Development of the production system through lean management tools

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Abstract. Lean management or lean manufacturing is a fairly new practice for Russian enterprises. The introduction of lean management systems into Russian realities began in the 2000s. The main problem is that domestic enterprises, starting from the state of the economy and mentality, cannot use foreign experience without changes. In this paper, the main tools of lean manufacturing are considered and a step-by-step method of system implementation is proposed using the example of Uralelectromed JSC. Currently, only large Russian enterprises have the practice of introducing lean production systems. In this paper, we consider the method of implementing the system on the example of a small group of employees of the enterprise. This technique can be successfully applied to small enterprises. The aim of this work was to develop a concept for the development of the production system through lean management tools.

1. Introduction

In the current unstable economic situation caused by the imposition of sanctions, there is a worsening of conditions for business activities, in particular for the largest companies in the country. The unfavorable economic situation has created the need to find sources for improving efficiency and competitiveness in the context of a shortage of resources. In this situation, the development of the production system is the main way to improve the efficiency of domestic companies. Industrial organizations seek to improve the efficiency of the use of available funds, and also pay great attention to identifying domestic potentialities. Thus, the development of the production system is the most optimal and least costly tool for increasing efficiency. In order to study the applicability of the principles of work of industrial systems of industrial organizations consider the relevant theoretical foundations and possible improvement tools.

Different authors note that the production system includes a set of heterogeneous elements, the functioning of which leads to the achievement of the main goal - the sale of finished products/services [1], [2]. It should be noted that in a market economy, an important factor in the functioning of the production system is the production-marketing system of relations between an enterprise and a supplier, an enterprise with consumers of finished products. Integration of the enterprise’s production system with the external environment requires a rational organization of internal processes, including transport and warehousing systems [3]. Achieving the main goal of the production system is possible through the management of its operation and development. We can say that the production system is a means of
realizing the interests of consumers. The approach to the development of the production system, which consists in the continuous improvement of the enterprise as a production and sales system, is reflected in the concept of lean production of Toyota [4].

2. Theoretical approaches to research
The structure of the production system in a modern competitive market is determined by the quality of the product, competitive price, production flexibility, speed of the production cycle, which is the key to improving overall efficiency. The effectiveness of the industrial enterprise's production system is determined by the ability to manufacture products or provide services with minimal losses, to identify and eliminate losses, and to train personnel. Thus, the cost of production and the competitiveness of the enterprise depend on the efficiency of the production system.

The production system is characterized by the rationality of the use of all resources of the enterprise (raw materials, capital, labor, etc.), taking into account the production specifics of the enterprise. The production system includes all stages of production and sales activities [5].

The structure and directions of development of the production system are independently determined by the company at a strategic level. In our opinion, the elements of the production system are personnel, equipment, quality, costs, the active element of which is a person, as well as financial solvency. The growth potential of the company is determined by operational efficiency. Improving operational efficiency is achieved through staff development. However, the development of the production system is the result of an integrated system approach to the organization of production, therefore, the efficiency of the production system is the rational use of all the resources of the enterprise [6].

The concept of lean manufacturing contains principles, methods and tools for organizing production and labor in industrial enterprises that differ from traditional approaches. Lean manufacturing allows to produce large volumes of products and services with less effort, on smaller production areas and at lower costs. In essence, lean manufacturing tools are a set of methods or methods of practical application of the proposed system. Such tools include, in particular, the 5S workplace organization system, Just in Time, kanban, kaizen blitz, quick changeovers (SMED), error prevention, creation of a value stream map (Value Stream Mapping), universal equipment maintenance (TPM - Total Productive Maintenance), visualization, One-touch setup, U-shaped cells, etc. [7], [8], [9]. One of the core values of lean manufacturing is the subjective feeling of the consumer that the products he needs will be delivered at the right time and place.

The need to develop and implement projects in the field of "lean production" is associated with the need to ensure the high competitiveness of a modern enterprise, and to increase global competition in traditional sales markets. To this end, it makes sense to turn to world experience in the field of lean manufacturing. It is thanks to the consistent implementation of the ideas of Deming, Juran and Kaori Ishikawa and other gurus that Japan, a country more than poor in natural resources and devastated by war, became one of the richest countries in the world.

