ЕКОНОМІКА ТА УПРАВЛІННЯ ПІДПРИЄМСТВАМИ

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DETAILING OF THE IMPLEMENTATION ALGORITHM AND APPROACHES TO CONTROL THE EFFECTIVENESS OF THE LEAN PRODUCTION SYSTEM

ДЕТАЛІЗАЦІЯ АЛГОРИТМА ВПРОВАДЖЕННЯ ТА ПІДХОДИ ДО КОНТРОЛЮ РЕЗУЛЬТАТИВНОСТІ СИСТЕМИ ОЩАДЛИВОГО ВИРОБНИЦТВА

Ukrainian enterprises are in conditions of uncertainty in the external environment, as a result of which there is a need to review existing production systems and search for the latest tools for optimizing production and management systems in order to ensure the possibility of saving various types of resources. The feasibility and effectiveness of the implementation of the lean production system has been proven by many developed countries using the example of the most successful companies, whose experience can be extremely useful for Ukrainian enterprises. Of course, domestic enterprises have their own specifics of activity, but they can also be taken into account in the process of developing a lean production system for each specific enterprise. The implementation of a lean production system for domestic enterprises can become the tool that will allow to reduce costs, strengthen the position in the market and survive in the difficult conditions of a country in a state of war.

Key words: *lean production, tools of lean production, benchmarks, saving resources, material resources, sequence of actions, system.*

Українські підприємства перебувають в умовах невизначеності зовнішнього середовища, внаслідок чого виникає необхідність перегляду існуючих виробничих систем та пошуку новітніх інструментів оптимізації виробництва та систем управління з метою забезпечення можливості економії різних видів ресурсів . Доцільність та ефективність впровадження системи ощадливого виробництва доведена багатьма розвиненими країнами на прикладі найуспішніших компаній, досвід яких може бути надзвичайно корисним для українських підприємств. Звичайно, вітчизняні підприємства мають свою специфіку діяльності, але її також можна врахувати в процесі розробки системи ощадливого виробництва для кожного конкретного підприємства. Впровадження системи ощадливого виробництва для вітчизняних підприємств може стати тим інструментом, який дозволить знизити витрати, зміцнити позиції на ринку та вижити в складних умовах країни, яка перебуває у стані війни. Бережливе виробництво не передбачає тотальної економії ресурсів з можливою втратою якості продукції, а навпаки, спрямоване на ефективне використання всіх видів ресурсів для забезпечення виробництва високоякісної продукції. Бережливе виробництво – це система, яка може бути застосована не тільки на виробничих підприємствах, а й на підприємствах сфери послуг. У статті проведено порівняння інструментів ощадливого виробництва та сформовано послідовність етапів впрова-

дження системи ощадливого виробництва з подальшим визначенням контрольних показників, які дозволять визначити ефективність впроваджених оптимізаційних заходів, відповідно до побудови системи ощадливого виробництва. Детально описано, який інструмент можна використовувати для вирішення конкретної проблеми та за якими індикаторами слід контролювати результати впровадження кожного інструменту. Використання таких інструментів дозволить своєчасно виявити недоліки системи управління та ухвалювати рішення щодо можливості оптимізації всієї системи ощадливого виробництва з урахуванням практики та особливостей розвитку кожного конкретного підприємства.

Ключові слова: *ощадливе виробництва, інструменти ощадливого виробництва, контрольна показники, економія ресурсів, матеріальні ресурси, послідовність дій, система.*

Problem statement. In the modern world, production processes are subordinated to the main idea - saving resources, as the rapid growth of the population of our planet and the increase in consumption of various types of products leads to a shortage of various resources. The need for economical use concerns not only material and energy resources, but also intellectual, financial, information resources, time, and capital. It is because of the need for economical use of various types of resources that the concept of lean production has emerged, which is quite actively used in the world today. For Ukrainian enterprises, the implementation of the concept of lean production can become the vector of development that will ensure the most efficient use of all types of resources for development in an uncertain environment. Given this, a detailed algorithm of actions for the implementation of lean production can be extremely useful for domestic enterprises.

Analysis of recent research and publications. The problem of implementation and further application of the concept of lean production today attracts the attention of many scientists. Conceptual issues of the introduction of lean production are considered in the works of Hontaruk O.V., Hubarenko L.M., Tsupryk L.M. [2], and Sych D.M. [9]. Applied aspects of the introduction of lean production tools are considered by such authors as Lazorenko T.V., Holub M.O. [5], Sych D.M. [10] and Shvets F.D., Pakharenko O.V., Andriitso-Ruzaieva A.Yu. [13].

Despite the fact that in recent years, significant attention of scientists has been focused on the problem of lean production, there is no consensus on the peculiarities of its implementation in the existing management system or details of ways to control the effectiveness of such a system in the literature.

