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TÍTULO: Análisis de la experiencia extranjera y rusa en la implementación de tecnologías lean en instituciones educativas.

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RESUMEN: El artículo está dedicado a comprender las posibilidades de aplicar las tecnologías de producción ajustada en el campo de la educación. Sobre la base de la investigación realizada, se determinaron las causas de los resultados negativos y las condiciones para lograr indicadores efectivos del uso de la tecnología de producción ajustada en el entorno educativo. Los resultados del estudio permiten eliminar errores en el proceso de implementación de tecnología de manufactura esbelta en el campo de la educación, encontrar nuevos componentes motivadores para aumentar el interés de los empleados en los resultados de sus actividades y pensar en crear un nuevo modelo de "lean" Universidad por movilización y activación de capacidades internas.

PALABRAS CLAVES: Lean manufacturing, Lean technologies, gestión, entorno educativo, Lean learning.

TITLE: Analysis of foreign and Russian experience in implementing Lean Technologies in educational institutions.

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ABSTRACT: The article is devoted to understanding the possibilities of applying the technologies of lean production in the field of education. On the basis of the conducted research, the causes of negative results and the conditions for achieving effective indicators of the use of lean production technology in the educational environment were determined. The results of the study allow to eliminate errors in the process of implementing lean manufacturing technology in the field of education, to find new motivational components to increase employee's interest in the results of their activities, to think about creating a new model of a "lean" university by internal capabilities mobilization.

KEY WORDS: Lean manufacturing, Lean Technologies, management, educational environment, Lean Learning.

INTRODUCTION.

The identification of the conditions for the implementation the philosophy of "Lean University" has required to make a research of the history of "lean manufacturing" implementing experience.

Currently, the term "lean" can be heard in relation to a wide variety of fields such as industrial enterprises as well as services, medicine and education.

Actually, “lean” means “carefully treated property, also prudent and economical” (according to Ozhegov’s Dictionary) [1]; prudently and carefully spending something, prudent, economical, and also based on prudence, economy, moderate expenditure of something (according to New Russian dictionary by T. Efremova) [2]. It is the economical use of resources (material, temporal, human), their professional and competent distribution in our high-speed century of technologization and informatization that allows to speak about the relevance of this concept nowadays.

To our consideration, the main terms connected with “lean” technology should be denoted in the article.

Lean manufacturing is a management direction to provide the competitiveness of a company by the production of goods (or services) with high quantity, required by a customer, minimal expenses and low cost.

The concept of lean manufacturing was formed in Japan after World War II. Taichi Ono is considered to be the founder of the concept. He began to work at Toyota Motor Corporation in 1943 and by the mid-1950s, having studied and applied the experience of leading industrial countries, built the system for production management. Japanese scientists and specialists developed this system, used new methods for production organizing and products quality providing. Shigeo Shingo was the person who made a significant contribution to the development of the theory of lean production. This system has been developed and improved for about 30 years.

In the 1980s the interest to the Japanese industrial production system organization appeared also in the USA. American automakers unexpectedly faced serious rivalry in their own market. Japanese cars served longer and required repairing less.

In western countries the Japanese concept was called “*lean production*”. This term was proposed by John Krafchik, a researcher at the Massachusetts Institute.

The terms “Lean technology”, “economical production”, etc. are used by Russian experts mainly in the field of industrial management.

The main principles of lean manufacturing are:

- Defining value of the product to the consumer.
- Mapping the value stream.
- Creating the value flow.
- Using a pull system.
- Pursuing perfection.

The principles are implemented using special methods and tools. Lean manufacturing methods include the following:

- Workplace organization system - a system of restoring order, cleanliness and strengthening discipline in the workplace (5S – sort, set in order, shine, standardize, sustain).
- Value stream mapping - mapping out descriptions of all types of actions performed during the creation of a product value.
- The organization of a single production flow.
- Visual management and control.
- The system of quick equipment changeover.
- Universal service system.
- Using the system "just in time".
- Standardized work.
- Defect-free production system.
- Pursuing perfection system (“kaizen”) – the principles and methods that ensure continuous improvement of the process.