Edward Deming, one of the leading experts in statistical methods of quality assurance, in 1950 received an invitation from the Japanese Union of Scientists and Engineers to take part in the program of restoring Japanese industry. There, Deming proposed a quality management program, developed the principle of continuous quality improvement, which revolutionized Japanese industry [10]. Crosby in 1964 offered the program "Zero defects" [11]. Feigenbaum developed the principles of total quality management and parallel (simultaneous) engineering. Ishikawa came up with a “quality circle”, proposed a "cause-and-effect" diagram (Ishikawa diagram), developed a quality management concept in which the entire enterprise team participates. Juran developed the principle of "quality triads". Messing proposed the “quality manual” as the main document of the enterprise quality assurance system.

In terms of the practical implementation of “lean production”, the issues of assessing the actual state and the long-term prospects for using the “lean manufacturing” instruments acquire particular significance. Because, firstly, there may be an illusion that a lot has already been done at the enterprise and you can reduce the activity of introducing tools and methods of lean production, and secondly, each next step to reduce losses and increase enterprise efficiency will require more significant efforts. In this
regard, there is a need to develop a model that would demonstrate further reserves for the implementation of tools and methods of "lean manufacturing".

3. Results of the study

Among the Russian enterprises, the first to begin to introduce lean production, mainly large industrial companies. In this textbook, KAMAZ, GAZ Group, VSMPO-AVISMA, Rusal, Evraz Holding, Eurochem and a number of others. Unfortunately, the most common reason for starting work with consultants are problems experienced by entrepreneurs. The main factor that necessitates the introduction of a lean manufacturing system is the growth of the spoilage. But at the same time, having received the first effect, they do not stop at what they have achieved, understanding that only constantly following the principles of the new system will lead to maximum return.

Table 1 shows the results of evaluating the effectiveness of the lean production systems implementations on the example of enterprises of the Sverdlovsk region, presented by 10 experts.

