

TRENDS AND SCENARIO MODELING OF UNIVERSITY EDUCATIONAL PROCESS DEVELOPMENT THROUGH THE USE OF LEAN MANUFACTURING PRINCIPLES

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ABSTRACT

The article is devoted to the study of lean manufacturing principles and technology application areas concerning the activities of educational organizations. The main trends of university educational process optimization and development through the application of lean manufacturing technologies are proposed and substantiated: identifying losses and problems in the educational process by interviewing students as the main clients of the process, identifying problems and prospects of the educational process by questioning employers as the clients of the educational process, advanced training of university employees and students in the field of lean-technologies at the “factory of processes”, the implementation of lean approach to the organization of labor in the educational process. They performed scenario modeling of multivariate economic and managerial decisions for the development of the educational process based on the application of lean manufacturing technologies in the activities of educational organizations.

Key words: lean production, thrifty educational process, customer-oriented educational process, thrifty organization of work.

1. INTRODUCTION

Optimization of the internal processes of an educational organization using lean manufacturing tools can significantly increase labor productivity. Currently, not enough attention is paid for the adaptation of lean manufacturing technologies to the activities of educational organizations, taking into account the specifics of their processes. The quality of the university educational process is a multidimensional category, which includes all the functions and various types of activities of the university, determines the existence of various approaches and a wide variety of criteria for its evaluation.

However, it is undoubted that one of the most important criteria to assess the quality of education is the satisfaction of its consumers and stakeholders. This emphasizes the need for further improvement of procedures and the methods for evaluation the level of educational process consumers and stakeholder satisfaction.

Lean manufacturing tools can effectively influence the educational process, identify the problems in the education system and achieve significant results in their resolution during a short period of time (Raju N., Prabhu D., 2017). In the case of lean manufacturing, the increase of efficiency and the search for development reserves occurs due to getting rid of unnecessary actions, rules or attitudes that do not add value. The use of lean manufacturing tools in an educational organization contributes to:

- educational process improvement, work optimization,
- education quality improvement,
- provision of educational process standardization and visualization,
- reduction of time and financial losses,
- increase the ability to work among employees and the preservation of human resources,
- an educational organization development.

Besides, lean technology can be an additional educational tool. Students who study lean production, become familiar with its culture and form a lean style of thinking and lifestyle. The most important areas of educational process optimization and development at a university during lean manufacturing technology use: identification of losses and problems in the educational process by interviewing students as the main clients of the process, identification of problems and prospects for the development of the educational process by questioning employers as the clients of the educational process, improving the qualifications of employees and university students in the field of lean-technologies at the "factory of processes", the implementation of careful approach to work organization in the educational process.

2.STUDY METHODS AND MATERIALS

They used publications on lean manufacturing, the reports about the implementation of lean manufacturing technologies in educational organizations, and educational and methodological complexes of work at "process factories" as study materials. A systematic approach will be applied to study the educational process of a university as a complex category. Positive and normative approaches are used to compare the current level of educational organization development with targets. Using the analogy method, lean manufacturing technologies were adapted to the educational process.

The expert method and logical analysis will be applicable during the development of a set of lean technologies recommended for implementation in the processes of educational organizations. The scenario approach will be used to develop several likely, but significantly contrasting options for the future development of educational organizations through the introduction of lean manufacturing technologies. The visualization method graphically presents action plans for the development of human capital of educational organizations and targets.

3.STUDY RESULTS

Identification of losses and problems in the educational process by interviewing students as the main customers of the process.

As the part of the university educational process development, one of the important areas is to improve the quality of training and educational services. In this

case, the following target guidelines can be considered: increase of student satisfaction level with the quality of education, increase the level of employee satisfaction with the organization of educational process, increase the efficiency of the value creation stream for consumers.

One of the main and the most numerous consumer groups of the educational process of the university are students. It is important to identify losses and problems for the development of the educational process at the university, while the most effective method may be the review of students as the main clients of the process. When interviewing or questioning students as the main clients of the educational process, it is advisable to find out the problems that students are faced with and their wishes to improve the existing situation.

They can apply the methodology for evaluation the quality of the educational process developed by Stepanova M.M. and Chernenko L.V. According to this methodology, students' satisfaction with the educational process is evaluated according to five parameters (quality indicators): the level of teaching, the work of the teaching staff, industrial practice, research work, the organization and support of the educational process. For a general assessment of students' satisfaction with the educational process, the authors proposed a five-point scale, where 1 is the minimum value of the indicator, 5 is its maximum value. (Stepanova M.M., Chernenkaya L.V., 2015)

In addition, it is necessary to assess the satisfaction with the quality of the educational process of students and different academic performance separately. Based on the results of the students' questionnaire, a list of identified losses and problems in the educational process should be developed, for example, a non-optimal training schedule, an incomplete process for practical training organization, etc. Then it is necessary to use lean manufacturing tools to eliminate these losses of the educational process.

