APPLIED ASPECTS OF THE IMPLEMENTATION OF THE CONCEPT OF LEAN MANUFACTURING IN PRODUCTION

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Abstract. Modern business conditions are characterized by a high level of competition and a high degree of dynamism. To remain on the market in such difficult conditions, as well as to develop, management is forced to look for new mechanisms to improve the efficiency of the company. One such tool is the application of the lean manufacturing concept. The concept of lean production is a special approach to managing the organization, which allows to increase the consumer value of the product by reducing production losses. The article discusses a practical example of the formation and. The resulting effect can be divided into two parts: economic and social. Economic - reflects an increase in labor productivity, a reduction in the time of the production process and the saving of the wage fund of employees The social effect is expressed in increasing the involvement of staff and changing the production behavior of staff for the better.

Keywords: Modern business conditions, high degree of dynamism, management.

1 Introduction

The modern economic environment is rapidly developing and unstable, therefore, almost any company operates in the face of fierce competition and constant changes. In such a situation, each leader at least once thought about how to increase the efficiency of his enterprise. The tougher and sharper competition in the market, the higher the rate of change, the more actively managers are forced to look for new effective ways to optimize the enterprise.

In a modern highly turbulent business environment, the main task of the enterprise is not only to simply develop a product, but also to constantly develop. Accordingly, the concept of lean production is becoming more and more relevant and in demand in business. This concept is one of the most effective ways of developing an enterprise, which is why today it is massively introduced in companies from different countries, including the Russian Federation. A properly and competently organized production system allows the organization to achieve significant success in the business environment, to occupy a leading position, and also to gain the trust of consumers.

The basic idea of lean production, in our interpretation, based on an analysis of the theoretical foundations of the concept, can be described as follows: a lean enterprise is in constant motion towards improvement, in which all employees are involved to achieve the ideal. The ideal is to instantly unhinderedly create the value that is currently needed by the end user. To achieve the ideal, continuous disposal of operations and actions that do not add value to the final product is carried out using a wide range of lean manufacturing tools. And since there is no limit to perfection, this movement is cyclical and endless.

The article considers a practical example of the formation and implementation of a project to improve the pilot section of an industrial enterprise based on the lean manufacturing concept tools.

2 Methods

The introduction of the concept of lean production at the enterprise means the transition of the organization to a completely new, better level, which involves a change in the philosophy of the organization and the thinking of its employees.

This transition is a rather long, complex and fragile process, which can take years, and also include many serious difficulties, for example, employees' resistance to changes in the organization's habitual way of life (Thakur, 2016).

Undoubtedly, the introduction of this concept at each enterprise will have specific features that are associated with the existing structure of production relations, the current situation, the attitude of the management, employees and the capabilities of the enterprise (Stukalov, 2009).

However, in the theory and practice of lean manufacturing, there are many different algorithms that describe the key steps necessary for the successful implementation of the lean manufacturing concept (Storozh, 2016). Such algorithms can be a guide for a company that decides to start implementing lean manufacturing tools.

Analyzing the algorithms of lean manufacturing implementation that are available in theory and practice, we can say that they are all different: someone focuses on the strategic side of the issue (D. Liker (Jeffrey, 2004), someone emphasizes the importance of team building and the search for a vehicle for change (D Hobbs (Hobbs, 2003) and D. Wumek (Womack & Jones, 2003)), someone attaches particular importance to the development of personnel (T. Ono (Ohno, 1988). But in each of them, in our opinion, one can read between the lines a special "skeleton" of lean manufacturing, which contains the main idea. This is a special foundation that can be represented as a cycle in Figure 1.

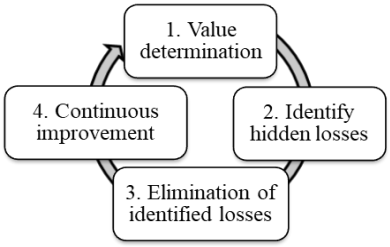

Figure 1. Lean Production Cycle

We took this cycle as the basis for the formation of the project for improving the pilot site of the enterprise in conjunction with the project approach for introducing the concept into pilot sites, which, according to experts, is the most effective (Kudryashov, 2016). The basis of this approach is the methodology for increasing labor productivity, the main purpose of which is to quickly find the potential to increase productivity, and in a few months to achieve the necessary improvements without much financial investment in modernization and global organizational changes.

