Making Use of Competitive Advantages of a University Education Innovation Cluster in the Educational Services Market

By Ivan Gryshchenko[1], Lyudmila Ganushchak–Efimenko[2], Valeriia Shcherbak[3], Olena Nifatova[4], Mykola Zos-Kior[5], Iryna Hnatenko[6], Liliia Martynova[7], Andrii Martynov[8]

Abstract

One of the major trends of the contemporary world market of educational services is the increasing role of knowledge and information in socioeconomic development, when knowledge becomes a key driver of economic prosperity and competitiveness as well as a critical factor in boosting the labour market demand for a new type of skilled workforce which gives rise to a sweeping demand for professional higher education, incrementally demanding requirements to Universities in terms of meeting social needs, and the globalization of the world economy. Such drastic development dynamics of University environment along with the objective escalation of competition in the area of educational services greatly affect the issues of strategic planning and University competitiveness management in the long run.

1. Introduction

In the context of integrated market environment, the national universities face the challenge of solving problems of their own development along with improving their academic staff quality using new, yet untapped potential and opportunities. However, Ukrainian universities traditionally have much to offer – their research and intellectual potential in the first place which is closely related to intangible assets as part of University equity capital. Apparently, in modern realia there is a critical need to promote and facilitate

|[1]Dr. Sc., Professor, Rector, Kyiv National University of Technologies and Design, Ukraine
[2]Dr. Sc., Professor, Vice-Rector for Research and Innovation, Kyiv National University of Technologies and Design, Ukraine
[3]Dr. Sc., Professor, Faculty of Economics and Business, Kyiv National University of Technologies and Design, Ukraine
[4]Dr. Sc., Associate Professor, Faculty of Economics and Business, Kyiv National University of Technologies and Design, Ukraine
[5]Dr. Sc., Professor, Educational and Scientific Institute of Economics, Management, Law and Information Technology, Poltava State Agrarian University, Ukraine; Corresponding Author
[6]PhD, Associate Professor, Faculty of Economics and Business, Kyiv National University of Technologies and Design, Ukraine
[7]PhD, Faculty of Law, Volodymyr Dahl East Ukrainian National University, Ukraine
[8]PhD, Associate Professor, Educational and Scientific Institute of Economics and Management, Volodymyr Dahl East Ukrainian National University, Ukraine

strategic development opportunities and gain a competitive edge which will drive further increase of the University key business performance indicators. The core product of the university activities is educational and research services. Hence, the most significant outcome in educational entrepreneurship development (in the public sector, too) is the emergence of University education innovation clusters.

Over the last 10-15 years the business realia in which the University education innovation clusters operate have changed dramatically due to the formation and the development of a qualitatively new economic environment which is to a different extent integrated into national and international markets of educational services. The most important reason for essential structural changes, the vast majority of universities are facing at present, is speeding up the knowledge generation and knowledge update process in a wide range of education, research and entrepreneurship domains which represents the business environment within the educational services markets. Ensuring and managing competitiveness in Ukrainian universities is an extremely broad and multifaceted problem that encompassed a wide range of research areas and aspects at the intersection of different sciences: economics and management, innovation, systemic approach, etc. A key to efficient national innovative education system is consistent adherence to innovation economy development concept based on the systemic institutional approach. From the authors' perspective, within the frameworks of this approach, there are four main theories that lay solid foundations to building competitiveness of universities, shaping and developing their sustainable competitive advantages: Diffusion of innovations theory (Freeman C. and Louçã F., 2001; Hall B., 2004); Technoeconomic paradigm concept (Duijn, J., 2013; Deves S., Mensfild E. & Romeo A., 2010); National systems of innovation approach (Dosi G. & Egidi M., 1991); Innovation cluster concept (Porter, M. & Kramer, M., 2006).

Ensuring a high level of the global education system competitiveness relies on effective strategy formation and use of competitive advantages by universities. The implementation of these strategies contributes to attaining global standards in the area of education, scientific research and development. The most striking examples of competitive universities are the so-called World Class Universities (WCU) included in well-known international rankings (ARWU, THE, QS). In the context of education globalization, there are three basic models of business strategies for developing competitive advantages most commonly used by world-class universities: "breadth", "depth" strategies and the combined "breadth and depth" strategy (S. Marginson, 2013). According to the authors of the world-class universities concept (Salmi, J. & Altbach, Phd. G., 2011), these universities are characterized by three main features: 1) concentration of talent – talented teaching and research staff and students; 2) abundant resource base capacity and modern infrastructure; 3) effective University management system. The concentration of talent is the ability of Universities to attract talented students, teachers and researchers. Abundant resource capacity assumes large amounts of government funding, private capital, funds from tuition fees, research grants, etc. Effective management practices are associated with the use of productive methods to attain superior results, effective organizational management, government support for encouraging institutional independence and self-sufficiency of universities, their autonomy and academic freedom, availability of strong management teams, strategic thinking and leadership culture.

