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TECHNOLOGY FOR IMPLEMENTING THE LEAN SIX SIGMA QUALITY MANAGEMENT MODEL IN HIGHER EDUCATION INSTITUTIONS. PART 2: INCONSISTENCIES ANALYSIS, EDUCATIONAL PROCESS IMPROVEMENT AND CONTROL OF IMPROVEMENTS SUSTAINABILITY

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Abstract
The relevance of the application of the newest quality management technologies, namely the Lean Six Sigma (LSS) methodology in ensuring the educational process quality in higher education institutions (HEIs) in accordance with the guidelines of DSTU ISO 21001:2019 Educational organizations – Management systems for educational organizations – Requirements with guidance for use (ISO 21001:2018, IDT) and Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) is substantiated. The current state of development the problem of the production-oriented quality management model LSS adaptation to the conditions of HEIs functioning is analyzed in the works of foreign and Ukrainian scientists. The purpose of the article is to analyze the conditions for the LSS model implementation in HEIs in order to increase the efficiency of educational and scientific business processes and the applied implementation of LSS technologies taking into account the peculiarities of the Ukrainian educational environment. The practical significance of the article is to improve the quality of educational services delivery in HEIs using the continuous improvement cycle DMAIC and LSS tools on the example of increasing the effectiveness of the key process “Development EMS for the educational process”. Critical to quality characteristics (CTQC) of the educational product “Complex of Educational and Methodological Support (CEMS)” have been established. Current and target CTQC values are defined. A critical analysis of the CTQC non-compliance causes with the target value was carried out using FMEA analysis and Value Stream Mapping (VSM). Practical measures to improve the process quality are proposed. Process quality indicators were calculated after the implementation of corrective measures in the educational process. The prospects of the study are the application of DMAIC technology and other tools for the implementation of the LSS quality management methodology to improve the efficiency of all key educational and scientific business processes within the framework of the development of a comprehensive model of the HEIs quality management in accordance with the principles of modern International and European standards in the field of education.

Keywords: Lean Six Sigma (LSS), higher education institutions (HEIs), business process, CTQC, DMAIC cycle, Value Stream Map, FMEA.

1. Introduction

Modern forms and models of the educational process quality management in higher education institutions (HEIs) provide not only for the training of highly qualified specialists, but also for the formation of a specific structure that guarantees support and continuous improvement of the educational services, educational and scientific products quality. Such a structure is the quality management system (QMS) of HEI. QMS of a modern HEI has to take into account the guidelines of international standards and national regulatory documents in the field of education quality. Such documents include, first of all, DSTU ISO 21001:2019 Educational organizations – Management systems for educational organizations – Requirements with guidance for use (ISO 21001:2018, IDT), DSTU ISO 9001:2015 Quality Management Systems – Requirements (ISO 9001:2015, IDT) and reflects the principles of the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) and "Recommendations for the application of criteria for assessing the quality of the educational program". As a consequence of the trend towards the use of multidisciplinary approaches to the QMS formation, the higher education quality standards recommend the use of not only traditional (Total Quality Management), but also production-oriented quality assurance technologies (Lean Six Sigma).

The Lean Six Sigma (LSS) quality management model in HEIs is aimed at increasing and continuously improving the educational services quality while reducing the cost of all types of resources and ensuring the business processes stability, which is the primary task of HEIs in the context of the need to save resources.

2. Literature review

A detailed review of the scientists research in the field of quality assurance, which led to the idea of the possibility of combining two competing quality management models Six Sigma and Lean Production into a hybrid effective LSS methodology in the early 2000s, and then the application of this purely production-oriented concept in the field of educational services, is given by the authors in the article [1].

Ukrainian researchers, unfortunately, do not pay enough attention to the analysis of the possibilities of implementing the LSS model or its individual tools in Ukrainian universities, although the world's leading educational institutions actively use the achievements of this leading quality management concept (Kings College, London; National University of Singapore; Valdosta State University, Georgia; Heriot Watt University, UK; Gordon State College, USA, etc.).