The algorithm for the formation and implementation of the project on the implementation of elements of the lean manufacturing concept at the pilot site of the enterprise includes certain stages, which are presented in Figure 2.

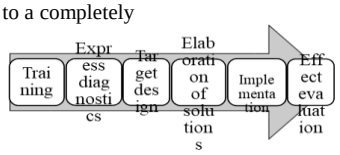

Figure 2. Stages of implementation of concept elements at the pilot site

Consider the essence of each stage, presented in Figure 2:

- As part of the preparatory phase, the goals and objectives of the project of introducing the concept of lean manufacturing in the pilot area were identified.
- At the stage of express diagnostics, work on the pilot site was monitored and interviews were conducted with employees of this site to identify hidden process losses.
- The target design on the pilot site was to take photographs of working time and identify the potential for optimizing work on this site, that is, the search for reserves to increase labor productivity.
- As part of the decision development phase, a system of measures was developed to optimize work on the pilot site.
- During the implementation phase, the proposed activities in a test pilot mode were implemented at the pilot site.
- The final stage was an assessment of the effect obtained from the implementation of the proposed system of measures.

3 Results And Discussion

For the formation and implementation of the project of introducing the concept of lean production at the enterprise (Kazan Homebuilding Plant - KDSK), a pilot reinforcement section was selected. The reason for choosing this site is that the reinforcement stage is the bottleneck of the production line, since it has the largest gap between the actual and design time of the process.

The situation is illustrated in Figure 3.

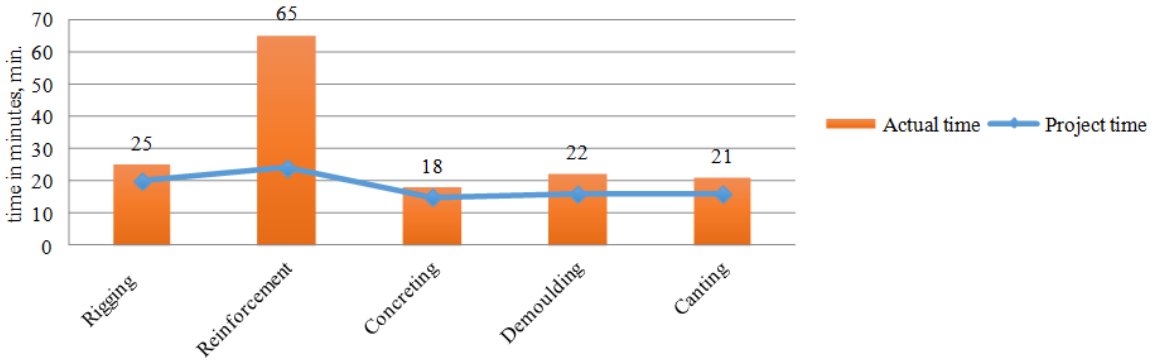

Figure 3. Actual and design time of the main stages production process

I would like to note that an equally important criterion when choosing a pilot site was the presence of hidden potential in order to maximize the effect in a short time, since tangible results set employees positively in relation to the concept and aimed at continuing the transformation of the enterprise along a lean path.

After choosing a pilot site, the main goal and objectives of the project to improve the processes of this production site based on lean production were formed (Rezaei & Nemati, 2017: Ingavale, 2013).

The goal of the project of introducing the concept of lean manufacturing at the pilot site for reinforcing products is to increase the productivity of the site by reducing losses by introducing the necessary elements of lean manufacturing. To achieve this goal, the following tasks were completed:

- Express diagnostics was carried out - the result: Ishikawa diagram;
- Target design (photograph of working time) was carried out - the result: maps of the current and future state of the process;
- a system of measures has been developed to reduce time losses and transition from the current state of the process to the future.

As part of the express diagnostics of the pilot site, the work of the employees of the pilot site was monitored, as well as a conversation with them, during which the main possible reasons for the high duration of the reinforcement process were formed, which include 4 units: components, working conditions, people and operations. The result of this stage is the constructed causal diagram (Figure 4).