The **purpose of the article** is to theoretically generalize the essence of lean production and practical detailing of the algorithm for implementing the concept of lean production with the development of approaches to monitoring its effectiveness.

Presentation of the main material. The concept of lean manufacturing is relatively new for Ukrainian enterprises and is based mainly on the experience of Western companies that have long been using the approaches, principles, and tools of lean manufacturing. That is why it is necessary to define what exactly is meant by lean manufacturing.

For example, researchers Vumek J.P., Jones D.T., Rus D. consider lean production as a breakthrough approach to management and quality management that ensures long-term competitiveness without significant investments [2]. It is worth noting that scientists here pay attention to the result, which is manifested in long-term competitiveness without significant investments, therefore, the concept is designed for long-term transformations in the enterprise without short-term results [2].

Instead, George M.L. gives a more significant definition of lean production as a logistics management concept that focuses on a reasonable reduction in the size of the order for the production of products that meet demand while improving its quality; reducing the level of inventory of resources used; continuous training of production personnel covering the entire contingent; introduction of flexible production technologies and their integration into a single chain with interacting technologies of partners [2]. In this definition, the emphasis is on the logistics component of transformations and the transition to the production of higher quality products, but in smaller volumes. But it should be noted that it is necessary to analyze the market and determine whether the buyer is ready for higher quality products, when the demand may not be fully satisfied [2].

But the Ukrainian scientist Sych D.M. [9, p. 74], summarizing the scientific achievements of scientists in the field of lean production and

management accounting, proposes to use the following definition: lean management accounting is a comprehensive accounting open subsystem based on a high level of self-awareness of participants in all processes and provides: the formation of detailed information about costs and results in the context of value creation flows; visualized cause-and-effect analysis based on modern technological maps that allow to determine the directions of reducing losses and waste, saving energy, reducing costs and reducing waste. [9, p. 74].

Summarizing the views of scientists, we consider it expedient to specify the definition of lean production and emphasize that, in our opinion, lean production is a system of enterprise management focused on the efficient use of all types of resources, aimed at qualitative transformations of internal production processes, relations with contractors in the direction of ensuring high quality of the finished product with minimal resource costs.

In the previously mentioned definition, Sych D.M. [9, p. 74] notes that the lean production system is primarily based on information transformations at the enterprise, and therefore, the first stage of the introduction of lean production should be the selection of information about the internal system of the enterprise and determining the feasibility of introducing a new concept.

To begin with, we should consider what approaches to building a lean production system exist today in management theory.

In the theory of modern management there are two ways to implement the concepts of lean production in practice:

1. Selection of the optimal set of tools for the enterprise, which will allow solving current and strategic tasks. Such tools include:

– SMED – a system that allows for rapid reconfiguration of production equipment and accelerate the production process and sales of products, resulting in savings of material and financial resources, as well as less time for the production process [12, p. 248];

– Poka-yoke (translated from Japanese – "protection against errors") – mostly a technical or information tool that allows to ensure the protection of equipment, employees, finished products from errors or defects ("protection against fool"). It provides for the protection of equipment, tools, products, and people at different stages of the process, from obviously incorrect or dangerous human actions when interacting with these objects [12, p. 248];

– Spaghetti diagram – a graphical tool for displaying the elements of the production process and understanding the involvement of specialists, equipment, machinery, information, etc. in it [6, p. 61];

– TPM (Total Productive Maintenance) – general care of equipment. It is a system of maintaining and improving the integrity of production systems, safety, and quality with the help of machines, equipment, processes, and employees that organize and increase the value of the business [8, p. 87];

– Single-peace flow – a tool that provides for the elimination of multitasking, resulting in reduced probability of defects, loss of attention by employees, irrational use of material resources [11, p. 43];

– kanban – a visual tool that allows you to monitor the timing of projects or production process. It allows to ensure maximum transparency and openness of the processes that accompany the production of products or the implementation of various projects at the enterprise [7, p. 33];

– 5S system – a tool for the rational organization of the workspace of each employee, according to which each workplace must meet all five requirements: cleanliness, order, accuracy, strict adherence to all standards, and compliance with labor discipline [6, p. 61];

– kaizen – a set of various tools, a concept that focuses on the continuous improvement of production processes and the enterprise management system [7, p. 33].

2. Implementation of the integrated system "Toyota Way". This system is based on transformations in the production process, according to which any activity that can consume resources but does not benefit the enterprise is terminated. The "Toyota Way" system is aimed at the qualitative transformation of the system into a more efficient and rational one, resulting in resource savings, rather than cost reduction as such.

