

# Quality Estimation Model of Higher Education Institutions

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**Abstract** – This paper presents quality indicators and performances of higher education institutions and a model for evaluating the quality of higher education institutions based on the application of the methods of analytical hierarchy process and trends of quality indicators changing.

**Keywords** – higher education, quality indicators, quality performances, quality assessment.

## I. INTRODUCTION

In the last decades of the twentieth century there was the internationalization of economic trends in production, market development and education. It was a period of constant change in technology, business and politics, working and living environment and integration of the organization and integration technologies. This led to the transformation of systems form traditional to systematic organization.

These changes are closely related to knowledge and education. Education is a dynamic system that tracks and initiates any changes in society, such as changes in technology, engineering, organization, management, regulation and standardization, quality policy, and examples of good practice [1].

Education and knowledge are increasingly becoming primary development resources for creating competitive advantage of any organization (companies, nations, states, the regions or economic integration).

Therefore, the challenges of higher education in the twenty-first century can be understood as a threat or an opportunity. If they are treated as a threat to universities, that will put emphasis on the preservation of the past. Otherwise, when seen as a chance, the emphasis is on the future, which requires the use of best practices from the past and the development of higher education institutions of high quality [2].

When evaluating of the quality of higher education institutions it is necessary to use a systems approach, where higher education institutions must be analysed as complex systems that are parts of a dynamic, changing environment with complex interactions between education, scientific research and support processes exist. This paper presents a model for evaluating the quality of higher education

institutions based on a modified AHP method.

## II. QUALITY OF HIGHER EDUCATION

The main tasks of higher education in the XXI century are the continuous provision, improvement and quality assurance of higher education. The implementation of these tasks influences the competitiveness of not only higher education institutions, but also a national system of higher education in general.

In the academic community there are two approaches to quality: (1) Approach to quality as measure of values, which means striving to be the best according to some criterion; (2) Approach to quality as the extent of reaching the threshold, which means compliance with minimum standards (of competence and burden on teaching staff, facilities, technical equipment, library holdings, etc.).

Research undoubtedly shows that the standards of quality with the minimum requirements are not sufficient to create a unique position of higher education institutions in the knowledge economy. It is essential for higher education institutions to have something that makes it different from their competitors. It can be: the quality of their curricula, technology and teaching process and extra-curricular activities, organizational culture, strategy, promotions, branding and the ability to build the public image, the quality of human resources, technical equipment, facilities and library facilities, but also the quality system and philosophy of Total Quality Management [3].

Higher education institutions (HEIs) are very complex systems for management, security and quality improvement and quality management. They are characterized by high level personnel, complexity of the process of education, high social importance of performance, long cycle process of education and training, the historical independence and freedom in the choice of lecturers teaching methods, the complexity of identifying the beneficiaries of higher education, their requirements, desires and expectations [2]. They are also characterized by various forms of education (traditional, electronic, lifelong learning), and different standards for different types and forms of basic processes and support processes.

The activity of higher education is described by three main areas: education, scientific research and application. Therefore, three basic processes can be defined in the institutions of higher education [4]:

- Educational process, through which the main purpose of higher education institutions is fulfilled;
- Scientific process, which, besides its basic role in raising the level of general and applied scientific knowledge, generates inputs into the educational process and

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- The process of applying the results in practice, primarily necessary to check the quality of research and educational process and achievement of feedback on these processes.

Way of organizing, implementation and management of these processes and support processes (administration, finance, and publishing) fully determine the quality of higher education institutions.

The quality of higher education is formed in accordance with the following requirements [2]:

- User requirements,
- International requirements,
- Requirements of national standards for accreditation,
- Standards requirements of higher education institutions,
- Requirements of technological standards,
- Quality management system requirements.

In estimating the quality special emphasis is given to users' satisfaction. Users of higher education are internal (teachers and staff) and external (students, parents, students, employers, society, state). Their demands are very different. Students sometimes want to get a grade more easily, while the employer always wants a professional who is ready to solve particular practical problems, and who also has the skills of communication, teamwork, planning and organization, writing and using numbers, and decision-making [5].

International requirements refer to the requirements of the Bologna process, the requirements of international standards of quality in higher education, as well as the requirements of international organizations dealing with issues of quality in higher education. Bologna process emphasizes flexibility as a core performance quality, which refers to the same standards, mobility and exchange of students and teachers in the wider educational area. International standards are based on the following basic principles [6]:

- Interests of students as well as employers and the society more generally in good quality higher education;
- Central importance of institutional autonomy, tempered by a recognition that this brings with it heavy responsibilities;
- Need for external quality assurance to be fit for its purpose and to place only an appropriate and necessary burden on institutions for the achievement of its objectives.