Given the specific nature of educational services in a wide context of University core activities, in this study competitive advantages of the University education innovation cluster are viewed as its integrated qualitative characteristic which is achieved by offering top quality educational services to consumers or low-price strategy, or by providing additional benefits that compensate for the high cost of educational services. Gaining a competitive edge by a University education innovation cluster is implemented through the use of unique personnel competencies and skills (academic staff as a first priority), providing competitive educational services (the quality and range of services), ensuring sufficient investment funding for high-quality training by implementation of a dual education paradigm, i. e. education – innovation – business. Below, Fig. 1. presents the characteristics of a competitive environment of the University education innovation cluster (Figure. 1).

COMPETITIVE ENVIRONMENT OF A UNIVERSITY EDUCATION INNOVATION CLUSTER

Specific features	*Challenges*		*Opportunities*
	long-term national	*current national*	
Rigorous government control and regulation of activities	Rigorous government control and regulation of activities	Reduction in government funding for higher education	High prestige of tertiary education in Ukrainian society
Lack of autonomy	Lack of autonomy	Low wages resulting in the outflow of highly skilled professionals	The need for cost-effectiveness in fixed assets update
Dominance of public ownership	Rigid hierarchical structures	Demographic problems	The market system starts to generate built-in incentives to innovate
Rigid hierarchical structures	Challenges in balancing educational and research activities	Transitional, volatile character of society development	The need to adapt imported education technologies to Ukrainian settings
Disciplinary arrangement of education and R&D		Deep structural imbalances in the Ukrainian economy	Increasing demand for high-skilled professionals
Integration of education and upbringing		Economic crisis in Ukraine	Crisis in academic and industrial science
High prestige of tertiary education in Ukrainian		Insufficient technology development in Ukrainian education system	Competition from foreign universities
High level of fundamental training, broad specialization		High degree of physical depreciation of fixed capital (70%)	Global transition towards knowledge economy
		Technological underdevelopment of high-tech industries	
		Lack of company's working capital	

Figure. 1: Competitive environment framework for a University education innovation cluster (proposed by the authors)

Thus, assessing the effects of educational services market upon the process of gaining and developing competitive advantages by a University education innovation cluster is of particular significance for verifying the research relevance as well as for promoting further enhancement of the national education system.

2. Materials and Methods

To accomplish the research objective on evaluating the competitive advantages of Ukrainian universities, the following range of data was collected: academic rankings of higher education institutions (HEI) of Ukraine of III and IV accreditation levels "Top - 200 Ukraine 2019" for the last 5 years; rankings of higher education institutions by the number of students enrolled funded from the state budget, competition per 1 government-funded place; the data on HEI participation in international projects (Horizon 2020, Erasmus+); information on HEI participation in international rankings (Webometrics, Scopus, uniRank); the data from the Ministry of Education and Science of Ukraine; the data from USEDE (Unified State Electronic Database on Education); the data from the Committee on the State Prize of Ukraine and Taras Shevchenko National Prize Committee; HEI participation in NATO-funded "Science for Peace and Security" programs; engagement of HEI in bilateral projects; average competitive HEI applicants' scores.

 The research base comprised 200 Ukrainian HEI included in the "Top-200 Ukraine" University rankings over the last 5 years. Emphasis should be made that all data collected was recorded in dynamics. Thus, the study covered the period from 2015 to 2019. The importance to explore the data in dynamics is explained by the need to improve the reliability of the results obtained which greatly affect the identification of the interrelationship between the competitive advantages of HEI and their competitive positions in the market of educational services.

Input information on the significance of integrated indicators of University competitive advantages development was obtained from the Center for International Education Projects "Euroosvita" (http://www.euroosvita.net/) and the international expert group IREG Observatory on Academic Ranking and Excellence (http://ireg-observatory.org/en/).

