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Use of modern logistics technologies in terms of saving resources

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Abstract. The necessity of research of modern logistic technologies is proved. The definition of “logistics technology” is given. The connection of technological and logistical operations with the Pareto principle is shown. The logistic technology "just in time" is considered, which once appeared in connection with the changing situation in the Japanese market, its basic principles are investigated. It is shown how this technology “just in time” became the foundation for the development and practical implementation of new technology “lean production”. The historical periods of introduction of "lean production" in various branches and evolution of the technology are considered. Also, the technology of Lean transformation system is offered which is based on 5 questions to the company, which seeks to increase its efficiency and ensures understanding how to implement effectively the principles, purpose and concepts of Lean manufacturing to make continual improvements to the operations of an organization. Methods, methodology and tools of Lean were reviewed on practical examples.

1. Introduction

Today, the process of research of logistics technologies (LT) by both specialists and researchers is becoming increasingly important. LT is the main part of the process associated with the “birth” of the material flow, its movement (transportation) and storage, distribution and marketing [1]. LT must be understood as a complex of logistical operations or actions similar in direction, with the material flow in a specific time interval and space and associated with change and movement to achieve the logistical goal.

LT is a regulated sequence of logistics processes. LT combines technology and logistics operations [2]. There are operations related to the direct transformation of raw materials, semi-finished products and other into a finished product or service. These operations are associated with obtaining a material product and called technological. And there are operations that are part of the technological processes of obtaining a product or service related to the movement, transportation, warehousing, storage, forwarding of material flow on the way to its passage to the final consumer. They are called logistics [3].

2. Methodology for using logistics technologies

2.1. Problem statement

The specific complex of technological and logistical operations accords to the Pareto principle (20/80) [4]. According to this principle, only one-fifth (20%) of the total number of operations, which usually compiles the technological process, is aimed at obtaining (manufacturing) a material product or service, and the rest is about 80% of operations are logistics, transportation operations, moving, storing and so on [5].

Today, one of the most common LT in Ukraine is the technology "just in time" (JIT) [6].

JIT is the technology of the logistics system or organization of the logistics process in a particular functional area, which ensures the delivery of material resources, work in progress, final products in the required quantity, in due time and to the right place.

JIT appeared in connection with the changing situation in the Japanese market. It led to the fact that increase output stopped giving the former effect. This led to the intensification of the struggle for markets and the search for new methods of production management aimed at increasing profits. The result of this situation was a pragmatic approach, known as “just in time”.

2.2. Optimization technology "just in time"

JIT emerged after the First World War in the Japanese automotive industry. The founder of the system was the Toyota motor corporation. There is an element of chance in the emergence of this system. Automotive in that period formed from the giant US automaker - Detroit. However, the Japanese could not afford large investments to accumulate stocks unlike the Americans. Because inventories were seen as unnecessary losses due to shortage of funds. Obviously, this was one of the ideological lines of production by reducing costs of production. To reduce the cost of production must be quickly, accurately and flexibly adapting to fluctuations in consumer demand in the market. Therefore, the JIT system ensures the production of the required product in the required quantity and at the specified time. Obviously, there are three main principles for the system.

The first is that the delivery of resources is carried out to the places of processing exactly at the required time (semi-finished products, components, etc.).

The second consists of the continuity of the process improvement methods to increase productivity and reduction of production losses [7].

The third is production philosophy based on continuous improvement of production (includes technical and organizational spheres).

The purpose of JIT is a continuous production or serial services with “zero” losses. The basic philosophy is continuous development and improvement. In general, the use of JIT implementation process for the delivery of goods to customers just in time, allows an average halve the execution of orders, about 50% lower inventory levels and reduce by 50-70% the duration of the contracts the company that manufactures the product. This is important for consumers because they believe that it is better to complete an order in 10 days than it will range from 3 to 30 days.

The implementation of LT JIT on average allows:

- 60% reduction inventories of materials and components in the enterprise;
- 40% reduction in transportation costs;
- 40% reduction in the cost of materials;
- 28% improvement delivery of materials.

