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USING THE LEAN MANUFACTURING METHODOLOGY TO IMPROVE THE QUALITY OF THE ENTERPRISE'S BUSINESS PROCESSES

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Formulation of the problem. In the conditions of global competition, lean production acquires special importance. For enterprises all over the world, the only way to survive in the market is to produce goods and provide services that most fully satisfy the demands of consumers, while using advanced management methods and technologies. Lean manufacturing is one of the modern tools of production organization and management technology, which is used to improve the quality of products and services, the most complete satisfaction of consumer needs, while ensuring a careful attitude to the company's resources and their savings.

The purpose of the study is the further development of methodological, methodical and practical approaches to the concept of Lean manufacturing to improve the quality of the enterprise's business processes.

Research methods. The research used scientific methods, such as theoretical generalization, comparison, analysis, synthesis.

Result. In the process of research, a comparison of traditional business management and the concept of lean production was made and revealed. that the concept of lean production has such advantages as the transition from centralized, vertical management to horizontal, involvement of all employees in the process, teamwork, focus on rational use of resources. The concept of lean production is aimed at eliminating the following main types of losses: overproduction of goods; waiting for raw materials, semi-finished products, necessary service information; unnecessary movement of materials; redundant processing steps arising due to errors in the design of business processes; excessive stocks and business processes leading to their occurrence; unjustified rotation of personnel in the work process; production of waste; underutilization of employees' creative potential.

Conclusions. Six main elements and 52 components (requirements) of Lean manufacturing are defined based on the SAE J4000 standard for more successful application of lean manufacturing ideas in practice production to analyze the levels of implementation of lean manufacturing methodology components and elements. The main elements of the concept of lean manufacturing, the development and improvement of which should be focused on, are: company management and trust in it; enterprise personnel; information environment; chain "supplier – organization – consumer"; product; business processes. An important role in the concept of lean manufacturing is played by the 5S ordering system and the system of general maintenance of TPM equipment .

Keywords: lean manufacturing; losses; flow of value creation; 5S ordering system; system of general maintenance of TPM equipment; SAE standard J4000.

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
10	0	2

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ВИКОРИСТАННЯ МЕТОДОЛОГІЇ LEAN PRODUCTION ДЛЯ ПІДВИЩЕННЯ ЯКОСТІ БІЗНЕС-ПРОЦЕСІВ ПІДПРИЄМСТВА

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Постановка проблеми. В умовах глобальної конкуренції бережливе виробництво набуває особливого значення. Для підприємств усього світу єдиним шляхом виживання на ринку є виробництво товарів та надання послуг, які найбільш повно задовольняють вимоги споживачів, використовуючи при цьому передові методи та технології менеджменту. Бережливе виробництво є одним із сучасних інструментів організації виробництва та технологією менеджменту, яке використовується для підвищення якості продукції та послуг, найбільш повного задоволення потреб споживачів, одночасно забезпечуючи бережливе ставлення до ресурсів підприємства та їх економію.

Метою дослідження є подальший розвиток методологічних, методичних і практичних підходів до концепції Lean production для підвищення якості бізнес-процесів підприємства.

Методи дослідження. В дослідженні використано наукові методи, такі як теоретичне узагальнення, порівняння, аналіз, синтез.

Результат. Проведено порівняння традиційного ведення бізнесу і концепції бережливого виробництва та виявлено, що концепція бережливого виробництва має такі переваги як перехід від централізованого, вертикального управління до горизонтального, залучення до процесу усіх працівників, командна робота, зосередженість на раціональному використанні ресурсів. Концепція бережливого виробництва націлена на ліквідацію таких основних видів втрат: надвиробництво товарів; очікування сировини, матеріалів, напівфабрикатів, необхідної службової інформації; непотрібне переміщення матеріалів; зайві етапи обробки, що виникають через похибки в проектуванні бізнес-процесів; надмірні запаси і бізнес-процеси, що ведуть до їх виникнення; невиправдана ротація персоналу у процесі роботи; виробництво браку; недовикористання творчого потенціалу співробітників.