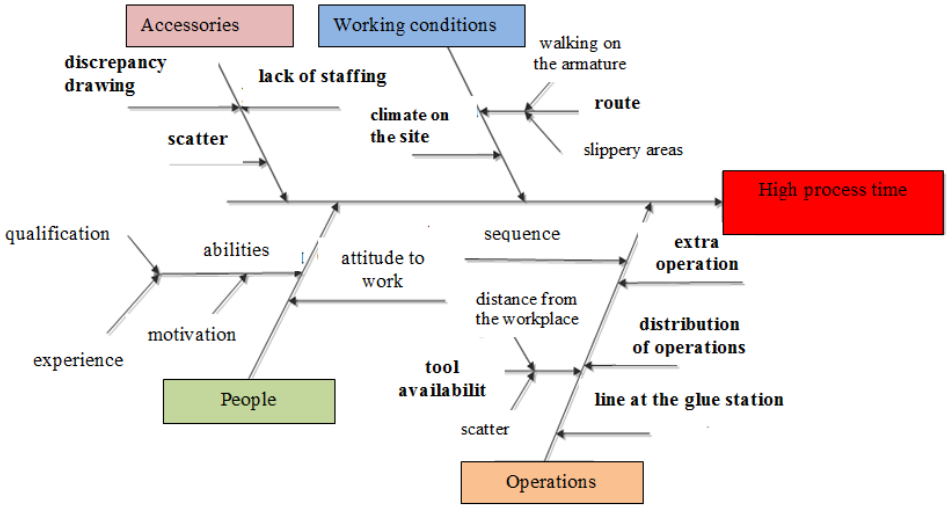

Figure 4. Causal diagram of the reinforcement section

As part of the target design, for a deeper diagnosis of the reinforcement process, as well as to identify hidden losses and possible reserves for increasing labor productivity, a photograph of the working time of workers was taken. Based on the results of a photograph of working time, the main losses of the process time were revealed, shown in Figure 5, the bulk of which (29%, or 19 minutes from the product) was made up of losses associated with the movement of employees and the search for necessary materials and tools.

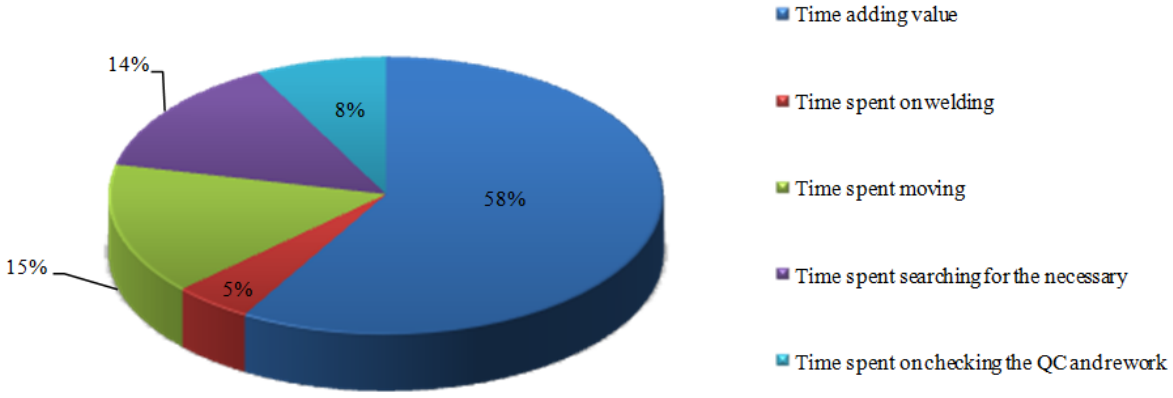

Figure 5. The cost structure of the working time of the reinforcement process

On the basis of the results of the photograph of working time, maps of the current and future states of the stream of creating the value of the reinforcement process were built taking into account the possibility of eliminating certain time losses (Figure 6).

Comparing the two maps constructed, we can conclude that due to measures to optimize the organization of the workspace and the process steps, it is possible to reduce the process time from 65 minutes to 48 minutes, and also to increase the efficiency of the process from 58% to 79%.