In the authors' article [1] the conditions for the LSS model in HEIs application were analyzed, an expert map on the use of LSS methodology tools and traditional statistical quality management tools at all stages of the basic LSS technology – the cycle of continuous improvement DMAIC (Define, Measure, Analyze, Improve, Control) implementation was compiled, identifies and measures critical to quality characteristics (CTQC) of the HEIs key educational process "Development of the EMS for the educational process" were identified and measured.

The article is aimed at analyzing the influencing factors that are the reasons for the non-compliance of the CTQC educational process with the target values, developing measures to eliminate inconsistencies and methods for monitoring the constancy of the educational process quality indicators using DMAIC technology and other complex LSS tools.

3. Research methodology

The practical implementation of the LSS quality model principles is based on the application of the DMAIC (Define, Measure, Analyze, Improve, Control) continuous improvement cycle. The DMAIC cycle is used to consistently improve the business processes in the organization in order to achieve maximum stability of the processes flow and reduce the number of defects to 3.4 units per million (DPMO (Defects per Million Opportunities) is 3.4), which corresponds to the 6 "sigma" quality level. Applied aspects of improving business processes in HEIs based on the implementation of DMAIC technology are given in the articles [2, 3]. However, in order to achieve more significant results in improving business processes, it is advisable to use not only the classic version of DMAIC technology, but also complex tools of the LSS methodology, first of all, the method of Value Stream Mapping (VSM), which is discussed in detail in the authors' article [1], and the FMEA method.

The FMEA method is the analysis of possible defects significance and their consequences (consequences of non-conformity, parameter S – severity of consequences), the determination of the defects causes (potential cause of non-conformity, parameter O – probability of occurrence) and the analysis of methods for determining the defect (methods of non-conformity detection, parameter D – probability of detection). To determine the significance of the parameters, a qualimetric scale from 1 to 10 points is used.

The scale of parameter assessment for the processes taking place in HEIs differs significantly from the standard qualimetric scale of production processes FMEA [4]. The value of the parameter S varies from 1 (the occurrence of a factor does not have any effect on the effectiveness of the process) to 10 (the occurrence of a factor makes the normal functioning of the process and the creation of an output impossible). The value of the parameter O varies from 1 (the appearance of the factor is practically impossible) to 10 (the factor is part of normal practice, the problem occurs constantly). The value of parameter D varies from 1 (the occurrence of a hazard can be detected almost always) to 10 (the occurrence of a hazard is almost impossible to detect).

The criticality of the factors is established by calculating the risk priority number (RPN) as a multiplication of the S, O and D indicators for each influencing factor.

4. Results

It was established in [1] that an important practical task of implementing the LSS concept to improve the educational process quality in HEIs is the practical implementation of the LSS technology (DMAIC cycle) in order to increase the effectiveness of the key process "Development of the EMS for the educational process".

In the article [1], the first two stages of the DMAIC cycle (Define and Measure) were implemented, the results of which were the determination of the CTQC list of the researched process and the determination of their quantitative current values (for 100 complex of educational and methodological support (CEMS) over the past 5 years, Department of Information and Measurement Technologies (IMT), NURE):

1) discrepancy of CEMS material volume with the requirements of EP – 0;
2) inconsistency of the CEMS structure with the Curriculum and the EP content – 0;
3) discrepancy of the CEMS content with the requirements of the regulatory documentation – 0;
4) inconsistency of the forms and methods of teaching used in the CEMS with the requirements of the student-centered approach and the principles of academic freedom – 0;
5) non-compliance of the CEMS in terms of clarity of information on the goals, content and program learning outcomes with the requirements of the regulatory documentation – 0;
6) inconsistency of the content of the CEMS with modern scientific achievements and practices – 1;
7) non-compliance of the control measures forms and evaluation criteria with the requirements of the regulatory documentation (RD) – 0;
8) non-compliance of the CEMS design with the requirements of regulatory documentation – 1;
9) failure to meet deadline on the CEMS – 4.

