

Розглянуто принципи розробки інформаційної технології моніторингу системи вищої освіти. Побудована модель оцінювання якості освіти, що складається з оціночних моделей, оснований на вподобаннях зацікавлених осіб, та виміральної моделі, реалізованої засобами сучасної теорії вимірювань

Ключові слова: моніторинг системи вищої освіти, інформаційна технологія, модель оцінювання

Рассмотрены принципы разработки информационной технологии мониторинга системы высшего образования. Построена модель оценивания качества образования, состоящая из оценочных моделей, основанных на предпочтениях заинтересованных лиц, и измерительной модели, реализованной средствами современной теории измерений

Ключевые слова: мониторинг системы высшего образования, информационная технология, оценочная модель

The principles of information technology development for the system of higher education monitoring are considered. For education quality estimation the evidence model is built. It consists of scoring models based on stakeholders' preferences and measurement model which is implemented using the modern measurement theory

Keywords: system of higher education monitoring, information technology, evidence model

Introduction

The system of higher education (SHE) is a complex hierarchical distributed system. The SHE management has various tasks that must be solved on different execution levels. The main goal of its management is providing the conditions for preparing highly qualified stuff for economic needs of the country and for social, cultural and intellectual nation's development. So the quality of higher education defines the level of country's development.

Different aspects of SHE management problems are considered by many authors, for example in the works [1-5]. The classification of management tasks is made in the work [3]. The problem of SHE monitoring is emphasized there.

The importance of higher education monitoring does not raise anyone's doubts [4]. As it is shown in [3] there can be defined different monitoring types and objects. There are two types of SHE monitoring: the internal and the external one. The external monitoring presents the evaluation of environ-

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INFORMATION TECHNOLOGY OF HIGHER EDUCATION MONITORING: A QUALITY-BASED APPROACH

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ment parameters which influence the control action choice. The internal monitoring reflects the SHE functioning results with the help of some indicators. So the solving of monitoring problems is a relevant task for SHE management.

The purpose of research: to increase the SHE monitoring efficiency by development and implementation of models, algorithms and information technologies.

High-level requirements for information system of higher education monitoring

The development of monitoring information system includes solving of problems of data collection, sending it to some warehouse, processing and storing.

We can define two kinds of data sources: the internal and external ones. The internal sources are defined by higher education establishment (HEE) and its departments. The external sources are formed by the feedback from the graduates, enterprises and public authorities. We can distinguish the state, the market and the society as the stakeholders of SHE.

The state as the SHE stakeholder forms the governmental order for satisfying the economy's need in the qualified

personnel. The state is interested in forming the developed, prosperous nation. Only well-educated people can be the basis of the country's prosperity. So the SHE must compare the results of its functioning with the goals of state.

Market is the SHE stakeholder which represents all enterprises and organizations in the country that are interested in giving an employment to the skilled and well-qualified people. The enterprises form the demand for labour force which is represented by HEE graduates. So the employers are the main consumers of the results of SHE work. Therefore their criteria for giving an employment to graduates must be taken into account during management decision making in the HEE.

Society consists of individuals who are interested in getting particular level of skills and knowledge and in the realization of their social and cultural needs. They consider the educational process as the getting of educational service. We can say that the market of educational services exists, and thus the society representatives are also the consumers.

The main criterion of management efficiency in the SHE is quality. Quality should be evaluated by consumers. So the efficient management must be based on the results of monitoring of all stakeholders' preferences.

Nowadays the SHE monitoring is organized in the following way: HEEs form the reports that contain the results of their functioning (for example, report about the number of students studying on different specialties) and pass them to the higher management levels. Licensing and accreditation procedures also take into account the defined characteristics which reflect the current HEE state.

Large volumes of data flows in SHE, their complexity and interrelationship require information technology (IT) support. The monitoring information system must provide:

- the collection of data from different sources (HEE, enterprises, public authorities, graduates);
- saving data in the warehouse;
- analytical processing of data;
- estimation of the results of SHE functioning;
- the convenient presentation of data for users.

Obtaining the estimates is the key task of monitoring. We suggest to evaluate the results of functioning on the basis of education quality estimation. Three types of monitoring objects were mentioned in [4]: the graduates, the educational process and the higher education establishment (HEE) as a whole. In this work we are going to pay attention HEE graduates as monitoring object.

The quality of education is a latent variable, because it can't be measured explicitly. That's why the theories of latent variable measurement can be used, for example, the Item Response Theory (IRT) [6]. For measurement of education quality the evidence model should be elaborated. It consists of scoring and measurement components. The scoring component contains procedures for extracting the salient features of education quality from the point of view of different stakeholders. The measurement component defines how the observable variables depend, in probabilistic terms and how to estimate the latent variable through them.