| Subsystem | Estimated indicators | Expert estimates | Av. |
|-----------|----------------------|------------------|-----|
| "Strategic Management" | Availability of strategic management | 3,5 5,1 3,0 3,9 5,2 3,0 4,0 3,6 4,4 6,9 | 4,26 | 5,5 5,3 5,0 5,7 5,7 5,0 6,0 6,0 5,0 5,45 |
| | Lean manufacturing philosophy | 8,1 7,1 8,4 8,5 7,3 7,9 6,8 7,8 9,0 8,1 | 7,90 | 5,8 6,5 5,8 5,3 7,0 5,5 6,9 6,6 6,6 6,5 6,25 |
| | Declaration and Principles of Lean Production | 4,6 4,5 4,4 3,2 4,5 3,2 3,9 3,4 3,8 4,8 4,03 | 4,03 | 3,7 3,1 3,1 2,0 2,4 2,9 3,3 3,8 3,0 2,8 3,01 |
| | Involvement of senior management, the implementation of personal projects | 2,0 5,0 2,9 4,3 2,2 4,1 2,4 2,3 2,4 2,7 3,03 | 4,85 | 6,2 6,8 7,8 6,5 7,8 8,0 7,5 6,8 6,0 7,5 7,09 |
| | KPI - key performance indicators | 7,9 7,4 7,8 8,2 8,0 7,9 7,6 7,6 7,5 8,9 7,88 | 7,88 | 2,5 4,5 4,5 4,1 2,3 2,7 1,7 2,8 2,3 4,2 3,16 |
| | Consumer requirements study | 5,8 4,3 4,1 4,2 4,0 6,0 6,0 4,6 4,6 5,3 4,89 | 4,89 | 5,0 3,6 4,6 4,6 3,5 3,2 4,9 3,8 4,9 4,1 4,22 |
| | Customer Satisfaction Assessment | 5,8 4,3 4,1 4,2 4,0 6,0 6,0 4,6 4,6 5,3 4,89 | 4,89 | 2,5 4,5 4,5 4,1 2,3 2,7 1,7 2,8 2,3 4,2 3,16 |
| | Average | 6,8 6,4 6,1 5,8 6,9 5,4 6,7 4,7 5,8 7,0 6,16 | 6,16 | 3,3 4,4 3,6 4,2 2,7 4,4 2,7 3,4 4,3 3,5 3,65 |
| | 5S availability | 6,8 6,9 3,5 3,2 5,7 6,2 4,5 4,7 3,4 6,8 4,89 | 4,89 | 6,1 5,5 5,5 4,2 3,1 5,0 5,5 3,6 4,86 |
| | Using a pull system | 6,8 6,1 5,5 5,5 4,2 3,1 5,0 5,5 3,6 4,86 | 4,86 | 6,1 5,5 5,5 4,2 3,1 5,0 5,5 3,6 4,86 |
| | Uniform distribution of work | 4,0 4,3 4,1 4,2 4,0 6,0 6,0 4,6 4,6 5,3 4,89 | 4,89 | 6,8 6,9 3,5 3,2 5,7 6,2 4,5 4,7 3,4 6,8 4,89 |
| | Use of visual control | 6,8 6,1 5,5 5,5 4,2 3,1 5,0 5,5 3,6 4,86 | 4,86 | 6,8 6,9 3,5 3,2 5,7 6,2 4,5 4,7 3,4 6,8 4,89 |
| | Loss reduction | 6,8 6,1 5,5 5,5 4,2 3,1 5,0 5,5 3,6 4,86 | 4,86 | 6,8 6,9 3,5 3,2 5,7 6,2 4,5 4,7 3,4 6,8 4,89 |
| | Improving product quality | 6,8 6,1 5,5 5,5 4,2 3,1 5,0 5,5 3,6 4,86 | 4,86 | 6,8 6,9 3,5 3,2 5,7 6,2 4,5 4,7 3,4 6,8 4,89 |
| | Improving the quality of service | 6,8 6,1 5,5 5,5 4,2 3,1 5,0 5,5 3,6 4,86 | 4,86 | 6,8 6,9 3,5 3,2 5,7 6,2 4,5 4,7 3,4 6,8 4,89 |
| | Work with suppliers on lean manufacturing technology | 4,3 3,2 4,5 4,2 3,7 5,7 5,6 3,4 4,8 3,9 4,33 | 4,33 | 5,9 3,9 3,3 5,1 3,2 4,9 5,2 4,9 3,3 4,5 4,38 |
| | Work with dealers on lean manufacturing technology | 5,9 3,9 3,3 5,1 3,2 4,9 5,2 4,9 3,3 4,5 4,38 | 4,38 | 7,0 6,9 5,8 7,0 6,16 | 6,16 |

As the analysis shows, there are high marks on such criteria as "Declaration and principles of lean production", "Employee training", "Availability 5s", "Availability and quality of kaizen offers". At the same time, at a sufficiently low level, experts estimate the level of implementation of such lean manufacturing tools as "Studying customer requirements", "Assessing customer satisfaction", "Using a draw system", "Working with suppliers and dealers on lean production technologies". It should be noted that the average values obtained are generally correlated with the indicators for big enterprises. In
In general, it can be noted that the degree of implementation of lean manufacturing technologies is at a relatively average level. However, in terms of the “Personnel” subsystem, there are higher grades, rather than the “Strategic Management” and “Processes” subsystems.

An expert assessment of the effectiveness of the implementation of individual parameters of the “Lean Production” system at Uralelectromed OJSC is presented in Figure 1.

4. Discussion and conclusions

To further improve the management efficiency of the implementation of a lean manufacturing system, competent use of all tools is necessary.

Lean manufacturing tools are simple techniques that allow you to see opportunities for improvements, significantly reduce losses, constantly improve the entire range of business processes, increase the transparency and manageability of an organization, use the potential of each employee of the company, increase competitiveness, and achieve significant economic benefits without large financial costs.
The authors recommend the company to introduce the program “Preparing Masters of Lean Manufacturing”, which will allow creating a new level of managers in production - both from newly hired employees and from those already working.

It is necessary to introduce a methodology for the selection of candidates for participation in this program. It should also more actively apply the method of 5S and KPI. Applying the 5S methodology - a rational organization, evaluating the workplace, will significantly increase the efficiency and controllability of the operating area, improve organizational culture, help improve employee productivity, reduce the number of defects, and ultimately save time and money for the enterprise. This system will also allow the entire staff of the enterprise to engage in regular activities to restore order, cleanliness and assessment of discipline in the workplace.

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