The CTQC system takes into account the requirements of the normative document "Recommendations for the application of criteria for assessing the quality of the educational program" [5] and the internal document of NURE "Regulations on the complex for educational and methodological support of the discipline". CTQC target values are equal to zero.

On the basis of the defined criteria, it is established that the studied process has a "sigma" level of defect-free $Z_{value} = 3{,}975$ (target value $Z_{value} = 6$).

The study [1] developed the current state VSM of the process "Development of the EMS for the educational process", which is formed by the sequence of production and logistics processes of creation and movement of the object (CEMS) value from the customer (Ministry of Education and Science of Ukraine) to the consumer (Higher education applicants). This tool allows to visualize the flow of the object consumer value adding in order to analyze non-productive costs and highlight the "bottlenecks" of the process.

It was determined that as process efficiency indicators it is advisable to use value-adding flow efficiency indicators: the Process Cycle Efficiency (PCE) and the Stream Non-Defectiveness Indicator (SNI). The PCE current value is equal to 11,3 %, while the PCE minimum target value is equal to 14,6 %. The SNI current value is equal to 98 %, SNI target value is equal to 100 %.

To develop and control the effectiveness of measures that will allow to achieve the target value of the researched process quality indicators, it is necessary to implement the last three stages of the DMAIC cycle, namely: Analyze, Improve and Control.

A (Analyze)

The purpose of the process efficiency analysis stage is to study and critically analyze the key indicators of the process in order to identify the influencing factors that cause their non-compliance with the target values, and then to identify the most important factors.

The "sigma" coefficient of non-defectiveness, which is based on the DPMO indicator determination according to the formula given in ISO 13053-1 [6], is equal to:

$$Y_{\mathrm{DPMO}} = \frac{c}{n_{\mathrm{units}} \cdot n_{\mathrm{CTQC}}} \cdot 10^6, \qquad (1)$$

where c is the total number of defects; n_{units} – the number of inspected units of production (100 CEMS over the past 5 years); n_{CTQC} – the number of characteristics critical for product quality (9).

The target value of the permissible number of non-conformities of critical process characteristics is calculated based on the target level of 6 sigma defect-free level. From formula (1) we get:

$$c = \frac{Y_{\mathrm{DPMO}} \cdot n_{\mathrm{units}} \cdot n_{\mathrm{CTQC}}}{10^6}. \qquad (2)$$

After calculations, we get a target value of 0,00306 permissible nonconformities CTQC per 100 CEMS, or only one unsuitable one is allowed for 32680 developed CEMS. In practice, this means that in order to achieve the 6-sigma level of the process "Development of the EMS for the educational process", all critical characteristics should meet the target value, that is, there should be no inconsistencies at all.

Since, as a result of the DPMO indicator calculation according to the Six Sigma methodology, it is found that the largest number of non-compliant CEMSs arises as a result of non-compliance with the criterion of "compliance of development time with normative values", it is advisable to analyze the time costs in order to identify the most significant factors of influence.

To rank the time costs (the waiting time (WT) between value-adding operations on the VSM [1]) according to the degree of impact on the overall result, we will use the ABC-analysis method, which is based on the Pareto principle ("80% of the result creates 20% of inputs"). The Pareto chart is shown in Fig. 1.

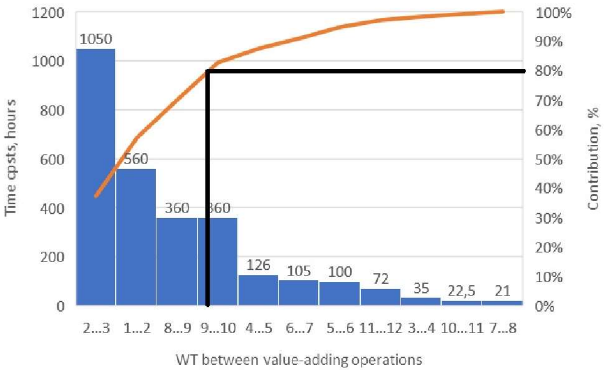

Fig. 1. Pareto Chart and Cumulative Lorentz Curve for Unproductive Time Costs

According to the Pareto principle, priority efforts should be concentrated on minimizing costs, which cause 80% of the total time consumption, namely:

WT 2...3 is the transition time between sub-processes within the process of developing CEMS elements.

