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ECONOMIC EFFECTIVENESS OF MONITORING SYSTEM FOR EDUCATION FACILITIES IN HIGHER EDUCATION

The article grounds that for providing the planning system of higher education in the field of culture & entertainment by indicators of educational facilities it is necessary to develop a monitoring system. Implementation of accounting and analysis systems of educational facilities for higher education entities should be based on the use of most advanced information technologies. This will provide significant cost saving of budget funds on management and acquisition of fixed assets. Annual economic effect from the implementation of the proposed monitoring system is calculated.
Keywords: *higher education; monitoring; education facilities.*

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ЕКОНОМІЧНА ЕФЕКТИВНІСТЬ СИСТЕМИ МОНІТОРИНГУ НАВЧАЛЬНИХ ПОТУЖНОСТЕЙ У ВИЩІЙ ОСВІТІ

У статті обґрунтовано, що для забезпечення системи планування вищої освіти в сфері культури показниками навчальної потужності необхідно розробити систему моніторингу. Система обліку та аналізу навчальних потужностей суб'єктів вищої освіти має базуватись на використанні сучасних інформаційних технологій. Це забезпечить суттєву економію витрат бюджетних коштів на управлінський персонал та придбання основних засобів. Розраховано річний економічний ефект від реалізації запропонованої системи моніторингу.
Ключові слова: *вища освіта; моніторинг; навчальні потужності.*
Форм. 8. Табл. 1. Літ. 10.

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ЭКОНОМИЧЕСКАЯ ЭФФЕКТИВНОСТЬ СИСТЕМЫ МОНИТОРИНГА УЧЕБНЫХ МОЩНОСТЕЙ В ВЫСШЕМ ОБРАЗОВАНИИ

В статье обосновано, что для обеспечения системы планирования высшего образования в сфере культуры показателями учебной мощности необходимо разработать систему мониторинга. Система учета и анализа учебных мощностей субъектов высшего образования должна основываться на использовании современных информационных технологий. Это обеспечит существенную экономию бюджетных средств на управленческий персонал и приобретение основных средств. Рассчитан годовой экономический эффект от реализации предложенной системы мониторинга.
Ключевые слова: *высшее образование; мониторинг; учебные мощности.*

Problem setting. Higher education of Ukraine belongs to complex systems and that is why the formulation of management decisions in it is the process of great complexity. The need to solve management problems in the multidimensional space of higher education management requires powerful information support, which is the main purpose of monitoring.

To develop and establish a monitoring system that can provide higher education planning system with necessary data using advanced models and information technologies, it is necessary to investigate the system of indices of education facilities and their structure. This will provide information recipients with relevant set of indices on education facilities of higher education institutions in Ukraine.

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Indices of education facilities of higher education is the important input information to developing plans on specialists training, as well as for managerial decisions-making at the levels of central executive bodies, local authorities and universities.

Research and publications analysis. The works of outstanding scientists are devoted to the research of development, modernization and management of the higher education in today's world and Ukraine. This topic was studied by: V.K. Halitsyn et al. (2013), V.V. Hapon and N.F. Stebliuk (2009), O.V. Kuklin (2011), A.N. Maiorov (2003), N.F. Stebliuk (2012), O.P. Suslov et al. (2013) and others.

Unresolved issues. An important factor in the development of higher education system is the improvement of its effectiveness and productivity. Today a number of unresolved issues remain related to the need for studying the economic effectiveness of monitoring system in higher education. This could be explained by the need to estimate budget costs, search the criteria for its planning for the efficient and economical use of budget funds.

The research objective is to determine the parameters of education facilities monitoring system on the example of higher education institutions (HEI) of state customer – the Ministry of Culture of Ukraine for calculation of the annual economic effect.

Key research findings. The subject of accounting and analysis, as well as providing information on education facilities of a particular state customer, can be described by the following main factors: permanent assets; management personnel; financial resources; the number of accounting operations; accounting time.

Number (volume) of these main factors, which represents a system, should provide for planning system of higher education and other users of information the necessary indices of education facilities on various grounds upon request.

Based on the basic relationship between the values of this problem

$$X_i = \sum_{j=1}^{m} a_{ij} X_j, \quad i = \overline{1,m}, \tag{1}$$

where a_{ij} – the rate of direct costs of the resource (factor) i on the creation of unit of resource (factor) j $(j = \overline{1,m})$; X_1 – the number of indices of education facilities, the development and issuance of which the system must ensure; X_2 – the number of required elementary operations; X_3 – accounting time required, hours; X_4 – management personnel, persons; X_5 – permanent assets required, ths UAH; X_6 – financial resources required, ths UAH.

Relations between the values of this problem are described by unit cost $[a_{ij}]$. These relations are presented in Table 1.

Table 1 is the matrix of direct cost of resources $[a_{ij}]$ and showing the relations existing between them. Filled squares indicate there are relations, empty one mean the absence of relations. For example, the value a_{21} shows the number of elementary operations, which must be done to calculate one index of facilities and value a_{32} – the amount of accounting time, which must be spent to perform one operation etc.