Having considered the basic terms and concepts that are used speaking about lean manufacturing, let us make an attempt to analyze foreign and domestic experience in the implementation of the principles of “lean production” in educational field.

DEVELOPMENT.

Discussion.

The educational process, one way or another, can be equated to production, where the “product” is a student, to whom “the cost” in the form of knowledge, skills and the level of generated competencies is added.

Obviously, the maximum benefit from lean production implementation in the field of education can be obtained if everyone understands its principles well and applies them in combination. The use of “lean” tools in educational process management in institutions of higher education makes it possible to analyze the losses that inhibit its optimization. In this regard, it would be appropriate to define the phenomenon of “lean learning”.

By “*lean learning*” we understand the organization of the educational process which eliminates losses that affect the effectiveness in the vocational education system.

Some examples of foreign experience describe both positive and negative aspects of “lean learning” implementation. The identification of negative assessments of the “lean production” implementation in education is considered even more valuable, as it allows to draw conclusions and avoid mistakes.

One of the examples, which is worth paying attention, describes the implementation of lean education in the United States of America. The material is posted on December, 12, 2012 in the e-magazine “Jacobin”, the columns of which are devoted to education, professional activities and professional unions and associations.

From the very beginning, the “business model” of education reform is sharply criticized in the article. The results of the changes are expressed in strikes by more than 30,000 teachers across the state. Among the reform measures associated with the organization of lean education in schools of Chicago and Michigan, an increase in the number of students in the middle school class from 25 to 40 people and in the senior classes to 61 students while reducing salaries to teachers by 10 percent is described [3].

Teachers associate the implementation of "lean production" into the education system in 1980-1990 with deterioration of working conditions for teachers and learning conditions for schoolchildren. The article cites the schools in New York that fell under the experiment as an example and were considered exemplary from the point of "lean production". They received high ratings in 2011 despite its poor academic reputation. The main advantage of these schools, according to the Department of Education, was a special system of administration in accordance with one of the principles of "lean production", that is the organizing teachers into teams, which were assigned various administrative duties. First, such innovations were perceived with interest: teachers jointly discussed and put forward the wishes of the administration, were critics of particular types of activities. However, this did not bring any improvement in learning results.

The teamwork of teachers should have been aimed at empowering them. However, in fact, the frequent team meetings devoted to the problems of school management took the teachers’ time which they needed to prepare for their own classes and created the impression that the school administrative staff shifts its administrative responsibilities to the teaching staff. Thus, as the teachers of such lean school’s state, they were forced to concentrate on command (administrative) duties instead of their pedagogical ones.

Professional stress and the accompanying physical and mental disorders have led to an increase in staff turnover. In 1987-1988 most of the teachers in the United States had 15 years of professional experience, in the 2007-2008 most of schoolteachers were the teachers with one year experience, that means that a natural replacement of qualified teachers for unskilled ones took place. Personnel turnover was directly provoked by the lack of a cohesion sense in the teaching staff.

Ratings are another key element of lean manufacturing philosophy. The annual compulsory ranking has publicly destroyed teachers. Later in American press the materials appeared in which was said that only “worst” managers use public humiliation and constant pressure on their employees, and they should be in charge of “worst” labor. What expected those who were in the top lines of the rating? They were offered to work with a large number of students, in addition to the basic workload, which did not affect their salary.

Another important element of "lean production" is pursuing perfection. At first glance, this is an absolutely correct goal, however, here too, difficulties arose. What is constantly being improved is the production process itself, and the metric for measuring improvement is efficiency. In the US experimental schools the goal was to improve the work process by maximizing efficiency, regardless of collateral damage to a teacher or a student, that is, the level of students’ education became secondary.

In 2011 “the New York Times” published alarming information that school graduates who succeed experimental laboratories for lean education, embodying the most realistic ideas of business-oriented education reform, were overwhelmingly not ready to continue their studies in colleges. It also called for parents and teachers to struggle with experiments of such kind, which in fact were focused not on creating “better” schools but on creating “convenient” schools for administrators with the goal of easier management.