WT 1...2 is the transition time from the process of work program (WP) developing to the process of WP approval at the meeting of the Department.

WT 8...9 is the transition time from the process of CEMS reviewing to the process of CEMS approval at the meeting of the Department.

WT 9...10 is the transition time from the CEMS approval process at the Department meeting to the process of CEMS approval by the Educational-Methodical Commission (EMC).

Let's analyze the reasons for these unproductive time costs within the framework of the process "Development of the EMS for the educational process" implementation.

In the LSS quality management methodology, wastes are divided into two categories:

1) first-order wastes that do not add consumer value to the product or service, but they are necessary from the point of view of the technological process (for example, the cost of design the accompanying documentation for CEMS). Such costs can and should be optimized, for which a wide range of tools has been developed within the framework of the Lean concept;

2) second-order wastes that can be removed from the technological process altogether without reducing the product or service quality (for example, the cost of transferring the approved CEMS to an employee of the scientific library (SL) for posting it on the website of the SL).

In the traditional Lean approach to quality management, there are 7 types of second-order wastes, namely: overproduction, excess inventory, defects, redundant operations and displacement in the workplace, overhandling, downtime, unnecessary product movements, and the recently added eighth type of waste – loss of creativity by employees (George, 2003). But for service organizations, and especially for HEIs, these wastes have a certain specificity, which is due to the duality of the result of the HEI's activities: the educational services delivery plus the educational and scientific products generation.

Let's analyze the second-order wastes for the process “Development of the EMS for the educational process”:

1) Excess inventory during the development of an educational product are transformed into partially completed work: development of CEMS elements without checking them for compliance with critical characteristics of the process; development of CEMS elements in advance without prior approval of the WP.

2) Overproduction is considered as the provision of excessive functionality to the educational product: oversaturation of the CEMS with information that is not provided for by the content of the EP.

3) Re-execution of work: re-discovery and re-processing of information that has already been used during the development of the previous element of the CEMS; after the development and approbation of the CEMS - the reviewing.

4) Transportation can be considered as the transfer of work to other performers: peer review of CEMS.

5) Unnecessary movements in the case of educational service delivery or educational or scientific product creating are considered as switching between tasks: the transition from the development of CEMS to teaching or research activities.

6) Waiting: time delays in the form of waiting a review of the CEMS, approval of the WP and CEMS at the meeting of the Department, EMC.

7) Defects: inconsistencies between the qualitative critical characteristics of the educational product and the normative values.

8) Loss of creativity by employees.

The discrepancy between the qualitative critical characteristics of the process under study, for which, according to statistical information, the unsuitability of the educational product was revealed (inconsistency of the CEMS content with modern scientific achievements and practices and the non-compliance of the CEMS design with the requirements of the regulations), was caused by the human factor due to non-compliance with the requirements of the NURE internal document “Regulations on the complex for educational and methodological support of the academic discipline” and EP. Measures aimed at optimizing first-order wastes and minimizing or even partially eliminating second-order waste components are developed at the next stage of the DMAIC cycle.

I (Improve)

The purpose of the Improve stage is developing measures to bring the critical characteristics of the process “Development of the EMS for the educational process” to the target values, namely, that the number of inconsistencies for all critical indicators is zero.

To identify the risks of each influencing factor and develop precautionary measures, ISO 13063-2 recommends the use of the FMEA method [7].

The FMEA results for the factors influencing the discrepancy between critical characteristics and target values identified at the analysis stage are shown in Table 1.