Thus:

a_{21} – the rate of spending elementary operations to calculate one index of education facilities, operations/index;

a_{32} – the rate of spending time on one elementary operation, hours/operations;

a_{43} – the required number of management personnel for performing accounting operations, persons/hours;

a_{54} – the rate of permanent assets on one manager, ths UAH/person;

a_{64} – the need for funds to pay for work of one manager per year, ths UAH/person;

a_{65} – specific need in funds to ensure the system's fixed assets, ths UAH/ths UAH.

Table 1. **Logical-information relations in designing the main parameters of the system,** *developed by the author*

Resource *i*, which is used	Resource *j*, which is uses					
	1. Indices of facilities, units	2. Accounting operations, units	3. Accounting time, hours	4. Personnel, persons	5. Permanent assets, ths UAH	6. Financial resources, ths UAH
1. Index of facilities, units						
2. Accounting operations, units	a_{21}					
3. Accounting time, hours		a_{32}				
4. Personnel, persons			a_{43}			
5. Permanent assets, ths UAH				a_{54}		
6. Financial resources, ths UAH				a_{54}	a_{65}	

1. Specific need to performing elementary operations (a_{21}). The calculation of each index of education facilities is achieved by performing elementary operations. The total number of indices consists of 9 subsets, each of which is created by combining features from 1 to 9.

The total facilities of the indices system set (the number of indices) $M\left(\sum_{n=1}^{9} C_9^n\right) = 8175065$ (Kocharian, 2013), where $C^n{}_9$ – the number of combinations from 9 elements by n, consists of subsets: $M(C^1{}_9) = 59$; $M(C^2{}_9) = 1458$; $M(C^3{}_9) = 19602$; $M(C^4{}_9) = 967540$; $M(C^5{}_9) = 91672$; $M(C^6{}_9) = 781834$; $M(C^7{}_9) = 2028444$; $M(C^8{}_9) = 3151896$; $M(C^9{}_9) = 1132560$. That is: $X_1 = 8175065$ indices.

The number of elementary operations on the processing of each facility index depends on the number of features, which it (index) takes into account. With increasing of features, which each index takes into account, the number of the required elementary operations increases.

So, for calculating the number of elementary operations we can suggest the formula:

$$S_{el.op.} = \sum_{n=1}^{9} nM\left(C_9^n\right). \quad (2)$$

According to (2) we calculate the total number of elementary operations required for calculating the entire set of indices of education facilities: $S_{el.op.}$ = 1 x 59 + 2 x 1458 + 3 x 19602 + 4 x 967540 + 5 x 91672 + 6 x 781834 + 7 x 2028444 + 8 x 3151896 + 9 x 1132560 = 58688621 elementary operations.

Thus, specific need for performing elementary operations per one index is:

$$a_{21} = \frac{S_{el.op.}}{X_1}. \quad (3)$$

Thus, find a_{21} = 7,18 el.op./index (58688621 / 8175065).

2. Rate of spending time on performing one elementary operation (a_{32}). Studying the complexity of economic systems (objects) management, V.M. Hlushkov (1972) found that at an average on performing of one elementary operation a manager spends 10 seconds, i.e. 0,0028 hours. Thus, we take the rate a_{32} = 0,0028 hours/el.op.

3. Specific need for management personnel (a_{43}). With the average annual fund of one office working time of 1840 hours, on 1 hour of accounting time falls a_{43} = 1 / 1840 persons/hour.

4. Normative specific need for permanent assets for 1 manager work (a_{54}). Determining the rate of permanent assets per manager the assumption accepted is that capital-labor ratio of personnel of designing monitoring system of education facilities is equal to the average capital-labor ratio of the entire economic activity "Education".

Total fixed assets of "Education" in Ukraine is 72520 mln UAH (Statistical Yearbook of Ukraine for 2011, 2012). The number of employed in this type of economic activity – 1677.6 ths persons (Statistical Yearbook of Ukraine for 2011, 2012).

Specific fixed assets per employee is 43.23 ths UAH/person (7250 / 1677.6 mln UAH/ths persons), so the normative is a_{54} = 43.23 ths UAH/person.

5. Specific need for funds on payment for personnel work (a_{64}). Assumption: payment for the work of monitoring system (department) manager of education facilities is taken as the average payment within economic activity "Education".

To calculate the specific rate of payment for work we use the dependence:

$$a_{64} = Z \times T \times k, \quad (4)$$

where Z – the average monthly payment for work in "Education"; T – the number of months in year; k – the coefficient of charges on payroll.

Thus, with the average payment for work of 2,081 ths UAH (Statistical Yearbook of Ukraine for 2011, 2012) specific costs on payment for one office is a_{64} = 34.96 ths UAH/person.

6. Specific need for funds on providing the department with permanent assets (a_{65}). Since the monetary measure (ths UAH) was taken as a unit of permanent assets, it can be assumed that the specific need for funds per unit of permanent assets is a_{65} = 1 ths UAH/ths UAH.