Returning to the **main principles of lean production** it is possible to conclude on the risks to which one should be prepared when implementing these principles in the field of education:

- **Determining the value of the product to the consumer**. The value in the educational space lies in the high level of graduate training, in well-formed competencies that will allow the young specialist to feel confident and competitive in the labor market. This is the main thing that the educational process should be directed to: the maintenance of a qualified education, rather than creating visible external quality conditions, as they were described in the example of American schools, where a large number of students were added to the "best" teachers, while creating conditions that are unacceptable for learning nor for the work of a teacher;

- **Determining the value stream for the product**. The value of educational activities in the given example was replaced by the pursuit of ratings, both from students and from teachers, because the statistics were perceived as a guarantor of the effectiveness of the experimental model of a school with "lean production". As a result, the quality suffered: the ratings did not reflect the real state of knowledge and the formed competencies of the graduates. The team work of teachers was focused on the administration of the educational process, and not on improving its quality. Thus, the presence of rating both educational and pedagogical activities should not disregard such important value components of the educational process as education level, teacher qualifications, comfortable learning and work conditions, joy of learning, emotional attitude to the process of activity, motivation to achieve success;

- **Ensuring a continuous stream of product value creation**. The accent on the creation of values in the given example of American schools' activities has led to increased professional stress and staff turnover. In this situation, the introduction of the concept of "lean production" probably should have been carried out gradually, which would have retained qualified personnel to implement the concept;

- **Use of the product pulling system**. The high statistics of the school were not really confirmed by educational institutions of higher education, in which students had to study, therefore, the figures did not reflect the real picture of the educational achievements of graduates. Thus, statistics is important not to confirm the effectiveness of the experiment, but for internal conclusions, fast response to the situation, correction of experimental innovations and, of course, should reflect reality;

- **Continuous improvement**. The implementation of this principle could be the main stimulus for moving forward. This is a natural goal of any educational institution - continuous development and improvement, therefore this principle should affect absolutely all areas of the institution, be implemented comprehensively, step by step and gradually.

In other words, an example of some American schools shows how important it is to treat sensible ideas of “lean production” competently and professionally, especially in relation to education, where the most important principle is “Do no harm!”

More fundamentally, the problem was investigated by Tobias Langer, a postgraduate student at the Royal University of Belfast (The United Kingdom), in his work “Lean University. The Application of Lean thinking for Improving Processes in Higher Education Institutions”. The study of lean thinking as a factor in the improvement of processes in higher education institutions. On the example of three universities in the UK [4].

In his scientific work, Tobias Langer notes the fact that despite the study of "lean production" in many universities in the world, there are only a small part of universities that have begun to implement this concept on their site. And this is due to the fact that it is easier to create external conditions than to bring up the so-called “lean thinking” in the team, which will work for the future. In the dissertation, the author presents a scheme by which he recommends being guided at the very beginning of the emergence of the idea of implementing “lean production” in a higher educational

institution:

Motives ================================ Why?

Lean approach: methods and opportunities ======= How and where?

Implementation: positive factors and risks ======== Due to what / despite what?

Result ================================= What for?

Such an approach, obtained on the basis of research conducted on the material of universities in the UK, clearly articulates the intentions and details the stages of the process of implementing the concept of "lean production" in education.

It is necessary to say a few words about the attitude to educational activities in Japan - the ancestor of the concept of "Lean Production". The material is presented in the book "Japanese Management & SMEDs application – («Single Minute Exchange of Dies») [5].

The book provides generalized examples of the implementation of the concept “lean production”, “Kaizen-technologies”, the SMED system and others, aimed at improving the quality and accelerating the tempos of production. Japanese education is the result of achieving the historically established goal of constant improving.

This position is based on four aspects that underlie the chain of actions: build an enterprise, make it more, work as a team and always do everything correctly. How does this affect education? Control. All students receive the same education throughout the country, and this is controlled by the state. Spirit of rivalry. This is considered by the Japanese to be very important for raising the level of education. Efficiency. The Japanese Ministry of Education spends its budget on educating people about important strategic thinking, modernization and industrialization, equality.

The best students in any class can continue their studies at the university, because the Japanese system is focused only on human abilities. It must be said that precisely because of this fact, one of the reasons for the high productivity in the life of the Japanese is the attitude that they deserve at

work, in their profession, in life in general. They always think positively, and this approach to education influences their further merits in work and life, it allows them to achieve what they want. That is why Japan is always quickly recovering from any crisis. Their behavior at work and in life is based on this.