2.3. Optimization of "Lean Production" technology

JIT became the foundation for the development and implementation of such LT as LP (Lean Production). This technology combines [8]:

1) maintaining high quality production;
2) production of small quantities parties that are not desirable on market conditions;
3) support for low reserves during production;

4) high level of staff qualification in different categories;
5) use of “flexible manufacturing”.

The main ideas of Lean Production are the following:
- elimination of problematic operations, such as warehousing, reloading, etc.;
- organization of low-cost production in batches of small volumes;
- minimization of using resources in production.

The effectiveness of the practical application of LP is determined by the level of production capacity, which is formed by the quantitative and qualitative flexibility of the production system, strong partnerships with suppliers and consumers, the introduction of constant control and regulation of the production process.

Henry Ford's idea of "flow" arose in the 1900s. In the postwar period, small markets had to be flexible at presence deficiency of resources. In the 1950s, the Toyota production system was developed and introduced in Japan, and widely used in the automotive industry. The first examples of the use of LP outside Japan and then outside production were discovered around 1996. Today, LP tools are used in the field of service and IT [9].

There are some companies in Ukraine which use Lean transformation system, for example, Nova Poshta, Alfa Bank and others. Lean transformation system is based on 5 questions to the company:

1) What is the purpose of the company? What is necessary to solve the actual problem?
2) How to improve performance?
3) How to develop business?
4) What is the behavior of the leader and which type of management system do companies need?
5) What are the basic opinions of the company's employees?

The first question shows the future answer to what transformation is needed. Reducing staff or costs is popular now, but it is no longer relevant. Today, it is important to find something that will help to become competitive, flexible and as viable as possible on the market. For example, to reach the level of a competitor during a certain period, to create a flow in accordance with the growing demand, to offer the customer a wider range, to create a flow while expanding the range, etc. Lean has a tool for “determining the true north.” Companies use it when they want to produce as much as possible with small stocks, despite changes in demand, rapid production. The acceleration of all processes is always right transformation.

The second question helps to determine the work that needs to be done, improved, and in which ways to do it, namely, as short and fast as possible. In terms of quarantine company «Toyota» developed materials for staff. The main goal is to prove the ability of one person to work with six units of equipment in a pandemic, and when the situation improves to re-staff up to 6 people.

The third issue concerns staff development, starting with the right skills of people and ending with ways to develop these skills. People often do not want to change and learn, but Lean's approach involves having staff in the company who are constantly learn and share knowledge [10].

The fourth question helps identify management system and behavior of leaders to support the new way of working in accordance with the company's mission, to support the objectives, processes and personnel changes. Leaders improve themselves and then motivate their staff. The success of «Toyota» is the right leadership.

The fifth question is based on understanding the current basic thinking (mental models, attitudes and values) and the degree of their impact on the organization and its culture.

Thus, LT can be used for modern companies and transport companies for the purpose of right and efficient transformation. Consider the resources of Lean for railway transport in Ukraine, as the transport is a manufacturer, but produces a service for the transportation of goods, mail, luggage and passengers.

Using simple formulas, the reduction of the volume of batches can be linked to the increase of efficiency of the process cycle. The first law of “lean production” to accelerate the supply chain (used with the permission of ProfiSight Technologies, protected by US patents 5195041 and 5351195) says that the level of consumer demand (P) amount to

$$P = Q_{\min} / t, \quad (1)$$

where $Q_{\min}$ is the minimum volume of the consignment of goods; t - workplace turnover time;

or

$$T = t/2 = Q_{\min}/2 \cdot P, \quad (2)$$

where T is the delay time in the supply chain.

Ultimately, the volume of work in progress decreases, and, accordingly, the area under warehouses of work in progress.

Efficient implementation of LP technology for resource conservation was carried out at PJSC "Mironivska Poultry Farm" (represented in Ukraine by "Nasha Ryaba") - a closed-loop enterprise from the production of young animals to the production of broiler meat. The commissioning of the poultry farm took place in two stages: the launch of the first phase began in 2006 and was successfully completed in 2007; the launch of the second phase began in 2008 and ended in 2009. By 2020, it is a major global player, beating 150 million chickens a year. It is not easy to transform it. The purpose of the introduction of LP technology was to increase productivity, staff moved to foreign companies. The company set a goal to increase the productivity of each person two years ago, now the situation is better (Tables 1-2).