Висновки. Для успішнішого застосування на практиці ідей бережливого виробництва на основі стандарту SAE J4000 визначено шість основних елементів і 52 компоненти (вимоги) Lean production для аналізу рівнів впровадження компонентів і елементів методології бережливого виробництва. Основними елементами концепції бережливого виробництва, на розвиток та удосконалення яких потрібно зосереджувати увагу, є: менеджмент компанії та довіра до нього; персонал підприємства; інформаційне середовище; ланцюжок «постачальник – організація – споживач»; продукція; бізнес-процеси. Важливу роль в концепції бережливого виробництва відіграють система упорядкування 5S та система загального обслуговування устаткування TPM.

Ключові слова: бережливе виробництво; втрати; потік створення цінності; система упорядкування 5S; система загального обслуговування устаткування TPM; стандарт SAE J4000.

Introduction. In the conditions of globalization and international division of labor, lean manufacturing acquires significant importance. For enterprises all over the world, the only way to survive on the market is to produce goods and provide services that best satisfy the demands and wishes of consumers, while using advanced management technologies, in particular, lean manufacturing as a management technology that ensures the rational use of the company's resources.

Resources and methods. In the domestic and foreign economic literature, the problems of improving the activities of enterprises based on the implementation of lean manufacturing have not yet been fully covered. The most famous are the works of James Womack and Daniel Jones (2003), Sigeo Shingo and Andrew Dillon (2019), Michael George (2002), Oleksandr Momot (2007), Taiichi Ohno (2019) and others. Today, there is a trend of growing interest in this problem in science and practice to ensure the sustainable development of enterprises. The competitive struggle in global markets prompts enterprises to search for modern, effective approaches to enterprise management, in particular to the use of lean manufacturing. Further development is needed to clarify the methodological foundations and practical principles of lean manufacturing and to determine possible directions for the use of this concept by companies, taking into account world experience.

Results and discussion. Currently, thousands of enterprises around the world are armed with lean manufacturing methodology. Lean manufacturing is an effective management concept that has its origins in Toyota company and the essence of which is the optimization of business processes due to the maximum orientation to the market interests and needs of the client, the constant elimination of all possible types of losses and consideration of motivation of each employee. This includes the process of involvement in the optimization of every employee’s activity and is fully oriented towards the consumer. The implementation of the concept of lean manufacturing allows solving several key problems that most enterprises constantly face: to achieve high quality at minimum costs, to reduce the products creation time, to avoid overproduction, to regulate supply issues.

The purpose of Lean manufacturing methodology consists in building a production capable of quickly responding to the changing demands of consumers and making profit in any market change, including in the event of a drop in demand; creation of a perfect production system, which would instantly deliver the necessary products upon receipt of an order, and at the same time, there would be no accumulation of intermediate stocks. Lean manufacturing is one of the main components of the Japanese kaizen management system. Differences between traditional business management and the Lean manufacturing concept are shown in Table 1.

Table 1

Differences between traditional business management and Lean manufacturing concepts

Characteristics	Traditional approach	Lean manufacturing
Goal	Execution of indicators	Continuous improvement
Priorities	Orientation on the result	Orientation to immediate improvement processes and results
Production management	The method of separation and detailing of operations is used with the determined cost of each process	Operations are built into a flow, the speed of production is regulated by the cycle time, exactly corresponding to the existing demand
Work planning	The process of supply of components and priorities of production in shops are determined with the help of "pushing" planning systems	Components from previous operations are "extracted" by the system if necessary, production priorities are determined by the sequence of extraction
Organization of production	Production is lined up in large batches to reduce the number of adjustments, there is no flexibility	Shortened reconfiguration time, which makes it possible to work in small batches and quickly change to another product
Fulfilment of the order	Long order fulfilment time, reference for large volume orders	Fast execution of orders of any volume and range
Management culture	Management is busy solving current problems, working with indicators	Management prevents the causes that cause difficulties
Approach to solving problems	When problems arise, they look for the culprits in order to punish them	When problems arise, everyone asks the question "How to fix the situation?"
The role of the manager	Head	Mentor
Attitudes towards staff	Employees are one of the cost items	Employees influence the effectiveness of the company's results

Source: developed on the basis of (Kharchenko and Romaniuk, 2016; Momot, 2007; Monder, 1983; Tricker, 2020).