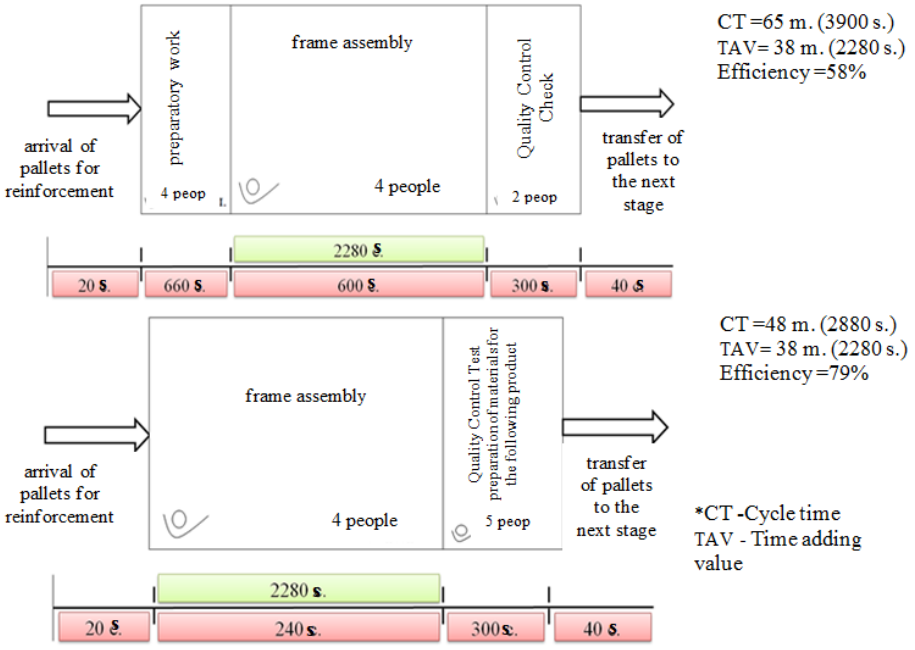

Figure 6. Current and future process value stream maps

Since the main losses are the time spent on moving and searching for the necessary (materials, tools, etc.), together with the value stream maps, we built “spaghetti diagrams” of the current and future state of the process (Figure 7).

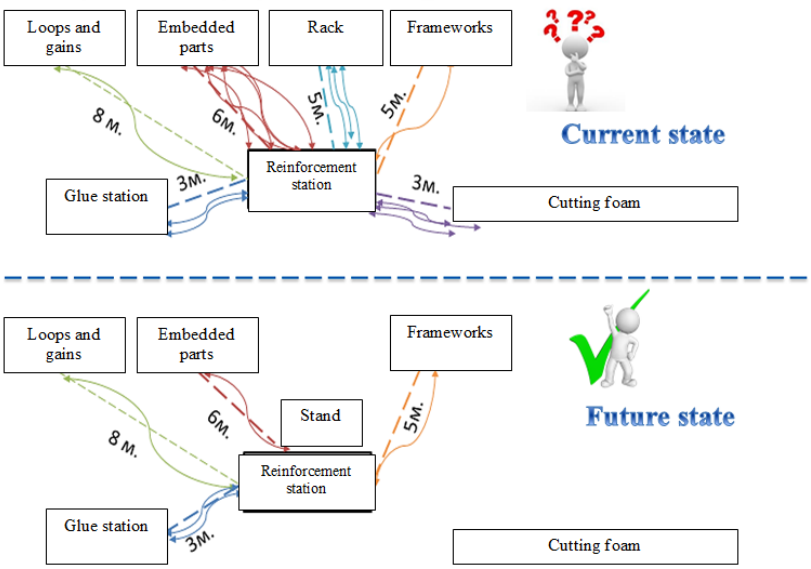

Figure 7. Current and future "spaghetti diagrams" of the pilot site

The current diagram was characterized by excessive movements behind embedded parts, polystyrene foam inserts, and tools. The future diagram involves eliminating unnecessary movements by optimizing the workspace and redistributing responsibilities.

To transition from the current state of the reinforcement process to the future state, a system of measures was proposed based on such lean manufacturing tools as the 5s system, visualization and kaizen. It is worth noting that the proposed activities do not require financial investments, as they are more organizational in nature. The system of recommended activities is presented in the Table 1.

