sequence of tasks that do not have an additional time reserve. At this stage it is expedient to define unambiguously the "points", the untimely achievement of which inspires a breakdown in the implementation of the entire project as a whole.
- Fourthly, it is important to unambiguously define - in the schedule of production processes - some special reserves - the so-called buffers, Fig. 1. This activity should be carried out taking into account the fulfillment of all project tasks as soon as possible.
- The fifth stage is the control phase. In this case, the very practice of control should be systemic: it is mandatory to control all four special buffers that are created.

The lean flow, determined by the mechanism of the critical chain of the project, starts from the project start date (we understand the system of production processes under this term) and ends with the date of the project buffer start date, but not the project completion date.

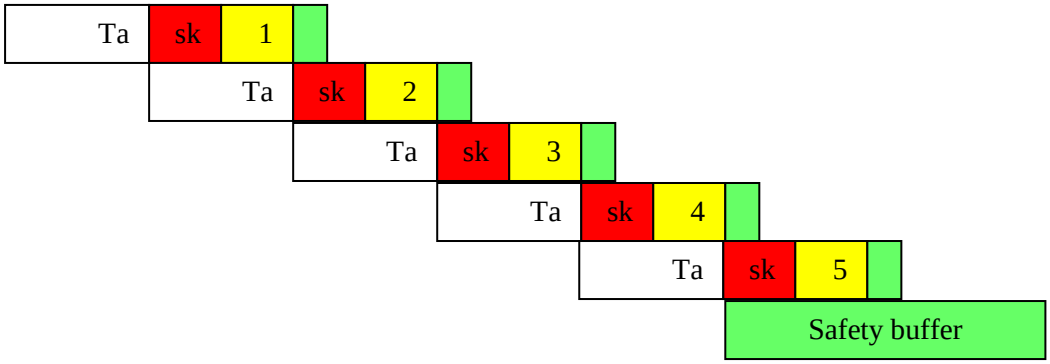

Fig. 1. Buffer formation that allow having some temporary reserve in the practice of lean flow management

Duration of the project buffer can vary - both in the direction of increasing and decreasing. The constant value here is the real period of time necessary to complete the changed project task.

Thus, the critical chain, determined by the feeding buffer, the capability buffer, the resource buffer will acquire some finished form. The general scheme is shown in Figure 2.

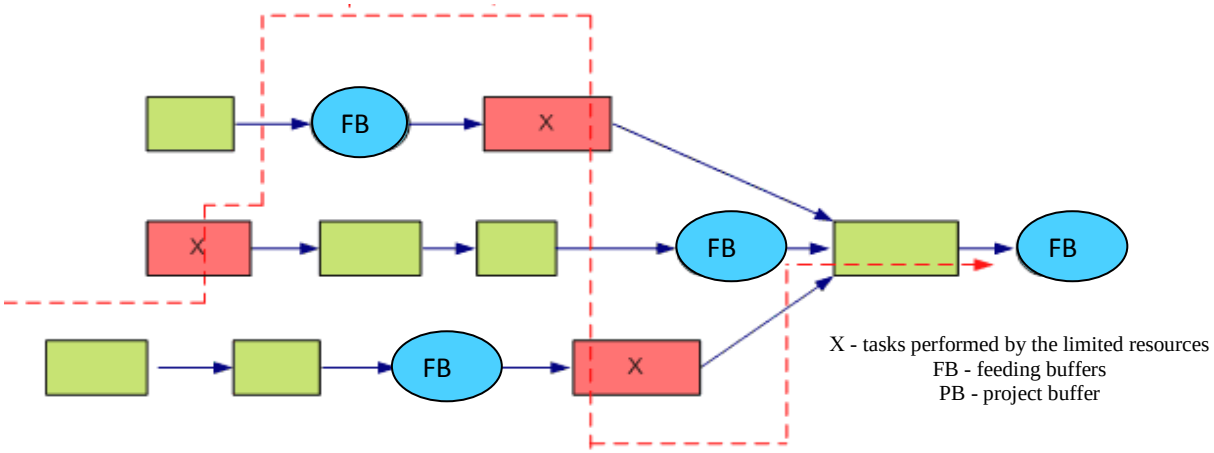

Fig. 2. General scheme for implementing the critical chain methodology in the implementation of the lean flow management processes (using a consistent combination of operations)

Thus, the practice of implementing the methodology under consideration can be reduced to the following sequence of practical steps and measures. Minimizing the duration evaluation of individual tasks, which can be implemented either by gradual reduction of the estimate by 50% or by implementing the PERT method for each task. Optimization and alignment of the entire variety of resources used in the project.