Fig. 2 presents a model for building network cooperation within a University education innovation cluster.
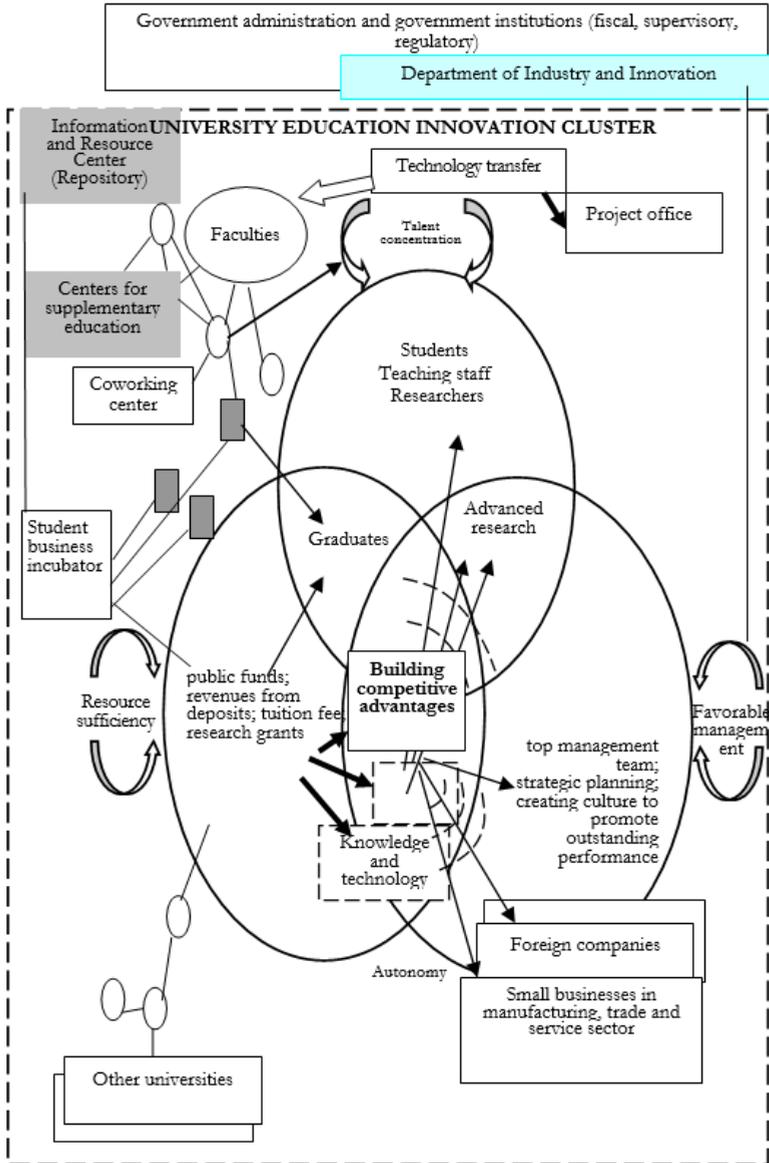
Figure. 2: A model for building network cooperation within a University education innovation cluster (proposed by the authors)

The assessment of the level of use of competitive advantages of the University education innovation cluster in the market of educational services was performed with respect to the four constituent elements of the "knowledge quadrangle" concept (education – science – entrepreneurship – government). This concept is a follow-up to the European idea of the "knowledge triangle" that accommodates a close link between higher education, research and technological innovation in the countries of European Union. These processes assume the "key role of universities in developing European cultural dimensions" in the contest

of building the common European Higher Education Area (ENEA) and the common European Research Area (ERA).

In the frameworks of the above "knowledge quadrangle" concept, a well-known "knowledge triangle" has been complemented by a new component of integration of entrepreneurship with science and education. This approach promotes applied business problem-solving learning by students and staff and monitors the latest research innovations that are born within the research laboratories of universities. Adding the "entrepreneurship" component contributes to transforming universities into the centers for knowledge generation and transfer (learning activities, research), knowledge dissemination (research, academic mobility), knowledge application and new knowledge creation (innovation activities of business entities).

The use of the "enterpreneurship" component adds to promoting the innovation economy infrastructure development through involvement of effective mechanisms of innovation exchange between potential participants; fostering more intensive interaction within the "University – science – business" triad; creation of regional specialized institutions to support innovation – technoparks, business incubators and technological firms. The implementation of the "entrepreneurship" component within the University education innovation cluster is carried out through attracting new partners (companies and organizations engaged in practical innovation activities). Businesses based on such innovation apprenticeship programmes and platforms open wide opportunities to facilitate better access to new technology that can be implemented, coordination of efforts and financial resources to develop new products and technologies and release them onto the market.

Within the University education innovation clusters, the fourth component, the "government" is a regulatory tool that allows for creating a continuous process of the national intellectual capital reproduction, a driver for generating, sharing and dissemination of knowledge (the partnership between education and business). Functioning of this fourth component (the "government") is embedded in the overall theoretical, methodological, institutional, structural and applied technological aspects to consolidate the interaction of the triad: education – innovation – business, the elements of which are operating at different levels (macro-, meso-, micro- and nano-) laying the basis for HEI competitiveness (Fig.1).