3.1. Identification of scientific and pedagogical workers and employee readiness for lean changes by questioning

The main problem of lean technology implementation in the educational process is determined by the contradiction between the objective need to change the process educational activity management at the university, the introduction of lean manufacturing tools, the development of lean management culture and the lack of information about the systemic readiness of the university staff (academic staff and employees) to dramatic changes in the approach to the organization of their work. The problem, which can be described as secondary, can be described as the need to focus on the request of the main customers (students) in the situation of value-oriented management introduction (as the basis of lean production) and the lack of data on the real demand of consumers.

Readiness for the implementation of lean manufacturing is a comprehensive assessment of an organization situation by the indicators of awareness, motivation, role structure, value distribution and the coordinates for the use of tools and lean manufacturing principles. In 2019, the research was conducted at the National Research University "BelSU", the main task of which was to determine the initial readiness for the introduction of lean production at a university among its employees and faculty.

After the study, they found that 40% of respondents noted the need for training the basics of lean manufacturing, 38% of employees introduce separate lean

manufacturing tools at their workplace within a few days after the training seminars, 50.5% say they are ready to introduce changes in the near future. Besides, as the conclusion during lean management introduction in educational activities, it should be noted that it is necessary to take into account the teaching staff perception of comparison, competition, rivalry situations - this can become the determinant of boundaries for the methods of best practice demonstration and the evaluation of individual and collective results during the implementation of lean manufacturing.

3.2. Identification of problems and prospects for the development of the educational process by questioning employers as the educational process clients

In order to develop the educational process of the university, a customer-oriented approach is important. It is necessary to conduct a survey of employers who are currently the customers of the educational service market, and they may also need additional qualified personnel in the coming years to implement innovative projects. To ensure continuous improvements of the educational organization in detail as the basic principle of lean production, it is important to identify correctly the existing shortcomings in the work and the trends for further improvements. According to the feedback of the main employers, we can conclude about the quality of student training, the demand for graduates by the labor market.

The survey of enterprise representatives that are the potential employers for university graduates allows us to identify weaknesses in student training to make appropriate adjustments for the educational process. It is also possible to determine the degree of training level conformity at a university with the current tasks solved by the graduates in the workplace, assess the degree of the competence application acquired at a university during the work process, and formulate recommendations to strengthen the formation of the necessary competencies.

Moreover, the university strategy should include preventive measures in the educational process, which include planning the contingent of student recruitment in the areas of expert training, as well as optimizing the applied educational programs. An application plan for lean manufacturing tools and principles should be developed according to the analysis of employer profiles.

3.3. Involvement of students and staff in training at "process factories"

Lean technologies increase the means of educational organization effectiveness. The expansion of student and educator competence in the field of lean-technologies is important for the development and improvement of the educational process quality. The most effective lean culture teaching method for an employee and a student is a practical one in the form of a business game called Process Factory.

Process factory is an innovative approach to the training and implementation of lean-technologies in educational practice (Kurmangulov A.A., Reshetnikova Yu.S., Bagirov R.N., Frolova O.I., Brynza N.S., 2018.). Training at process factories is always carried out on the basis of a real production process, in which participants acquire the skill of identifying losses, problem formulation and solution, and production process balancing. The value of training at "process factories" is an interactive training format with a small amount of theoretical training and considerable time devoted to practical work.

At the process factory, a group of students is given the task of the production flow optimization with specific, measurable performance indicators that should increase from shift to shift. The idea of the "Process Factory" is universal; it allows you to simulate not only production, but also office processes. "Factory" provides an opportunity to show how and due to what it is possible to make the work of managers and supporting processes more efficient.

Involving students and staff in training at "process factories" allows us to solve the following problems:

- involvement and motivation of university employees and students in process improvement at the stage of preparation for changes;
- provision of the necessary level of starting knowledge and skills of university employees and students, which will be possible to apply at a workplace;
- provision of the lean manufacturing system understanding and the exchange of gained knowledge, involving all employees and students in the process of continuous change.

In other words, the "factory of processes" is the optimal form of training and the development of lean manufacturing culture through the mastery of relevant competencies using a practice-oriented approach. The competence of university employees and students in the field of lean manufacturing will contribute to the development of the educational process.

3.4. Lean approach to the organization of labor in the educational process

A significant effect in the development of educational organizations can be obtained by optimizing the organization of labor. One of the areas of lean technology application can be called streamlining, bringing people into the system of labor activity.