Table 1.The system of recommended measures to improve the pilot site

Problem	Purpose	Tool	Essence	Result
Long search for embedded parts	Reduced time to search for embedded parts	Visualization	The use of bright color cards for marking bins with embedded parts according to the nomenclature and projects	Reducing the time to search for parts from 10 minutes to no more than 2 minutes for one product
Long search for necessary tools	Reducing the time to find the necessary tools	5s	Implementation of a standardized tool storage stand near each post	Elimination of time for searching tools and moving to the rack
Lack of employee interest in improving their activities	Increasing employee involvement in the process of improving production processes	Kaizen	Implementation of a kaizen offer system with financial incentives for proposed and implemented activities	Involvement of employees in the process of improving production processes
Irrational distribution of process steps	Reduce time without value	Process steps optimization	Combining the preparatory phase with the final stage of the process	Reducing the time of not adding value in the preparatory and final stages from 16 minutes to 5 minutes

Thus, the proposed recommendations are aimed at optimizing the operations of the reinforcement process and the organization of the workspace by eliminating time costs that do not add value to the process, based on the tools of the lean manufacturing concept.

4 Summary

The effect obtained as part of the improvement of the pilot reinforcement section can be divided into two parts: economic, which can be expressed in figures and socio-psychological, associated with improved working conditions and increased staff involvement in the production process.

It is worth noting that the proposed system of measures is based on the most fundamental tool of lean production - improvement and organization of the workplace together with visualization. In fact, the main form of the result that can be obtained is to reduce the process time.

In order to achieve the economic effect in monetary terms, we consider the effect of increasing labor productivity, reducing the time spent on reinforcing one product, and also increasing the overall efficiency of the process (Table 2).

Table 2. Effect of the implementation of the recommended system of measures

Options	Before applying the proposed activities	After applying the proposed activities
Labor productivity	72 moldings per day	96 moldings per day
Time for reinforcing one product	65 min	48 min
Reinforcement Process Efficiency	58%	79%

It can be concluded that the processing time of the product on the site, as a result of applying the system of recommended measures, decreased on average by 17 minutes from one molding. Since the reinforcement time was saved by reducing the time, which does not add value, the process efficiency increased: from 58% to 79%, that is, by 21% as a whole. During the work shift, the time saved will total 153 minutes (17 minutes from each of the 9 molds). Due to the time saved, the number of moldings per shift at the experimental post will increase by 3 units, i.e., the productivity per shift will be 12 moldings. If the proposed system of measures, based on the philosophy of lean production, is extended to the remaining posts of the site, the potential productivity of the site as a whole can be 96 moldings per day, taking into account work in 2 shifts, that is, there is a potential increase in production volumes by 24 products per day.

As for the economic effect, the potential effect due to savings in the salaries of the employees of the pilot site per year will amount to 2,131,200 rubles. This effect will be achieved by increasing the efficiency of the process and increasing productivity, by reducing time costs that do not add value. That is, if earlier the workers of the site per shift did about 36 moldings, then after the implementation of measures to optimize the process time, this number may increase to 48 moldings, but the wage will remain the same. Therefore, in this case, the company receives savings, since the order will be completed faster, but the payroll will not increase.

As for the social effect, in addition to standardizing the work environment to stabilize the production process on the pilot site, the implementation of the proposed activities will make it clear to the team that improvements should primarily begin with jobs. In addition, the standardization of the workplace improves and makes working conditions safer, and this, in turn, gives a psychological effect: in a clean place where there is complete order, it is more pleasant to work than in chaos, and the return on work will accordingly be higher. Separately, it should be noted the long-term prospect of standardizing the workspace of the site, because optimization of the workspace is the basis for the introduction of other lean manufacturing tools.

5 Conclusion

Thus, we can conclude that in modern reality the concept of lean production is an effective way of thinking and one of the key ways to increase the competitiveness of an enterprise in a market economy.

We can say that there is no universal algorithm for introducing the concept of lean manufacturing that would be suitable for any organization, since there cannot be two identical projects for introducing lean manufacturing tools. Each organization chooses its own path, starting from its specific features, capabilities and understanding of this philosophy. But the most effective way to introduce the concept today is considered to be its implementation, on the basis of the project approach, by the pilot sites. The introduction of the lean manufacturing concept on the pilot site allows you to get immediate and tangible results that are demonstrated to employees of the entire enterprise, so that subsequent implementation of the concept is perceived by employees positively and with minimal resistance, which is especially inherent in the Russian mentality.

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