The main objectives of these standards are [6]:

- To encourage the development of higher education institutions which foster vibrant intellectual and educational achievement;
- To provide a source of assistance and guidance to higher education institutions and other relevant agencies in developing their own culture of quality assurance;
- To inform and raise the expectations of higher education institutions, students, employers and other stakeholders about the processes and outcomes of higher education;
- To contribute to a common frame of reference for the provision of higher education and the assurance of quality within the European Higher Education Area.

National standards for accreditation define requirements related to higher education institutions, curricula, internal assessment and external quality assurance.

The requirements of higher education institutions work are related to the organization and technology of work, educational context, human, material and information

resources, while technological requirements of standards are related to technology and pedagogical subsystem [2].

A large contribution to the quality of higher education is made by the introduction and compliance with the requirements of quality management systems (planning, managing, securing and improving the quality of) the TQM model.

### III. QUALITY PERFORMANCE INDICATORS

Key performance indicators (KPI) are non-financial and financial measures which, on the basis of quantifiable targets, reflect strategic performance of higher education institutions. KPIs are used to assess the current situation and define the main directions of development. Originally, KPIs are applied in order to determine the strategy of the institution and evaluate the progress in achieving goals. The essential application of KPIs is reflected in the establishment of standards for their own control over the parameters of the quality of higher education institutions [4].

The purpose of Performance Indicators is to [7]:

- provide reliable information on the nature and performance of higher education sector
- allow comparison between individual institutions of a similar nature, where appropriate
- enable institutions to benchmark their own performance
- inform policy developments
- contribute to the public accountability of higher education.

In a quality-driven and never ending improvement environment, the following are some of the main reasons why measurement is needed and why it plays a key role in quality and accountability improvement [7]:

- To ensure that customer (internal, external) requirements have been met.
- To be able to set sensible objectives and comply with them.
- To provide standards for establishing comparisons (not ranking) for continuous improvement
- To provide transparency and provide a 'score-board' for people to monitor their own performance levels.
- To highlight quality problems and determine which areas require priority attention.
- To give an indication of the costs of poor quality
- To justify the use of resources.
- To provide feedback aimed at improving quality, healing the weak points and updating the strong ones.

Performance indicators, therefore, are the means by which performance will be evaluated. To be meaningful, they must be measurable, relevant and important.

KPIs are of interest to a wide range of bodies, including Government, universities and colleges, and the higher education funding bodies. The indicators are also relevant to schools, prospective students and employers.

### IV. ASSESSMENT MODEL OF HEI PERFORMANCE

The model is based on combination between AHP, trend analysis and comparative data [8]. It consists of: (1) Key

success factors identification, (2) Key performances identification, (3) KPIs identification, (4) Building KPIs tree, (5) Trend and comparison based scoring.

(1) *Key success factors identification*. Three key success factors (KSFs) of HEI are: achievement of education activities, achievement of research activities quality and achievement of community services and supporting activities.

(2) *Key performances identification*. Identification of key performance is based on standards. In the Republic of Serbia that are the standards for accreditation of institutions. Each standard can be regarded as a performance of quality: 1- objectives of the institution, 2-planning and control, 3 - organization and management, 4-studies, 5-scientific and artistic work; 6-teaching staff; 7-non-teaching staff, 8 students, 9-workspace and equipment, 10 -library, textbooks and information support; 11-funding; 12-QA, 13-transparency of its operations. HEI has to choose the key performances.

(3) *KPIs identification*. Based on the above criteria and key performances, it is necessary to identify a list of KPIs related to each performance. The selected KPIs were analysed by experts group in a Delphi Forum. The experts used the three-point scale of “not important”, “somewhat important” and “very important”. The result is the selected KPIs according to their degree of importance. In this case, we have to find first the most important KPIs from list of KPIs. This list is completed by experts who are more aware of the problems that HEI have to cope with.

(4) *Building KPIs tree*. KPIs tree is basically composed by four levels: 1st level - the goal: total score of HEI performance; 2nd level - the criteria: education, research and supporting; 3rd level - the key performances; the rating scale (4th level) contains KPIs related to each performance, and its rating scale (Figure 1).

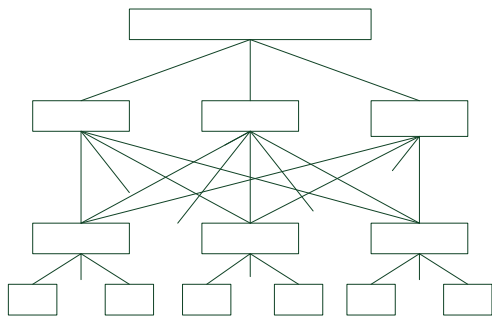


Fig. 1. Hierarchy of KPIs tree

(5) *Trend and comparison based scoring*. In the second level (criteria), the three criteria (education, research, supporting) are weighted using pairwise comparison proposed by AHP approach [9]. The expert group compared relative importance of each criterion in the pairwise manner using 1-9 comparison scale, where 1 means that importance of two criteria is the same, while 9 means that one criterion is extremely more important than the other, as shown on Table I.