Running the University education innovation cluster assumes the organization and self-organization of continuous information and educational counterflows in the "education – science – entrepreneurship – government" paradigm that promotes the enhancement of competitive advantages and competitiveness of all participants in the process of innovation development at all levels of interaction. Fig. 1 presents the key participants identified as the subjects of the system of education and science (HEI, research institutions), the entrepreneurship system (large, medium-sized and small business), the government and its institutions. Intellectual entrepreneurship is viewed as an outcome of the integration of science and entrepreneurship and the channel for knowledge transferring among them.

The evaluation participants were the HEIs that had been included into the University Rankings "Top - 200 Ukraine 2019" (osvita.ua). The assessment of the level of competitive advantages of HEIs was performed with respect to the four constituent elements of the "knowledge quadrangle" concept by the method of multivariate analysis:

– education (16.5% of the total score) – indicators assessed: the level of students' basic, general education, the level of professional training, the level of practical skills in information technology;

– science (45.4% of the total score) – indicators assessed: the number of publications, number of citations, the Hirsch index for 2019 (h-index), involvement of HEIs in international projects (Horizon 2020, Erasmus+);

– entrepreneurship (13.5% of the total score) –indicators assessed: the demand for graduates by a labor market, participation of HEIs in bilateral projects, the level of research commercialization (sale of licences, patents, spin-off creation), start-up creation;

– government (18.8% of the total score) – indicators assessed: enrolment competitive score by EIA (External Independent Assessment) results (contract-based applicants), the number of persons enrolled funded from the state budget, the competition per one budget place, the average competition score of applicants.

Within the scope of this study, using the method of multivariate analysis four integral indicators have been obtained, each of them reflecting the development level of every component from the knowledge quadrangle (Fig. 3).

Variable	Factor Loadings (Unrotated) (Вх_дані) Extraction: Principal components (Marked loadings are >,700000)			
	Factor 1	Factor 2	Factor 3	Factor 4
x1	-0,367835	-0,141469	0,319998	0,531621
x2	0,713137	-0,191116	0,480274	0,146273
x3	0,911252	-0,189931	0,106199	0,108201
x4	0,911283	-0,196719	0,094940	0,102514
x5	0,102514	0,072783	0,844690	-0,122837
x6	-0,133911	0,120513	0,824160	-0,133911
x7	0,016693	0,113187	0,868557	0,016693
x8	0,074409	-0,330379	-0,503719	0,479510
x9	0,106199	0,102349	-0,073588	0,926159
x10	-0,416911	-0,251529	-0,382993	-0,349001
x11	-0,176418	-0,149498	0,636894	-0,407956
x12	0,067821	-0,180079	-0,025296	0,851991
x13	-0,685734	-0,028037	-0,273509	-0,248047
x14	-0,699703	0,284748	-0,177218	0,035035
x15	-0,018698	0,819058	0,067821	0,132724
x16	-0,316213	0,795426	0,044154	0,118349
Expl.Var	7,306108	1,787039	1,345084	1,015326
Prp.Totl	0,456632	0,181690	0,168451	0,134636

Legend: X_1 – the number of publications; X_2 – the number of citations; X_3 – Hirsh index for 2019 (h-index); X_4 – participation training of HEIs in international projects (Horizon 2020, Erasmus+); X_5 – professional qualification assessment; X_6 – education quality assessment; X_7 – international recognition assessment; X_8 – EIA competitive score for contract-based enrolment; X_9 – demand for University graduates; X_{10} – participation in bilateral business projects; X_{11} – research commercialization level; X_{12} – the number of spin-offs and start-ups; X_{13} – the number of persons enrolled for state budget funded programs; X_{14} – the number of persons enrolled with contract-based funding; X_{15} – the ratio of contract-based/state budget funding; X_{16} – competition per 1 government-funded place

Figure. 3: Results from multivariate analysis of the development level of each of the knowledge quadrangle component for the HEIs under study (calculated by the authors)