Table 1. Dependence of marriages on the number of staff at the poultry farm.

The staff of the conical line of the poultry farm, pers.	16	14	13
Production capacity of one conical line per hour, kg	529	508	439
Defect, %	2.63	4.9	5.24

The process value creation flow map solves all the necessary processes in which the least people are involved. If there is a conveyor with chicken, there should be no pass, as the system and the person will not process this pass. This is the basis of energy efficiency (Figure 1).

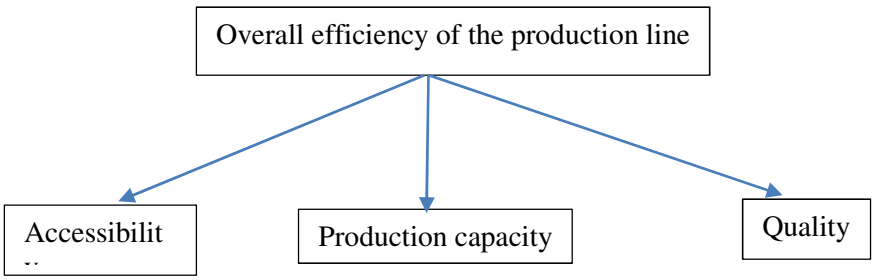

Figure 1. Components of efficiency in the production enterprise.

The Pareto curve (Figure 2) is drawn on the downtime of the equipment, the person came and worked 8 hours on the equipment without waiting until it is set up.

Table 2. Statistical indicators of PJSC "Mironov Poultry Farm".

Month, 2020	Total change time, min.	Just outage, min.	Total outage, %	Heads were scored, units	Actual production capacity, units / hour	Plan, units	Regulatory production capacity, units / hour	Equipment availability, %	Production capacity (staff efficiency), %	Total line efficiency (per shift), %
May	27,968	900	3.2	6,012,209	12,932	6,250,725	13,500	96.8	98.7	92.5
June	28,338	824	2.9	6,113,859	12,996	6,376,050	13,500	97.1	98.8	93.99
July	29,201	1,401	4.8	6,189,490	12,815	6,570,225	13,500	95.2	99	94.2
August	27,287	1,065	2.9	5,858,880	12,956	6,139,575	13,500	96.1	99.3	95.4
September	30,343	1,111	3.2	6,567,593	13,064	6,827,175	13,500	96.3	99.9	96.2

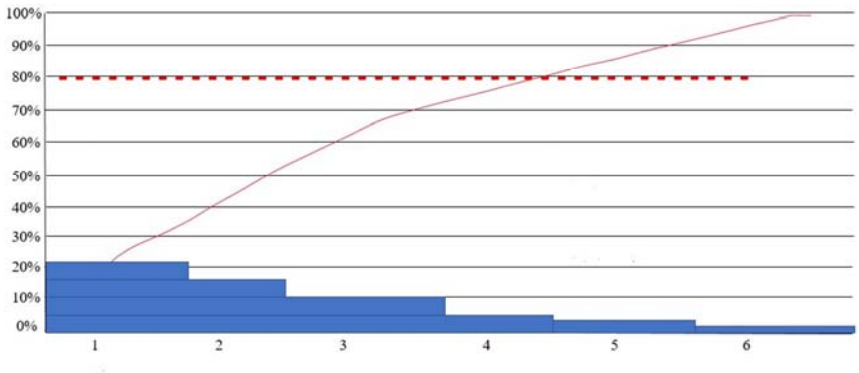

Figure 2. Stork line overall flow line efficiency (1 – tipper, 2 - the absence of Moffett, 3 - linear motor, 4 – container, 5 - no car with a bird, 6 – turntable).

3. Technology for "Ukrainian Railways" Joint Stock Company

Lean Transformation Technology for Joint Stock Company "Ukrainian Railways" (JSC "UR"):

1. Lean culture among employees: to change the thinking of employees so that problems are perceived positively, without processes loss and to help people do not afraid and do not resist changes.