For enterprises where the latest management optimization tools have not been introduced before, it is advisable to start with the first approach and introduce some tools that will optimize a certain component or direction of the enterprise, but when the enterprise already has experience in using various modern management optimization tools,

and managers have considerable experience, it becomes possible to apply the second approach, more comprehensive and systematic.

Thus, it can be argued that the use of individual lean manufacturing tools can be considered a preparatory stage for the restructuring of the management system to implement a comprehensive lean manufacturing system. When deciding to introduce a lean production system into the company's management, it is advisable to pay attention to the experience of large companies that are already successfully using these systems. Thus, Ukrainian enterprises can be recommended to use the experience of such well-known world companies: Toyota Motor Corporation, WestRock, AMD, Ford Motor Company. For example, Toyota Motor Corporation began implementing the concept of lean manufacturing in the 1950s and for the first five years showed positive results that allowed to save up to 15% of production costs. AMD company, implementing the lean manufacturing system, abandoned its own production facilities and switched to the production of microprocessors at the expense of its partners around the world, such transformations in the first years of implementation were perceived as unpopular, but now the concept has shown its results by a significant increase in the company's capitalization and increase in its profitability. WestRock, which specializes in the manufacture of general-purpose paperboard packaging, is focused on a lean production system not only for the efficient use of resources but also for the proper use of recycled paper raw materials. Summarizing the experience of large world companies and scientific literature on the subject of the study, it becomes possible to present an algorithm of actions for the implementation of the lean production system in the activities of domestic enterprises – Fig. 1. When the company has already implemented and actively uses individual tools of lean production, they can be extended to the management accounting system. The principles of "lean production" are disclosed in the SMA IMA management accounting standard "Accounting for the Lean Enterprise: Major Changes to the Accounting Paradigm" and are usually reduced to the following five: value; value stream; the principle of continuity of flow; the principle of operational control; the principle of continuous improvement of business processes [4, p. 278; 10, p. 62].

The basic principles of the concept of "lean production" are the study of the system for the presence of losses in the process of its functioning, elimination of damage from the identified losses by special methods and tools, as well as continuous monitoring of the efficiency of the system [3, p. 165].

Following the sequence of actions that are prescribed in Fig. 1, each enterprise will be able to determine the feasibility of implementing a lean manufacturing system and find out the optimal set of tools for implementing this system.

After individual tools or the whole system of lean production has been implemented in the activities of the enterprise, it is necessary to monitor the effectiveness of this system. We propose a list of benchmarks for the performance of the lean manufacturing system for each of the problems that this system could solve (Table 1).

As you can see, the main indicators that allow you to monitor the effectiveness of the functioning of the lean production system are the classical financial and economic indicators, from which a checklist can be formed to track the dynamics of changes in the enterprise.

Conclusions. As it was proved in the article, Ukrainian enterprises need modern effective tools for optimizing production to save limited resources, which is especially important in an uncertain environment. The article analyzes the approaches of different authors to the definition of the essence of lean production and formulates its own, according to which lean production is a system of enterprise management focused on the efficient use of all types of resources, aimed at qualitative transformations of internal production processes, relations with counterparties in the direction of ensuring high quality of the finished product with minimal resource costs. It is proven that the first step in the implementation of the lean production system should be the identification of the most pressing problems and the choice of tools to solve these problems. And the next step is to introduce a comprehensive system of lean production. The list of performance indicators of the lean production system for each of the problems that could be solved by this system is also specified. It is proved that constant monitoring of the dynamics of these indicators will allow more qualitative and rational implementation of the lean production system.