The values of the parameters S, O and D are determined by the expert method. The expert group was formed by staff of the Department of IMT, NURE. The degree of consistency of the scores was confirmed by the calculation of the Kendal concordance coefficients using the formula [8]:

$$Wg = \frac{\sum_{i=1}^{n}\left(d_i^2\right)}{\frac{1}{12}m^2\left(n^3-n\right)-m\sum_{j=1}^{m}T_j}, \quad (3)$$

where m is the number of experts;

n – number of indicators;

d_i – deviation from the average value of total points $\overline{S}$;

T_j – the sum of points duplicated by the j expert $T_j = \frac{1}{12}\sum_{k=1}^{n}\left(t_k^3 - t_k\right)$, where t_k is the number of indicators to which the j expert gave the *k*-th point.

To check the significance of the concordance coefficient for *n*>7, the Pearson test is used. The null hypothesis h_0 assumes that *Wg* is close to 0 (that is, the opinions of experts are not agreed), and the alternative hypothesis h_1 is that *Wg* is significantly different from 0 (the opinions of experts are agreed). The empirical value of the Pearson criterion is calculated using the formula:

$$\chi^2 = m\cdot(n-1)\cdot Wg\,. \quad (4)$$

The calculated concordance coefficients and the results of testing the hypothesis of agreement according to the Pearson criterion for *n*=10, *m*=10 are shown in Table 2.

Since the critical value χ^2_{cr} = 21.7 for *n* = 10 and the significance level of 0.01 (hypothesis h_1 is accepted), the consistency of expert opinions can be considered proven. For the causes of inconsistencies with the RPN value exceeding the critical value of PRN_{cr}, preventive measures must be applied without fail (an unacceptable level of criticality has been identified).

Table 1 – Results of the process "Development of EMS for the educational process" FMEA

№	Consequences of discrepancy	S	Potential cause of discrepancy	O	Methods for detecting discrepancy	D	RPN	Measures to solve the problem
1	Discrepancy between the qualitative critical characteristics of the educational product and the requirements of the RD and EP	10	Development of the CEMS elements without their current verification for compliance with critical process characteristics	4	CEMS Testing for compliance with the requirements of RD and EP	3	120	Filling out the form during the author's development with the definition and justification of the degree of compliance of the CEMS elements with the criteria for the product suitability
2	Discrepancy between the CEMS content and WP of the discipline	8	Development of CEMS elements in advance without prior approval of the WP	3	Discrepancies may be detected during the approval of the CEMS at a meeting of the Department or EMC	3	72	Filling out the form during the author's development with the definition and justification of the degree of compliance of the CEMS elements with the WP
3	Inconsistency of the criteria of volume, content and program learning outcomes with the requirements of EP	8	Oversaturation of CEMS with information that is not provided for by the content of the EP	2	Discrepancies may be detected during the approval of the CEMS at a meeting of the Department or EMC	3	54	Development of a form with the definition and justification of the degree of compliance of the CEMS elements with the criteria of volume and content
4	Discrepancy between the time of development and publication of CEMS with the requirements of the educational process	10	Retrieval and reprocessing of information that has already been used during the development of the previous CEMS element	4	Moderately high chances of detecting a discrepancy	4	160	Structuring the development of CEMS elements by topics. Documentation of current processes. Consulting with other scientific and pedagogical staff (SPS)
5	Discrepancy between the time of development and publication of CEMS with the requirements of the educational process	4	Time delays in the form of waiting a review on CEMS	3	Moderately high chances of detecting a discrepancy	4	48	Exclusion of the review process from the general cycle. Implementation of the form with the definition and justification of the degree of compliance of the CEMS elements with the criteria for the suitability of the product, which the author submits for approval of the Department
6	Discrepancy between the time of development and publication of CEMS with the requirements of the educational process	10	Transition from the development of CEMS to teaching or research activities	3	It is very difficult to identify the risk of non-compliance	8	240	Planning the workload of the teacher, taking into account the time of development of the CEMS. Rebalancing operations within the overall process according to the Yamazumi methodology
7	Discrepancy between the time of development and publication of CEMS with the requirements of the educational process	10	Time delays in the placement of CEMS on the website of the SL	4	Moderately high chances of detecting a discrepancy	4	160	Planning the workload of the SL employee
8	Discrepancy between the time of development and publication of CEMS with the requirements of the educational process	10	Time delays due to the approval of the CEMS at the meeting of the Department and the EMC	5	Moderately high chances of detecting a discrepancy	4	200	Planning the timing of the development of the current CEMS in order to synchronize the date of approval or to hold an unscheduled meeting of the Department for the purpose of approval of the CEMS
9	Discrepancy of CEMS with the RD requirements to the criterion of "design"	6	The CEMS design does not meet the RD requirements	5	Discrepancies may be detected during the approval of the CEMS at a meeting of the Department or EMC	3	90	Filling out the form "Compliance of CEMS with suitability criteria". The use of specialized software for the preparation of scientific documents, for example, the LaTeX publishing system
10	Discrepancy with the criteria of "student-centered approach", "academic freedom", "modern scientific achievements and practices"	6	Loss of creativity by the teacher	2	Discrepancies may be detected during the approval of the CEMS at a meeting of the Department or EMC	3	36	Filling out the form "Compliance of CEMS with suitability criteria ".