2. Continuous analysis of processes to eliminate or minimize 8 types of losses: waiting (at all stages of work with cargo, train traffic, etc.), "overproduction" of services (resource planning more than the demand for rail transport services, for example, the number of wagons in passenger trains), excessive processing (for example, insufficient automation of technological processes of transportation), unrealized potential, displacement, defects (errors and delays in the train schedule), excess stocks (components, fuel, etc.) [11].

3. Processes are analyzed using a value stream mapping (VSM), i.e. visual systematization of value flow. VSM is a tool that visualizes the process of transforming various technological operations and actions into finished products of transport to consumers.

The objects of it are material, financial and information flows of resources and also time. Toyota Corporation is a pioneer in systematizing of value flows. And the term VSM was first used in 1990. VSM is a way to visualize the steps needed to turn the needs of rail service consumers into a product or service. VSM is often referred to as kaizen flow, means the continuous improvement of value flows. It is the best tool for identifying and planning opportunities to improve the production of rail transport services. Therefore, value flow maps are compiled in a way to clearly depict the current state, to plan and implement the future state with measurable goals.

Systematization of the flow of value is performed on various scales - from simple administrative procedures to large-scale production of services in international traffic. The method helps to identify steps that do not add value and need to be solved, as well as weaknesses where the process can be improved – speed up, reduce costs or provide safe working conditions [12].

Creation VSM is divided into blocks: the production or process-flow - the traditional block diagram, which is fixed from left to right way to create value from procurement of raw materials to shipment of products. If in addition to the main process there are additional or auxiliary, they are applied under the main. Thus, the main task is separated from the secondary. The information or communication flow is depicted by "arrows" at the top of the flow map and occur in parallel with the production. Both formal and informal data exchange are taken into account. Information flows are plotted on the map in free form, as they flow in reality.

Timeline and distance are the lines drawn at the bottom of the map. The timeline is divided into upper and lower parts. The lead time is displayed at the top. The duration of the cycle is plotted below. Below the timeline may be another line, at the very bottom, showing the distances that the product or personnel move within the process.

It is recommended to use this method for a service or department and to compare it with the goals of the whole unit for certain regional branches.

4. All employees have a Lean approach to solving problems in such a way as to find the root causes and make it never happen again in the future: using the A3 tool (A3 letters near the offices of managers to reflect the tasks and trends), Ishikawa diagrams (graphical method of research and determination of the most significant cause-and-effect relationships between factors and consequences in the studied situation or problem), technology "5 Why" (interactive technology questions used to identify causal relationships that underlie a particular problem [13].

The main purpose of this technique is to determine the key cause of the defect or problem by repeating the question "Why?").

5. Employees of UZ JSC in their daily activities use the following lean-tools:

- 5S - workplace rationalization system. It was developed in the post-war Japan by the Toyota Corporation. It is used mainly in the manufacturing industry and in the service sector. 5S is an idea from the Japanese concept of production, according to which discipline and cleanliness are the main requirements for improving the work of the processes running on them. Cleanliness and maintaining order are seen as the basis of quality work.

5S system is used in all areas of the organization, both in production and in services and management [14]. The direct participation of all employees is encouraged. 5S is five Japanese words: “Sorting” - a clear division of things into necessary and unnecessary and getting rid of the latter; “Keeping order” (accuracy) - the organization of storage of necessary things, which allows you to quickly and easily find and use them; "Keeping clean" (cleaning) - keeping the workplace clean and tidy; "Standardization" (maintenance of order) - a necessary condition for the implementation of the first three rules; "Improvement" (habit formation) - education of the habit of exact execution of the established rules, procedures and technological operations;

- Kanban system (routing system for economical and "on time") (JIT) production, Kanban is a system for controlling the logistics chain in terms of production, but not an inventory system.

6. UZ JSC constantly introducing Kaizen, that operates on the principle of continuous improvement.

7. UZ JSC regularly holds 3-4-days’ Kaizen events to implement rapid changes.

8. All employees strive to find true value for the customer (passenger, cargo owner or consignee) by building a value creation stream.

9. Strategic planning is carried out according to the system HoshinKanri (strategic planning technique, introduced in 1954 by Peter Drucker, Hoshin planning - a logical continuation of management by objectives (MBO), Hoshin strengthens the power of MBO and avoids its weaknesses).