Lean technologies in the organization of labor are, in fact, effective time management of university employees. They allow teachers and students to avoid spending time on unproductive activities - shifting papers, finding tools, preparing reports - and to devote more time and attention to the educational process. Labor organization in the educational process is a system of measures that ensures the rational use of labor, which includes the appropriate placement of people in the production process, the division and cooperation of labor, techniques and methods, rationing and stimulation of labor, the organization of jobs and their maintenance, and the creation of necessary working conditions.

A lean approach to labor organization in the educational process can be based on an empirical, based on methods directly obtained by labor practice, and rational (scientific), established in accordance with the requirements of scientifically-known objective laws, and therefore characterized by a different degree of objectivity and scientific validity (Tkachev I.S., Fedorovskaya V.V., 2018.). The main goal of a lean approach to the organization of labor in the context of the educational process development is the systematic improvement of the organization of work among university employees, bringing its forms and methods in line with the current level of engineering and technology in this organization.

The main trends for a lean approach implementation to the organization of labor in the educational process:

- Development and implementation of rational forms of labor division and cooperation in the educational process (selection and distribution of workload between employees).
- Definition of the most rational forms and sizes of labor collectives in the educational process.
- Development and implementation of an optimal work regime, drawing up a lean training schedule.
- Layout, equipment and maintenance of teacher jobs.
- Improving the basic and additional pay.
- Training, professional development to ensure the quality of the educational process.
- Improving the sanitary-hygienic, psychophysiological, aesthetic working conditions at a university.
- Strengthening labor discipline in the educational process.
- Development and use of rational labor methods and techniques, the use of best practices in the educational process of a university.

3.5 Scenario modeling of the educational process development through the introduction of lean manufacturing technologies

Implementation of the proposed trends for the university educational process optimization using lean manufacturing technologies allows for scenario-based modeling of development options for university activities. Let's consider a generalized representation of alternative scenarios for the development of the educational process through the introduction of lean manufacturing technologies in the areas discussed above (table 1).

Table 1 - Generalized representation of alternative scenarios for the development of the educational process through the introduction of lean manufacturing technologies

Scenario parameters	Alternative scenarios		
	Optimistic scenario	Average scenario	Pessimistic scenario
Key strategic goal (trend)	<ul style="list-style-type: none"> - Rationally organized educational process of high quality - A high level of customer satisfaction with the quality and level of the educational process organization 	<ul style="list-style-type: none"> - A more rational organization of the educational process of satisfactory quality - The average level of customer satisfaction with the quality and level of the educational process organization 	<ul style="list-style-type: none"> - An educational process of satisfactory quality - Low level of customer satisfaction with the educational process organization quality and level
Key internal factors	<ul style="list-style-type: none"> - A full-fledged process of the educational organization staff training on 	<ul style="list-style-type: none"> - Motivation of the educational organization staff to the perception of 	<ul style="list-style-type: none"> - Resistance of the educational organization team to innovations

	innovations - Formation of a lean corporate culture (the culture of continuous improvement)	innovations - Familiarization with the principles of lean corporate culture	- Formal review of lean corporate culture principles
Key environmental factors	- Scientific and technical progress - Actions of competitors at the educational services market	- Scientific and technical progress - Actions of competitors at the educational service market	- Scientific and technical progress - The actions of competitors at the educational service market
Strategic decision	- The widespread use of lean technologies in the educational process	The use of lean technologies in the educational process	An attempt to apply lean technologies in the educational process
Performance indicators	1. Organization income from educational activities 2. The number of applicants 3. The share of employed graduates 4. Customer satisfaction 5. The level of competence mastery		

To ensure the development of the educational process of the university through the application of the principles of lean manufacturing, the monitoring of performance indicator system is required, which allows for continuous improvement in key areas. The main indicators in this system should be: the organization income from educational activities, the number of students enrolled in the training, the share of employed graduates, the level of customer satisfaction (students, employers, parents of students), the level of competence mastery, the level of staff satisfaction.

4.CONCLUSIONS

The transition to the principles of effective education management by identifying and eliminating losses widespread in the educational process will allow not only to solve such problems as the effective implementation of new federal state educational standards and creation of conditions for the self-realization of each student, but also to increase the manageability of processes in each educational organization. To identify losses and problems in the educational process of educational institutions, it is advisable to use the methods of interviewing students and questioning employers as the clients of the educational process systematically. In educational institutions of different levels, it is advisable to create educational and methodological centers of lean technologies in education ("Process factories"), focused on teaching the lean principles of students and employees. A significant effect in the educational process optimization of educational institutions can be achieved by a lean approach introduction to labor organization.

5.SUMMARY

The proposed main stages and scenario solutions for the development of the educational process of a university through the introduction of lean manufacturing technologies can be effectively applied in educational organizations at various levels.

The implementation of the considered areas of lean technologies in the activities of educational institutions will increase its effectiveness without additional costs due to organizational improvement.

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