According to formula:

$$X_i = \sum_{j=1}^{5} a_{ij} X_j, \quad i = \overline{2,6}, \quad (5)$$

we calculate the main parameters, which the designing department under study.

The number of elementary operations required for calculation of facilities indices:

$$X_2 = a_{21} \times X_1 = 7.18 \times 8175065 = 58696966 \text{ el.op.}$$

Accounting time required for performing elementary operations:

$$X_3 = a_{32} \times X_2 = 0.0028 \times 58696966 = 164352 \text{ hours.}$$

Amount of management personnel:

$$X_4 = a_{43} \times X_3 = \frac{1}{1840} \times 164352 = 89 \text{ person.}$$

Need for fixed assets:

$$X_5 = a_{54} \times X_4 = 43.23 \times 89 = 3847.5 \text{ ths UAH.}$$

Amount of funds required for the establishment of the department of education facilities:

$$X_6 = a_{64} \times X_4 + a_{65} \times X_5 = 34.96 \times 89 + 1 \times 3847.5 = 6959 \text{ ths UAH.}$$

The results of solving the problem show that for creating the system able to provide planning in higher education in the field of culture with necessary parameters of educational facilities we must organize a subdivision, the parameters of which are presented above.

Its parameters – 89 managers in total and costs in the amount of about 7 mln UAH as compared to the total costs of state budget on higher education are not significant, but it should be noted that accounting and analysis of education facilities is necessary for making grounded planning decisions among many processes in the system of higher education management that also require financial support.

In this regard, the implementation of accounting and analysis system of education facilities of higher education subjects should be based on the use of advanced information technologies that provide significant cost savings in spending on management personnel and permanent assets acquisition.

Application of the proposed monitoring system basins on IT enables delegating search, calculations and delivery of information to computers. There is no need to prove that the computing power of a computer is much higher than the amount of information that is 58.7 x 10^6 of elementary operations required for monitoring of 8.2 x 10^6 indices of education facilities.

Thus, for performing the full amount of accounting operations in the monitoring system based on modern IT, only one PC and one manager-operator is enough.

Using the standards costs grounded above, we calculate the costs for organization and functioning of this system for one year:

- costs of payment for work – 34,96 ths UAH/person;
- costs of permanent assets (space, computer, communications etc.) – 43.23 ths UAH;
- costs of software for the monitoring system (capital investments; cost, determined on the basis of necessary spending of time for development and implementation of information processing system) – 64 ths UAH.

Calculation of the annual economic effect from the introduction of this monitoring system is based on comparing the costs reduced to one year, of two variants – the traditional and the proposed monitoring systems:

$$E = \Phi_0 - \Phi_{ms}, \quad (6)$$

where E – the annual economic effect from the introduction of a new monitoring system; Φ_0, Φ_{ms} – reduced to one year costs on organization and functioning of traditional variant and new monitoring system accordingly.

Now we can calculate the consolidated costs on developing variants:

$$\Phi_0 = ZTkM_0 + E_n KM_0; \quad (7)$$

$$\Phi_{ms} = ZTkM_{ms} + E_n KM_{ms} + E_n K_{pr}, \quad (8)$$

where M_0 – necessary quantity of management personnel for realization of traditional variant; E_n – normative coefficient of investments effectiveness ($E_n = 1 / T_{payback}$, where $T_{payback}$ – terms of payback of permanent assets); under current state of economy we take $E_n = 0.1$; K – specific permanent assets per one employee in education; M_{ms} – necessary quantity of management personnel in realization of the suggested monitoring system; K_{pr} – single capital investments in the development of methodological, software and information support.

In formulas (7), (8) the coefficients E_n is added to compare the current annual costs with single capital investments.

Reducing to one year the costs on organization and functioning of the monitoring system under the baseline variant and the variant of developed monitoring system based on information technologies look like this:

$$\Phi_0 = ZTkM_0 + E_n KM_0 = 34.96 \times 89 + 0.1 \times 43.23 \times 89 = 3496.187 \text{ ths UAH};$$

$$\Phi_{ms} = ZTkM_{ms} + E_n KM_{ms} + E_n K_{pr} = 34.96 \times 1 + 0.1 \times 43.23 \times 1 + 0.1 \times 64 = 45.683 \text{ ths UAH}.$$

The annual economic effect from the introduction of the suggested monitoring system based on the systems of information processing is:

$$E = \Phi_0 - \Phi_{ms} = 3496.187 - 45.683 = 3450.504 \text{ ths UAH}.$$

Comparing the total costs for both variants:

- baseline variant – $U_0 = ZTkM_0 + KM_0 = 6958.91 \text{ ths UAH};$
- suggested variant – $U_{ms} = ZTkM_{ms} + KM_{ms} + K_{pr} = 142.19 \text{ ths UAH}.$

Thus, the difference in the total (current and single) costs for these two variants is $U_0 - U_{ms} = 6816.72$ ths UAH.

Conclusion. Here we have presented and grounded the parameters of a department, designed to provide a planning system of training specialists for education facilities. This author's suggestion allows significant budget savings on management personnel and acquisition of fixed assets.

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