A peculiar starting point in this matter is the transition from centralized, vertical management to horizontal management, with the involvement of all employees in the process. In other words, the cornerstone of the lean manufacturing philosophy is teamwork. In traditional management, teamwork means corporate meetings, corporate charter, joint discussion of tasks, etc. This is not enough for lean manufacturing. Ideally at enterprises implementing Lean manufacturing, it is necessary to create an atmosphere "like in a family", where everyone helps each other and does without punishments (punishments are prohibited in the Lean concept).

According to the Institute of Lean manufacturing, the implementation of these approaches allows to reduce on average: the duration of the production cycle – by 50%, the volume of work in progress – by 60%, the number of cases of overproduction – by 70%, the required area – by 30%, time required for reconfiguration of equipment – by 65%.

According to the philosophy of lean manufacturing, if there is a problem, the cause should not be sought in the employee, but in the system. Ideally, all business processes at the enterprise should be built in such a way that it is simply impossible to make a mistake. Relationships with clients are built in a similar way. For an enterprise that works according to the principles of lean manufacturing, customers and suppliers are not a source of income, but friends, almost relatives. Therefore, to successfully implement the philosophy of lean manufacturing, many companies often have to radically change the foundations of their corporate culture.

So, the concept of lean manufacturing is focused on avoiding the following main types of losses:

- overproduction of goods when the demand for them has not yet arisen;
- waiting for raw materials, semi-finished products or necessary service information;
- unnecessary movement of materials (for example, due to suboptimal logistics chains of the workshop);
- extra stages of processing arising due to errors in the design of the business process;
- excessive stocks and business processes leading to their occurrence;
- unjustified rotation of personnel in the work process;
- production of waste;
- underutilization of employees' creative potential.

Avoiding the prerequisites for the appearance of certain types of losses allows you to reduce the time and level of costs to minimum. To combat losses, lean manufacturing offers a whole set of approaches.

For example, a description of the flow of value creation to identify "bottlenecks" in the production process; pulling (cascade production system, in which the shop or production area does nothing until the shop-consumer, located further along the technological chain, reports its need for components); production of parts or semi-finished products in small batches. But the main fight against losses begins in the literal sense from every workplace in the enterprise and with the implementation of the principles of the 5S system – one of the main "bricks" of the lean manufacturing methodology: sort, straighten, shine, standardize, sustain.

For more successful application of lean manufacturing ideas in practice, the Society of Automotive Engineers (SAE) developed the SAE J4000 standard and

a guide to implementing this methodology. The standard defines six main elements and 52 components (requirements) of Lean manufacturing and includes evaluation criteria to determine the levels of implementation of components and elements of the lean manufacturing methodology.

So, among the six main elements of the concept of lean manufacturing, most authors single out:

- company management and trust in it;
- personnel of the enterprise;
- information environment;
- chain "supplier – organization – consumer";
- products;
- business processes.

Company management. The degree of importance of each of the elements in the process of implementing the lean manufacturing methodology is determined by the number of components. The first element of the system – management / trust – affects two key principles of the lean manufacturing methodology: horizontal management (constant two-way interaction between managers and subordinates) and the human factor (attention and respect for each employee, understanding his importance for the company). The role of management in the process of implementing the concept of lean manufacturing consists, first of all, in the ability to convey to the enterprise team the essence of the changes that are taking place, as well as how important the degree of participation in the process of each of the employees is for achieving the desired result. The requirements of the standard determine exactly how and in what sequence it should be carried out and how the results of the actions taken are evaluated.