Foreign experience and analysis of examples confirms that each institution goes its own way of improvement, finding those methods and tools that most contribute to the achievement of optimal effective results.

Let us analyze the experience of implementing the concept of "lean university" in Russian educational institutions.

In March 2018, the First All-Russian Interregional Scientific and Practical Conference "Lean University" was held in Izhevsk and gave start for other conferences of such kind. There the experience of Russian universities in implementing the concept of "lean production" was presented. The best practices were noted at the conference and they were taken by many Russian institutions of higher education as the examples of efficient universities-pioneers which initiated the implementation of the concept of lean production/ Among them the Udmurt State University, the Kuban State Medical University, and the Maikop State Technological University.

Vice Rector for Economics and Personnel of Udmurt State University Ph.D. G.N. Vasilyeva presented a report on the basics of introducing lean manufacturing at the university and reported on ongoing projects. Among the main values and objectives of the Udmurt State University, the following are noted: reasonable resource management; concentration of attention to the needs of students and teaching staff; elimination of all types of losses; effective use of property and intellectual potential of staff.

Among the projects implemented by the university there are “Organization of external independent assessment of the quality of student training”, “Optimization of the procedure for selling souvenirs”, “Preparing graduates for the Master's program”, “Economics of Lean Production ”, “Lean Library”.

As a result of the projects implemented at the university, quantitative and qualitative results were noted:

- Four times reduction in the total duration of the process and the absence of queues for admission of applicants entering the training in the normative time for the main educational programs on a fee basis.

- Four times reduction of the total duration of the process of documenting a business trip for university employees (from 1920 to 480 minutes) with the transition to electronic document management.

- Six times reduction of the length of the process of applying for state social scholarships through the Single Window and the minimum time for submitting certificates.

- Two times reduction of the total duration of the process (from 7-8 to 3 days) of the organization of procurement activities and contracts with the transition to electronic document management.

- Creation of convenient and comfortable conditions for making payments and receiving payments when organizing a client-oriented cash desk process and saving time by 50%.

- Information-analytical system integration, that allowed the teacher to collect all the working information in one place with round-the-clock access from any place in the world, reduce paper workflow and create convenient and comfortable conditions for the learner and teacher.

- The creation of modern working conditions of the library: automatic identification of the reader by the code of the student card or certificate; automatic identification of the book by RFID tag; free access repositories; direct communication with academic disciplines; digital catalogue; digitization

and work with electronic publications; automated system for issuing and accounting books; room zoning and comfortable conditions.

The positive results of the pilot projects allowed Udmurt State University to start implementing new projects that also focused on lean production principles: “Improving the procedure for documenting the business trip of the university employees”, “Implementing electronic document management in the procurement process”, “Client-oriented cash desk”, “Improvement the process of admission of applicants entering the training in normative terms of the main educational programs on a fee basis", “Lean electronic documents for registration of civil law contracts”, “One-window principle in teaching staff employment” and others.

Among the positive results of the projects being implemented, the following are planned to be achieved: the formation of an effective university image, an increase in competitiveness, an increase in the level of teaching, an increase in the quality of training and the relevance of graduates, an integrated approach. The main goals of the integrated approach are: the improvement of processes, the efficiency of the management infrastructure, changes in the way of thinking and behavior of employees; transformation of values and worldview; increasing students’ and teachers’ satisfaction [6].

At the Kuban State Medical University, the project “Lean University” was implemented with the support of the Ministry of Health of the Russian Federation. The main goal was to improve gradually the efficiency of the university’s activities, especially the quality of services provided, and high-tech work by reducing costs while at the same time developing innovative potential. The university launched several pilot projects at the university, aimed at improving the use of existing human resources, material and technical base, management methods, as well as enhancing work in the field of innovative development; participation in federal long-term and departmental target programs of modernization of education and science.