10. The company regularly collects and analyzes the “Voice of the Client” to assess the effectiveness of its processes.

11. The company uses personal development plans for employees who clearly and transparently describe career opportunities.

12. The company has a system of proposals that allows employees to put forward their ideas about process optimization.

13. Decisions inside the company are made on the basis of data and facts, not assumptions.

14.The data on the efficiency of machines analyze on a regular basis (automation) - performance, availability and quality. Employees use offline tools every day.

15. Visual management (instructions, tips, visualizations) helps to improve the quality and productivity of processes.

16. In case of stopping the process (downtime, breakdowns, etc.) there is a clear scheme of escalation of the problem in the organizational structure.

17. Managers, process owners and employees regularly go to Gemba (the place where the process takes place) to understand the real situation about the processes.

Artificial intelligence is taking up the pace when it comes to global logistics and supply chain management. The on-going evolution in the areas of technologies like artificial intelligence, machine

learning, and similar new technologies is said to possess the potential to bring in disruption and lead innovation within these industries.

Today, transport logistics solves a set of tasks related to the organization of the movement of goods by public transport. One of the tasks of transport logistics is the creation of transport systems, corridors and chains, in which the use of artificial intelligence approaches is of particular importance and is, even, necessary to support decision-making by the operational staff of the transportation industry [15].

The relationship between material and information flows is obvious, but the responsibility of one stream to another is conditional, since the content of the material flow, as a rule, reflects the data of the information stream, but they may not coincide in terms of time.

Material and information streams can be both unidirectional and multidirectional, and this feature allows artificial intelligence to control transport processes [16]. The path in which the information flow moves may generally not coincide with the flow path of the material flow, which significantly complicates the flow control of vehicles.

Talking about artificial intelligence means using robotics. They are used to track, locate and move inventory within the warehouses. Apart from robots, artificial intelligence is also about big data. When the insights of Big Data are used along with artificial intelligence, it helps to improve different areas of supply chain like supply chain transparency and route optimization [17].

Advantages of artificial intelligence for Supply Chain Management [18]:

1. Predictive Analytics. Forecasting of requests helps to upgrade supply chain forms. Ideal inventory levels and decreased holding costs are key advantages of exact interest forecasting.

2. Improving Inventory Management. With an effective inventory management system in place, you can help reduce costs, keep business profitable, analyze sales patterns and predict future sales, and prepare the system for the unexpected.

3. Automated Quality Inspections. The use of artificial intelligence to control automated quality inspections lessens the odds of conveying broken merchandise to customers.

4. Quick High-Yield Shipping. These technologies save time of workers, enabling them to give more an incentive to their more important duties or solve other problems in management or technical process.

The introduction of artificial intelligence into supply chain operations can propel logistic business into the future – harnessing automation, optimizing supply chain planning, and evaluating multiple scenario outcomes processes in decision-making. That's a powerful future for transport.

4. Conclusion

The introduction of the Lean Production practice in Ukraine is all the more important because the quality of high-tech domestic products produced for the mass consumer, as a rule, is rather low not only by Japanese, but also by the average European standards. At the same time, in many cases, domestic enterprises do not have access to international sales markets, are forced to use not the cheapest and not the most qualified labor force and constantly invest in the renewal of fixed assets. If in this situation we continue to adhere to the ideology of large-scale production of the beginning of the last century, then the result will be only one – bankruptcy. This bankruptcy can only bring the growing interest of international corporations closer to the Ukrainian economy. Fortunately, today a number of Ukrainian companies are already implementing their programs for introducing Lean Production elements. Thus, lean manufacturing is becoming a kind of sign of industry leadership, which makes it possible to predict a further surge of interest in this production system on the part of the most dynamically developing large and medium-sized companies operating in a competitive environment and in dire need of new breakthrough technologies for organizing business processes. In general, the introduction of lean production technologies in railway transport enterprises will consistently reduce non-production costs and improve the quality of repair and operation of railway facilities. To do this, it is very important to create working groups at each of the structural units of the railway. Their task is to identify non-production costs and losses as a result of the production process, and to determine the area where the

introduction of advanced methods would give the greatest effect. This will increase productivity, reduce the time of implementation of the main technological processes in railway transport and ultimately significantly reduce costs.

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