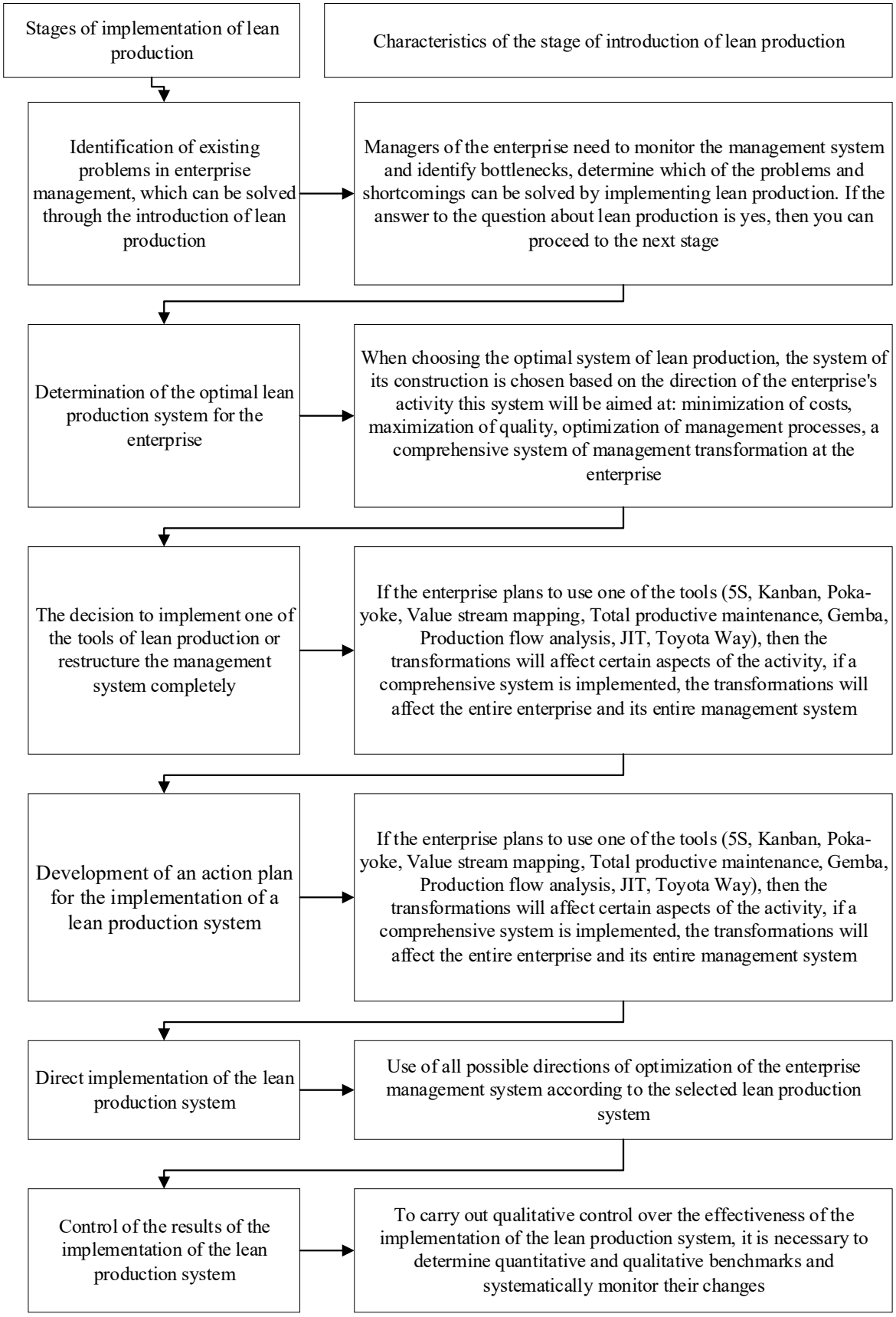

Fig. 1. Algorithm of actions for the introduction of the lean production system in the activities of domestic enterprises

Source: compiled by the author

Table 1

List of performance benchmarks of the lean manufacturing system for each of the problems that could be solved by this system

Shortcomings in the management system before the introduction of the lean production system	The direction of correcting deficiencies as a result of the implementation of the lean production system	Benchmark to determine the effectiveness of the lean production system
The suboptimal production process, resulting in a longer production cycle. Then that of competitors	Spaghetti diagram will allow you to analyze the entire production process and identify reserves for reducing the production cycle	Duration of the production cycle, turnover period of current assets, turnover period of accounts payable and receivable, turnover period of inventories, return on current assets, duration of storage of inventories in warehouses
A significant percentage of defective finished products	It is advisable to use three tools: Poka-yoke, Single-peace flow, and Single-peace flow, which will make the work of employees more comfortable and minimize the possibility of rejects	Percentage of products with defects, number of complaints
Lack of discipline in the workplace and poor organization of the work process	The application of kanban tools and the 5S system will contribute to solving the problem, as they allow you to plan the work of employees and build a clear sequence of actions to obtain optimal results	Number of dismissals due to violation of labor discipline, idle time of employees, duration of the production cycle for certain types of products (where a significant share of manual labor), the labor intensity of products
Significant production costs, high cost of production compared to competitors	The problem of unaccounted costs can be solved by using a combination of two tools Single-peace flow and kaizen, which minimize the use of material resources and minimize the problem of unaccounted costs	Cost of production, the share of material costs in the cost of production, the profitability of production, return on investment
Inefficient organization of the production process and capacity utilization	For complex transformations in the production and sales system, it is advisable to use the SMED tool, which will save both material and financial resources	Cost of production, the share of material costs in the cost of production, the profitability of production, the profitability of sales, duration of equipment downtime, percentage of equipment utilization
The significant depreciation of equipment and its irrational use	To optimize equipment utilization and rationalize the production process, it is advisable to use the TPM (Total Productive Maintenance) tool	Wear of production equipment, equipment utilization, percentage of products with defects, production profitability

Source: compiled by the author based on [9; 10; 12]

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