Among the key cases that were addressed during the implementation of the Lean University project, the following were noted: the work of the faculty's dean's office and faculty members (results: elimination of all types of process losses (waiting, extra reporting and accounting documents, unnecessary walking, etc.), increasing the satisfaction of students with the quality of services they received; standardizing the organization of the educational process based on "best practices" and reducing their variability, creating samples of the development of effective flows to replicate them to other structures of the university); personnel management: hiring (results: increasing the productivity of personnel department and related departments, speeding up the process of incorporating the new employee into the workflow, increasing the loyalty of new employees to the Kuban State Medical University); student dean's office: procedure for obtaining admission to medical activities in middle-level positions (results: creation of a single stream for submission of documents for the examination for admission to medical and pharmaceutical activities, operational information support of students about the timing of the examination, reduction of temporary losses for employees and students, timely identification of "unloaded" and "overloaded" participants of the process); admission campaign (results: optimization of the applicants' flow, facilitating the planning of priority when applying for applicants, eliminating conflict situations associated with an unregulated flow of applicants, operational information support of applicants in the rating ranking message).

According to the colleagues' from the Kuban State Medical University investigation, the effectiveness of any project is achieved by eliminating the main elements: unnecessary steps to process information and documents; excess inventory; unnecessary staff movements, solving issues in one place; losses due to waiting due to equipment downtime; losses due to the request for unnecessary information; losses due to duplication of information [7].

At the Maikop State Technological University, the Lean University project is considered as a special scheme of university management. The main idea is to constant strive to exclude any kinds of loss that does not add value to the educational and / or scientific processes. The goal that the university staff is achieving is to improve the quality of training by creating, on the basis of lean manufacturing principles, a comfortable environment of interaction between key participants of the educational process - students and teachers. The accents in accordance with the principles of lean production are placed on a strategic focus, continuous improvement, consistency, focus on creating value for the consumer, respect for the person, reducing losses, visualizing and consolidating best practices as well as engaging staff in the project implementation process.

The project affected all areas of the university and was a systemic one. For each of the areas, the projects that affected the most problematic areas have been implemented. They were the following: education (teaching students the principles of lean manufacturing); information and communication space (increasing the efficiency of using the informational and educational electronic platform; improving the process of checking students' written work for originality based on platform “Antiplagiat. University”); science (improvement of the rating system of scientific activities of pedagogical workers in structural departments of the Maikop State Technical University); the university as an element of the regional business environment (shaping the image of the Maikop State Technological University as a lean university; organizing the process of opening and operating specialized classes at Maikop schools; ensuring the continuity of lean manufacturing ideology: “Lean School - Lean High School”, “Lean College - Lean University”); multicultural social environment (preparation for training in the general medical education program with elements of the English language for students from English-speaking countries; preparation for the championship of WorldSkills); organizational and management sphere (development of a project management support system (university level); simplification of the procedures for awarding state

social scholarships to students; formation of the system for ensuring the performance of duties by foreign students in terms of compliance with the stay regime in the Russian Federation; optimization of the process of entering into contracts for the provision of paid educational services; monitoring systems for project implementation and action plan); university as a property complex (implementation of the 5S-system in all structural units of the university; improvement of the navigation and routing system in the university buildings) [8].

The “Lean University” project at the Maikop State Technological University is still underway, but there are already tendencies to achieve the following results: increased attention to the needs of teachers and students; focus on the problem of eliminating all types of losses in the process of organizing the educational services provision; improving of educational process quality at a constant cost reduction; application of the principles of lean production by teachers and students in various spheres of life.

CONCLUSIONS.

The modern educational environment is changing very quickly. The Russian education system faces new challenges. Dynamically developing and having a limited amount of internal resources, higher education institutions are beginning to feel the need in searching for new motivational components to increase pedagogical staff interest that, of course, requires the creation of a new university model.

Lean manufacturing technologies in domestic educational institutions are well-timed. They allow to achieve the mobilization and revitalization of domestic resources, lead to savings of resources both financial and temporal and, what is the most important, professional ones.

Modern educational professional institutions in accordance with the federal state standards orient students to the formation of universal, general professional and professional competencies which provide a sufficient level of competitiveness in the market of professional services. Such a

standardized vision of the formation of a young specialist must necessarily take into account a number of modern requirements based on the experience and experimental results of domestic and foreign institutions. The processes of globalization suggest the integration of world trends, the consideration of positive effective technologies in the professional training of the specialists of new generation.

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