Enterprise personnel. For a more successful implementation of the principles of lean manufacturing, the company needs to train its staff in the principles of Lean. For this purpose, training programs are being developed for all categories of employees, including newcomers. The curriculum includes training in lean manufacturing tools and evaluation criteria at all levels of the organization (participation in training programs outside of working hours is paid for separately). After training, instead of functional divisions, new structural units corresponding to value creation flows (products) are formed. Each team (unit) is responsible for its area of work and continuous improvement and has a certain set of powers within which it can act without interaction with senior management. Sometimes companies implementing Lean face rejection of what is happening from middle and junior staff. As a rule, this attitude is the result of ignorance and misunderstanding of the principles of lean manufacturing. The worst thing is when the implementation takes place by "directive from above", when there is an order, but no one knows what its purpose is. In order for the

implementation process to be successful and effective, it is very important that all staff are involved in the training. The company itself is primarily interested in this, because if people look at their work business processes in a new way, they themselves will find the right, more effective solutions.

Information environment. The third important element of lean manufacturing is information. For the successful implementation of Lean, the company's employees must receive complete and reliable information on all the main issues related to production, such as productivity, equipment downtime due to malfunctions, the level of defects, the injury rate, downtime due to waiting for supplies, the number of hours of overtime work. The information is provided both centrally – for the enterprise as a whole, and individually - for the work of each of the labour units - in real time, which facilitates the collection, systematization and analysis of the received data.

Chain "Supplier – organization – consumer". The "supplier – organization – consumer" element involves the direct participation of the first and third links of the chain in the development and analysis of projects, products, etc. already at the initial stages. For this purpose, representatives of customers and suppliers are included in the composition of project groups, which makes it possible to identify all "bottlenecks" and eliminate them already at the early stages of work on projects.

Production. The fifth element of lean manufacturing is the product. The development of the product and the process of its production is carried out by united groups representing all interested parties, unlike traditional mass production, when the project passes through several departments, and there are delays when moving between departments. Much attention is paid to the prevention of losses and the prerequisites for their occurrence. The development of the product and the production process is carried out accordingly, taking into account the life cycle of the product, the principles of DFM / DFA (design assessment for manufacturability) and lean manufacturing methodology. Development time is constantly measured and reduced, which is one of the key performance indicators. Strict adherence to the procedure for launching new products built on APQP (quality planning) allows you to reduce development and launch time by 50%.

Business processes. The implementation of the sixth element of lean manufacturing – business processes – to achieve the required result involves the use of the main Lean tools – 5S and TPM, extraction and visualization methods, and as a result, it comes down to one thing – the improvement of the production process. With a lean approach, products are not made for storage. Customer orders initiate production and the passage of work through the production system, work is performed only if it is a link in the pull chain. Pulling systems give greater flexibility in production, as they allow you to produce products in

different combinations. Customers know what and when they will receive. This makes demand more stable.

In accordance with SAE J4000, the effectiveness of the implementation of each of the components is evaluated depending on the degree of achievement of the result on a scale from 0 to 3. The zero level of implementation indicates that the component is absent or significant inconsistencies with the requirements of the standard are found. Level 1 – the component is present, but minor inconsistencies were detected during the inspection. Level 2 indicates that the component is present and implemented successfully. Level 3 (which is considered a best practice for Lean companies) indicates that the component is present, effectively implemented, and actively improving over the past 12 months.

The main goal of implementing the philosophy of lean manufacturing is to create the most efficient production system, and the main advantage of the methodology is small and quick-payback investments, which can be achieved thanks to its implementation. According to world practice, the implementation of the lean manufacturing methodology allows achieving stunning economic results:

- reduction of losses in production up to 75%;
- reduction of production costs up to 40%;
- reduction of the order fulfilment cycle by up to 50%;
- reduction of labour costs and labour losses up to 45%;
- reduction of stocks up to 80%;
- increase in production volume up to 50%.

The practical experience of implementing the concept of lean manufacturing shows the possibility and expediency of using individual tools for the development of an individual system of improving the efficiency of the enterprise, the use of which undoubtedly has advantages over the "blind" copying of the methodology in general (Table 2).