Table 2 – Concordance Coefficients and Values χ^2

WgS	*WgPO*	*WgD*	χ^2_S	χ^2_O	χ^2_D
0,78	0,85	0,84	70,2	76,5	75,6

The critical value of the PRN_{cr} set at the level of 100 points for processes that do not pose a threat to human life and health. The risk diagram of ranked causes of potential nonconformities is shown in Fig. 2.

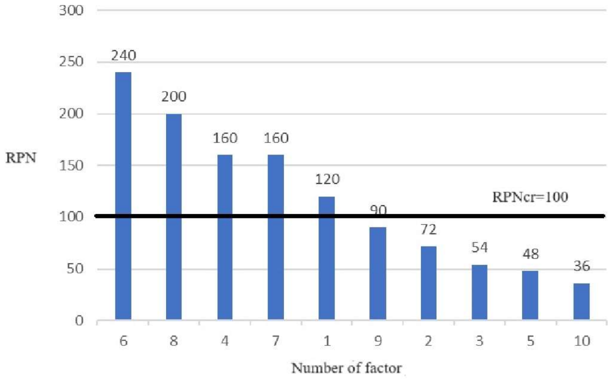

Fig. 2. Risk diagram of the causes of nonconformities according to FMEA results

Based on the results of FMEA, it is necessary to implement preventive measures to minimize the occurrence of critical risks, namely:

1) Planning the workload of the teacher, taking into account the time of CEMS development. Rebalancing operations within the overall process according to the Yamazumi methodology.

2) Planning the timing of the development of the current CEMS in order to synchronize the date of approval or to hold an unscheduled meeting of the Department for the purpose of approval of the CEMS.

3) Structuring the development of CEMS elements by topics. Documentation of current processes. Consulting with other SPSs.

4) Planning the workload of the SL employee in order to reduce the time of transition from the CEMS delivery to the CEMS placement on the website of the SL.

5) Implementation of a form with the definition and justification of the degree of compliance of the CEMS elements with the criteria for the suitability of the product, which the author submits for approval by the Department. At the same time, it is possible to exclude the review process from the general cycle.

C (Control)

After the implementation of measures to minimize the occurrence of critical risks in the process under study, it is necessary to control the results by constructing the VSM taking into account the implemented changes and calculating new critical characteristics of the process. After the implementation of the measures developed at the Improve stage, the VSM took the following form (Fig. 3).