Evidence model application for higher education monitoring

Let's consider the scoring component of evidence model. So all of the SHE stakeholders have different preferences. That's why for estimating the latent variable of education

quality different scoring models can be defined for different stakeholders.

First of all on the basis of statistics let's build the scoring model for quality estimation from the state's point of view. As it was mentioned above any country should have the list of obligatory indicators which statistics must be collected in the form of reports. While creating such list most of the countries are oriented on the indicator lists made by world public and political organizations, such as UNESCO, OECD, Eurostat and European Commission Directorate-General for Education and Culture.

After analyzing their documentation we can define a set of indicator variables from the state's point of view. This set includes the groups of indicators connected with: the percent of graduates in different training directions; percent of foreign graduates; percent of employed graduates; percent of eliminated students. The built state scoring model includes 18 indicator variables.

The next scoring model concerns the society as the SHE stakeholder. Society is represented by the graduates who estimate the education quality as the quality of obtained service. Therefore method SERVQUAL [5] can be used for evaluation of service quality. Its essence is in measuring of the gap between the consumers' expectations and perceptions of the service. On the basis of this method the questionnaire was elaborated. It combines 19 questions which are formulated in such a way that a graduate has to define in his answers how much his perception differs from what he has expected from the HEE. So the answers will give a possibility to measure the gap between perception and expectation according to SERVQUAL. The graduate is supposed to answer the questions using the Likert scale from 1 to 7 points. The sum of points of all the graduates for each question is a value of indicator variable. The set of indicator variables includes the groups of indicators that correspond to five SERVQUAL dimensions [5]: reliability, tangibility, responsibility, security and empathy.

The scoring model built for the market as the SHE stakeholder must reflect the correspondence of graduates to employers' requirements about their professional, competence and personal characteristics. So we can form the set of indicator variables which describe the education quality from the enterprise's point of view. This set contains the group of indicator variables which are connected with: characteristic of career growth, professional skills and personality level of development.

For implementation of measurement component of evidence model we suggest to use Partial Credit Model (PCM) which is one of the IRT models [6]. According to PCM the probability P_{njx} of scoring category x from $x-1$ of indicator j with one of possible categories $x \in \{0, \dots, m_j\}$ by the object n can be modeled in the following way:

$$P_{njx} = P(x_{nj} = x | \theta_n, \delta_{jk}) = \frac{\exp \sum_{k=0}^x (\theta_n - \delta_{jk})}{\sum_{h=0}^{m_j} \exp \sum_{k=0}^h (\theta_n - \delta_{jk})},$$

where θ_n represents the measured latent variable of object n ; δ_{jk} is the difficulty of k category of indicator j , $k \in \{0, \dots, m_j\}$; x_{nj} is a value of indicator j for object n .

In our case θ_n is the education quality of HEE graduates and the set of indicators correspond to one of the scoring models.

Conclusions

So in this scientific work the necessity of IT creation for solving the problems of SHE monitoring has been proved and the high-level requirements of monitoring information

system were developed. The evidence model for measurement of education quality is implemented with the help of three scoring models that reflect different stakeholders' preferences and the measurement model based on Partial Credit Model.

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Описано ближнє та дальнє оточення проекту, визначені коефіцієнти впливу оточення в умовах турбулентності, побудована діаграма впливу оточення на реалізацію проекту

Ключові слова: проект, оточення проекту, турбулентність, коефіцієнт впливу

Описано ближнее и дальнее окружение лизингового проекта, определены коэффициенты влияния окружения в условиях турбулентности, построена диаграмма влияния окружения на реализацию лизингового проекта

Ключевые слова: лизинговый проект, окружение проекта, турбулентность, коэффициент влияния

Described near and far surroundings leasing project, the coefficients of influence of the environment on leasing projects in turbulence, built environment influence positioning diagram for the implementation of the leasing project

Keywords: leasing project, the environment of the project, the turbulence, the coefficient of influence

Известно, что все проекты реализуются в окружении, которое имеет на них определенное влияние по различным категориям внешней среды. В предыдущей публикации [1] в общей классификации проектов был выделен специфический вид инвестиционного проекта - лизинговый проект. Под окружающей средой лизингового проекта, согласно [2], будем понимать

совокупность факторов и объектов, их порождающих, непосредственно не принимающих участия в проекте, но влияющих на проект и осуществляющих взаимодействие с проектом и отдельными его элементами. При этом выделим непосредственное окружение проекта, то есть факторы и объекты, взаимодействующие с проектом напрямую, и дальнее окружение проекта, то есть факторы и объекты, взаимодействующие с проектом через другие факторы и объекты, обычно входящие в непосредственное окружение (рис. 1).

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ТУРБУЛЕНТНОЕ ОКРУЖЕНИЕ ЛИЗИНГОВЫХ ПРОЕКТОВ

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