The principal objective here is to prevent the emergence of conflict or to level out their consequences. Ultimately, the critical path is transformed into a critical chain. Integration of some part of duration reserves of the shortened tasks into the project buffer, which should be completed at the project completion stage.

Placement of feeding buffers at the key points, where the outputs of non-critical tasks are the inputs of tasks on the critical circuit.

- Insert of resource buffers at the key points where it is advisable to minimize the risk of resource unavailability
- Scheduling the performance of tasks that have no previous tasks. The only principle is to implement them as late as possible.
- Encourage of early task completion.
- Manage the amount of buffers to implement, if necessary, some preventive and/or corrective actions.

There is also one more point, which Vesnin V.R. adheres to. According to it, the introduction of critical chain methodology into the practice of lean flow management can fully determine such a complex element of the concept under consideration (actually "lean flow") as pull production - "pull production" (Vesnin,2012).

This term determines a certain scheme of production organization, through which the volumes of production at each production stage are determined by the requirements of the subsequent stages.

It is ideal to organize the processes in which an internal supplier, located upstream, does not perform any processes (preparatory, production) until the internal consumer, located downstream, makes a signal about its readiness.

In fact, there is a flow, in the framework of which the subsequent operation "pulls" the products from the previous one. This flow arrangement scheme facilitates the flow synchronization and line balancing.

In addition to the above-mentioned "organizational and logical" aspects, the lean production flow management of the organiza-

tion is determined by the optimization of technical and technological component: machine tools, equipment, volumes and structure of production areas.

There is some set of measures based on the improvement of the operational characteristics, the implementation of which contributes to a consistent increase in the level of product competitiveness, for example, in the machine-building production.

Let us specify the following:

1. Reducing the energy costs during operation due to the increased efficiency, reducing the length of kinematic circuits, applying electrical speed control.
2. Reducing the occupied area due to the vertical layout of the machine design, the machine and the control system in one unit.
3. Reducing the structure weight due to its optimization and use of non-metallic materials in the load-bearing structures.
4. Reducing the cost of repairs due to the transition from scheduled maintenance to diagnosis of technical condition.

Let us characterize all four of the above stated directions in detail and consistently. Reducing the energy costs during operation due to the increased efficiency implies the following activities:

1. A comprehensive analysis of the entire list of tools and mechanisms used in the technological cycle.
2. Technical and technological re-equipment of production facilities.
3. Introduction of modern machinery and equipment into operation.

We note that both machinery, equipment and power tools are consistently losing their level of efficiency due to natural "aging", the growth of non-productive energy costs over time.

An example is the following: lamps, light fixtures, soldering irons, which have been released and put into operation twenty years ago, initially have had an efficiency level not exceeding 65%, while the modern devices have had an efficiency factor of 90-95%. Obviously, the replacement of this kind of outdated equipment creates a huge reserve of optimization of energy costs.

Reducing the energy costs during operation due to reducing the length of kinematic circuits, applying electrical speed control is determined by the following aspects.

Firstly, a comprehensive analysis of the existing kinematic chains, the search for "bottlenecks", as well as areas characterized by irrational (excessive) length.

Secondly, the determination of the degree of accuracy and the range of speed control. Thirdly, the choice and installation of such a technical element that would take into account the type and power of electric motors, achievement of the required level of speed control range, torque accuracy on the motor shaft.

The second direction - the institute, defined as a potential way to optimize performance characteristics, is to reduce the occupied space due to the vertical layout of the machine design, the machine and the control system in one unit.

The implementation of this direction is determined by the following factors. The vertical machine layout leads to a certain console appearance. In fact, all the main machine parts are mounted both on the frame and inside it. The vertical layout, within which there is a combination of control function blocks, allows achieving the following advantages: firstly, a decrease in the occupied area entails a decrease in the volume of depreciation deductions (calculated from the cost of production areas as such).

In addition, the machine organization in this way allows optimizing the labor costs of the worker (reducing the level of unreasonable and irrational movements); achieving the optimal number of rotational and rectilinear movements.

2 Conclusions

The lean production flow management of an organization is always and necessarily the integrity of logically related business processes, which, with a greater effect (result) are determined by a smaller amount of resources involved: labor, capital investments, production areas, material support.

In general, we can make a conclusion that: the use of the methodology in question while managing the lean flow, the competent and consistent implementation of it is objectively detected by the factor of successful implementation of processes and production, marketing, production logistics, and the duration of the successive "chain" of the operation combinations is optimized without loss in quality.

3 Summary

The innovative transformations, sequential modernization, processes of technological renewal, the use of critical chain mechanism are all unconditional bases that determine the medium and long-term prospects of the lean production process management of the organization. The modern competitive environment requires complex economy; the lean production flow is a methodology, the implementation system of which allows getting the desired effect.

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