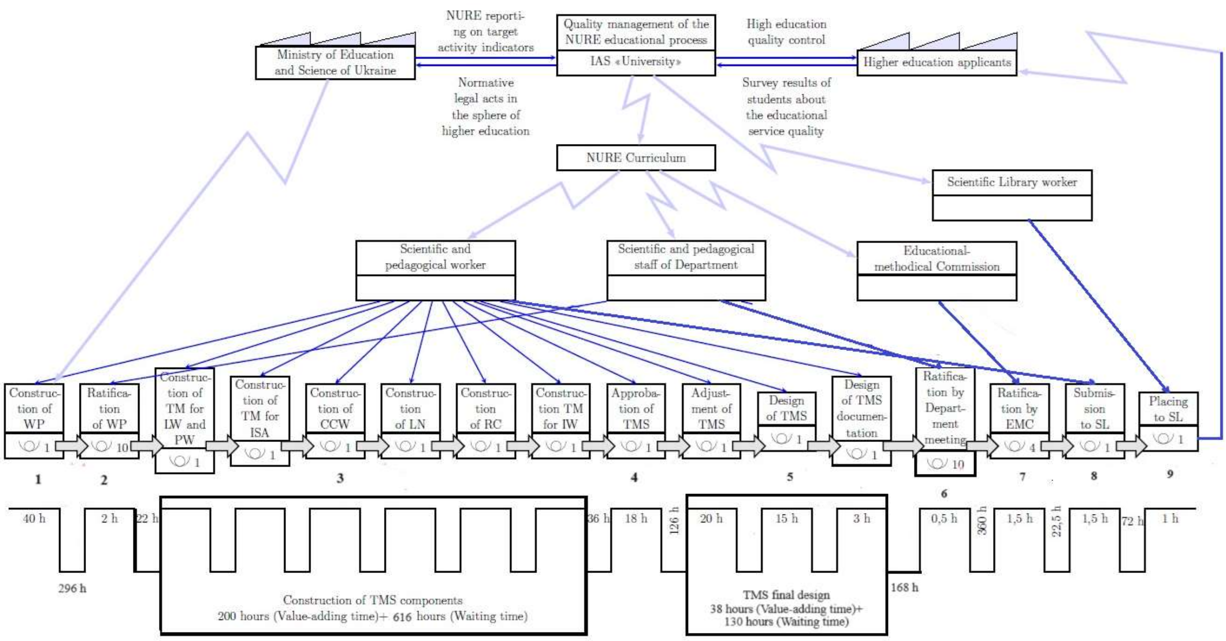

Fig. 3. VSM after the implementation of optimization measures (developed by the authors)

The PCE, calculated according to the line of chronology of the VSM, after the implemented measures, was:

$$PCE = \frac{307,5}{1848,5} \cdot 100\% = 16,6\% .$$

The complexity of the process "Development of EMS for the educational process" has decreased: instead of 12 subprocesses, 9 subprocesses remained, since the subprocess "Peer review of CEMS" was eliminated and the subprocesses "Adjustment of TMS", "Design of

TMS", "Design of TMS documentation" were combined, since they are consistently performed by the certain SPS and in the same conditions. As a result of scheduling the workload of the SPS in order to free up time for consistent work on the CEMS up to 6 hours a day and holding an unscheduled meeting of the Department (on average during the week) for the approval of the WP and CEMS, the calculated PCE increased to 16.6 %, which exceeds the target value of the PCE = 14.6 %. The measures were implemented within the Department of IMT, NURE, but even without reducing the time for waiting for the approval of the CEMS by EMC and planning the workload of the SL employee, the criterion of compliance with the time of development and publication of the CEMS was met.

After the development and implementation of the form with the definition and justification of the degree of compliance of the CEMS elements with the criteria for the suitability of the product, the SNI of the process "Development of the EMS for the educational process" reached 100%, that is, all the CEMS developed by the SPS of the Department of IMT, NURE during the academic year, met the qualitative criteria of suitability.

The calculation of the updated "Sigma Coefficient" of process quality (target level $Z_{value} = 6$) does not make sense under these conditions, since the number of CEMSs developed during the study period is insufficient. To achieve the target value Z_{value} only one educational product out of 32680 CEMSs may not meet the suitability criteria.