TABLE I  
SCALE FOR AHP PAIRWISE COMPARISON [10]

Level	Importance	Explanation
1	Equal	The equal contribution of two factors to the objective
3	Moderate	Experience and judgment slightly favor one factor over another one
5	Strong	Experience and judgment strongly favor one criterion over another one
7	Very strong	A factor is favored very strongly over another; its dominance demonstrated in practise
9	Extreme	The evidence favoring one factor over another is of the highest possible of affirmation

Assumption is that if criterion A is extremely more important than criterion B and is rated at 9, then B must be absolutely less important than A and is valued at 1/9.

Each expert has to compare elements of the same hierarchy level. Results of these judgments are summarized in pair-wise comparison judgement matrices. An example of a pair-wise comparison for the first hierarchical level is shown in Table II.

The procedure for obtaining a priority vector is:

1. Calculate the sum of all elements in each column;
2. Divide elements of each column with sum of the values of the column, which was obtained in the previous step;
3. Calculate the sum quotient obtained for each species and determined the average value of each species.

Column consisting of the average value is normalized by its own vector.

TABLE II  
PAIR-WISE COMPARISON JUDGEMENT MATRIX

Criterion	E	R	S	Priority vector
Education (E)	1	3	3	0,6
Research (R)	1/3	1	1	0,2
Supporting (S)	1/3	1	1	0,2
$\Sigma$	5/3	5	5	1,0

The consistency value is determined as follows:

1. Pairwise comparison judgement matrix is multiplied by the priority vector:

$$\begin{bmatrix} 1 & 3 & 3 \\ 1/3 & 1 & 1 \\ 1/3 & 1 & 1 \end{bmatrix} \cdot \begin{bmatrix} 0,6 \\ 0,2 \\ 0,2 \end{bmatrix} = \begin{bmatrix} 1,8 \\ 0,6 \\ 0,6 \end{bmatrix} \quad (1)$$

2. The calculated matrix Eq. (1) is divided by priority vector:

$$\begin{bmatrix} 1,8 \\ 0,6 \\ 0,6 \end{bmatrix} \div \begin{bmatrix} 0,6 \\ 0,2 \\ 0,2 \end{bmatrix} = \begin{bmatrix} 3 \\ 3 \\ 3 \end{bmatrix} \quad (2)$$

3. Further, eigenvalue  $\lambda_{\max}$  is calculated as maximum value of elements in Eq. (2) matrix:

$$\lambda_{\max} = 3 \quad (3)$$

4. The consistency index is calculated as follows:

$$CI = (\lambda_{\max} - n) / (n - 1) = 0 \quad (4)$$

5. A value of a random index, RI, is selected according to the matrix size, as shown on Table III. For a 3x3 matrix selected value is RI= 0.52.

TABLE III  
RANDOM INDEX

<i>n</i>	1	2	3	4	5	6	7	8
<i>RI</i>	0	0	0.52	0.89	1.11	1.25	1.35	1.4

6. The consistency ratio is calculated as follows:

$$CR = CI / RI = 0 \quad (5)$$

If  $CR \leq 0.10$ , it means that judgment is consistent. If it is more, the judgment matrix is inconsistent. To obtain a consistent matrix, judgments should be reviewed and improved.

Key performances and KPIs are weighed using the same method as the criteria described above.

KPIs are measured based on the principles of trends and comparison dimensions. Trends consist of the current level and last year performances. The following decision making rule has been suggested in [7]:

(1) If KPI trend is growing and current level is higher than competitor/benchmark, then the score is 100.

(2) If KPI trend is growing and current level is lower than competitor/benchmark, or if KPI is declining and current level is higher than competitor/benchmark, then the score is 50.

(3) If KPI trend is declining and current level is lower than competitor/benchmark, then the score is 0.

The total score of Higher Education Institution performance (TPS) is calculated as follows:

$$TPS = \sum_{i=1}^n W_{i,I} \sum_{j=1}^m W_{j,II} \sum_{k=1}^{r_j} s_{jk} w_{jk} \quad (6)$$

where, *i* is index for criteria; *j* is index for performances; *k* is index for KPIs;  $W_{i,I}$  is weight of criterion-*i* (1st level);  $W_{j,II}$  is weight of performance-*j* (2nd level);  $w_{jk}$  is weight of KPI-*k* related to performance-*j* (3rd level);  $s_{jk}$  is score of KPI-*k* related to performance-*j*.

## V. CONCLUSION

The best model ensuring the quality of higher education institutions is introducing the concept of total quality management and continuous improvement. This requires the use of tools and techniques for monitoring, measuring and evaluating quality. The proposed model for quality assessment, based on the AHP method and the development trends of key performance indicators, provides higher education institutions with a real picture of their comparative advantages, and their positions in higher education.

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