When implementing the concept of lean manufacturing, companies often make common mistakes. The main mistake is usually a technological approach to understanding the improvement of the enterprise. But the technological approach means the implementation of modern equipment without support from the management, that is, the approaches to the management of human resources remain unchanged. Therefore, the management should avoid such a view of the concept and apply a management approach that considers the process of production optimization as a search for "weak spots", and later the introduction of appropriate technologies in accordance with the emerging need. Also, typical mistakes are misunderstanding the role of management in the implementation of a lean manufacturing system, insufficient flexibility of such a system, changing

jobs without changing habits, collecting data but not using it further, constant analysis of the situation, instead of constant improvements.

Table 2

Practical aspects of implementing the concept of lean manufacturing

Problem	Decision	Result
Significant stocks, long order fulfilment cycle, high level of defects, losses	Lean manufacturing implementation program	↑ Efficiency ↑ Speed ↓ Stocks ↓ Delivery terms
Unsatisfactory process indicators, presence of hidden losses	Blitz-kaizen of a specific process	↑ Target indicator ↓ Losses
The process or product is too complex, too expensive, or too slow	Radical process changes to ensure rapid value creation with less waste (kaikaku)	↓ Losses ↓ Expenses ↓ Speed
Unknown causes of existing problems, lack of understanding of their solutions	Diagnostics of the enterprise to identify the main problems and their causes, determine further actions	√ Awareness of the problem √ Awareness of reasons √ Further actions
An improvement strategy exists, but its implementation is unsuccessful, changes are ineffective or too slow	A change management program to implement improvements or implement a new strategy	↑ Changes ↑ Results √ Achieving goals
Inefficient workplaces, unsatisfactory level of production organization	Creating efficient workplaces and production areas to improve production and office processes	↑ Stability ↑ Discipline ↑ Transparency ↓ Losses
Losses of production capacity due to frequent downtimes, high costs of maintenance and repair of equipment	Implementation of the TPM system to maintain it in good condition and reduce maintenance costs	↓ Downtime ↓ Expenses ↑ Productivity
Inflexible processes and production in large batches, which worsens the response to consumer requests	Implementation of the principles of "extraction" in production and rapid reconfiguration of equipment	↓ Lot size ↓ Stocks ↑ Speed ↑ Flexibility
Unstable, unpredictable work results, process management is complicated	SDCA cycle tools to stabilize and standardize processes	↑ Stability ↑ Controllability ↑ Efficiency ↑ Speed
Employees lack the skills and knowledge to improve business processes at the enterprise	Training programs for the concept of lean manufacturing	↑ Knowledge ↑ Motivation ↑ Indicators ↓ Losses

Source: developed on the basis of (Kharchenko and Romaniuk, 2016; Momot, 2007; Hammar, 2021; Shingo and Dillon, 2019).

Separately, we can note the relevance of the implementation of the concept of lean manufacturing not only for profitable enterprises, but also for organizations facing difficulties, since the concept is focused on improving basic processes without involving additional investments. It is only necessary to have knowledge of lean technology, as well as to have the skills of practical application of knowledge, that is, no material resources are needed. In fact, many companies start using lean technologies already after new equipment or technologies do not achieve the expected result. And even though technology involves the entire company, it's usually in the form of small focus groups. But one must be aware that the use of lean manufacturing methods will naturally not provide an instant increase in turnover, because lean technology works together with proper capital management and cost reduction.

Conclusions. Lean manufacturing as an approach to improving management is based on the principles of total quality management. In unstable market conditions, providing value to the consumer and saving all kinds of resources, which lean manufacturing strives for, makes it possible to win in the competition. For more successful application of lean manufacturing ideas in practice, based on the SAE J4000 standard, six main elements and 52 components (requirements) of Lean are defined to analyze the level of implementation of components and elements of the lean manufacturing methodology. The main elements of the concept of lean manufacturing, the development and improvement of which managers at all levels should focus on, are: company management and trust in it; enterprise personnel; information environment; chain "supplier – organization – consumer"; product; business processes. An important system-forming role in the concept of lean manufacturing is played by the 5S ordering system and the system of general maintenance of TPM equipment.

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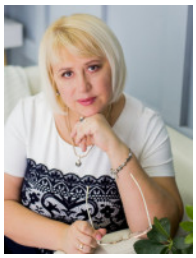

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