To track the presence of deviations in a certain interval from a given value in the LSS methodology, indicators are used, which are individually set for each process. For the process of "Development of the EMS for the educational process", the indicators are the PCE and SNI, which reflect the degree of compliance of the process characteristics with the criteria of suitability. According to DSTU ISO 7870-1:2016 Control charts – Part 1: General guidelines (ISO 7870-1:2014, IDT) the stability of the process over time is monitored by constructing Control Maps for each indicator.

5. Conclusion and agenda for future research

In the article the possibilities of implementing the LSS quality management model in HEIs are analyzed. The practical implementation of the basic LSS technology - the DMAIC cycle, with the help of which a significant increase in the effectiveness of the HEI key process "Development of the EMS for the educational process" implementation was achieved. The reasons for non-compliance of the process CTQC with the target values were determined and analyzed. According to the FMEA methodology, the risk priority analysis was carried out and measures to minimize the occurrence of critical risks were proposed. At the control stage, the VSM was built after implementation optimization measures and calculated the process efficiency indicators.

As a result of the DMAIC cycle implementation to improve the process "Development of the EMS for the educational process", an improvement in the process performance indicators was obtained, which reflect the degree of compliance of the process characteristics with the suitability criteria, namely: the PCE increased from 11.3 % to 16.6 %, which exceeds the target value of the PCE = 14.6 %, the SNI reached the target value of 100 %.

Prospects for further research are seen in the use of DMAIC technology and other tools for implementing the LSS quality management methodology to improve the efficiency of all key educational and scientific business processes during the development of the HEI's quality management comprehensive model in accordance with the principles of modern International and European standards in the field of education.

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Технологія реалізації моделі управління якістю «Lean Six Sigma» в закладах вищої освіти.
Частина 2: Аналіз невідповідностей, вдосконалення освітнього процесу та контроль сталості поліпшень

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Анотація

Обґрунтовано актуальність застосування новітніх технологій управління якістю, а саме методології Lean Six Sigma (LSS) в забезпеченні якості освітнього процесу в ЗВО згідно з настановами ДСТУ ISO 21001:2019 Освітні організації. Системи управління в освітніх організаціях. Вимоги та настанови щодо застосування (ISO 21001:2018, IDT) та Стандартів і рекомендацій щодо забезпечення якості в Європейському просторі вищої освіти (ESG). Проаналізовано сучасний стан розробленості проблеми адаптації виробничоорієнтованої моделі управління якістю LSS до умов функціонування ЗВО в працях закордонних та українських науковців. Метою статті є аналіз умов впровадження моделі LSS в ЗВО з метою підвищення ефективності освітніх та наукових бізнес-процесів та прикладна реалізація технологій LSS з урахування особливостей українського освітнього середовища. Практичне значення статті полягає в підвищенні якості надання освітніх послуг в ЗВО за допомогою застосування циклу безперервного поліпшення DMAIC та інструментів LSS на прикладі підвищення ефективності реалізації ключового процесу «Розробка науково-методичного забезпечення освітнього процесу». Встановлено критичні характеристики CTQC освітнього продукту «Комплекс науково-методичного забезпечення (КНМЗ)». Визначено поточні та цільові значення CTQC. Здійснено критичний аналіз причин невідповідностей CTQC цільовим значенням за допомогою FMEA-аналізу та картографування потоку створення цінності. Запропоновано практичні заходи щодо покращення якості процесу. Розраховано показники якості процесу після впровадження корегуючих заходів в освітній процес. Перспективами дослідження є застосування технології DMAIC та інших інструментів реалізації методології управління якістю LSS для підвищення ефективності всіх ключових освітніх та наукових бізнес-процесів в рамках розробки комплексної моделі управління якістю ЗВО згідно з принципами сучасних міжнародних та європейських стандартів в галузі освіти.

Ключові слова: Lean Six Sigma, заклади вищої освіти, бізнес-процес, CTQC, цикл DMAIC, Мапа потоку створення цінності, FMEA.