At the next stage of the study the analysis of the impact of each of the components of the University knowledge quadrangle on its competitive position has been performed. The application of cluster analysis helps to identify homogeneous groups in a HEI by the level of their competitive advantages development (Fig. 4).
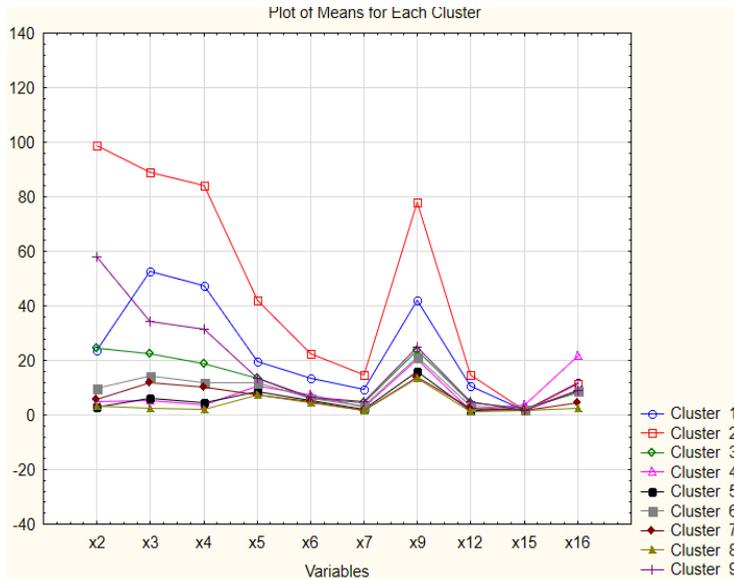
Figure. 4: Results from cluster analysis by the level of competitive advantages development for each of the knowledge quadrangle within HEIs under study (calculated by the authors)

Further, a hierarchical clustering, a dendrogram on grouping the HEIs by the level of their knowledge quadrangle components development has been built (Fig. 5).
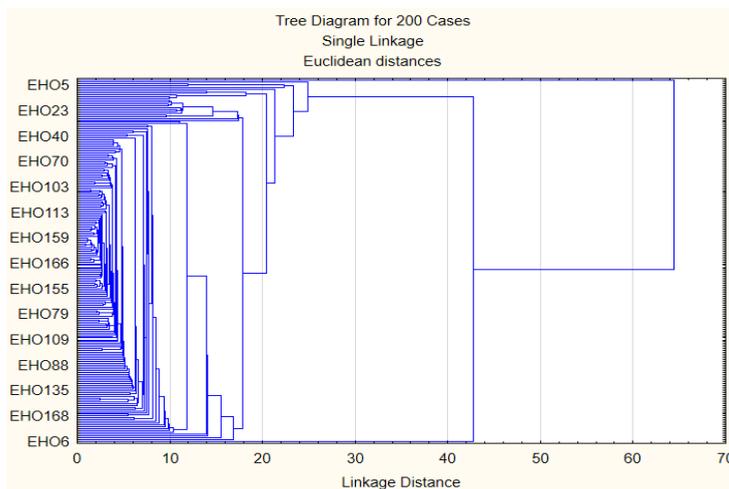
Figure. 5: A dendrogram on grouping the HEIs by the level of their knowledge quadrangle components development (calculated by the authors)

The visualization of the competitive positioning of the HEIs under study by the level of their knowledge quadrangle components was conducted by using a matrix in the coordinate system: axis OY: "education – science"; axis OX: "entrepreneurship – government" (Fig. 6).

| Segment 1	Segment 2	Segment 3
High level of the «science» and «entrepreneurship» components development Low level of the «education» and «government» components development	High level of the «science» component development Low level of the «education» component development Medium level of the «entrepreneurship» and «government» components development	High level of the «science» and «government» components development Low level of the «education» and «entrepreneurship» components development
Segment 4	**Segment 5**	**Segment 6**
High level of the «entrepreneurship» component development Low level of the «government» component development Medium level of the «education» and «science» components development	Medium level of all the four components development: «education», «science», «entrepreneurship», «government»	High level of the «government» component development Low level of the «entrepreneurship» component development Medium level of the «education» and «science» components development
Segment 7	**Segment 8**	**Segment 9**
High level of the «education» and «entrepreneurship» components development Low level of the «science» and «government» components development	High level of the «education» component development Low level of the «science» component development Medium level of the «entrepreneurship» and «government» components development	High level of the «government» and «education» components development High level of the «science» and «entrepreneurship» components development

Y axis: «Science» component gain / «Education» component gain
X axis: «Entrepreneurship» component gain / «Government»

Figure. 6: The positioning matrix for the HEIs under study by the level of the knowledge quadrangle components development (proposed by the authors)

At the last stage of the study, the effects from the transition of a HEI from one matrix segment to the other (increase or decline in the competitiveness level) has been revealed with regard to certain organisational and administrative activities undertaken in dynamics over 2015-2019 (Fig. 7).
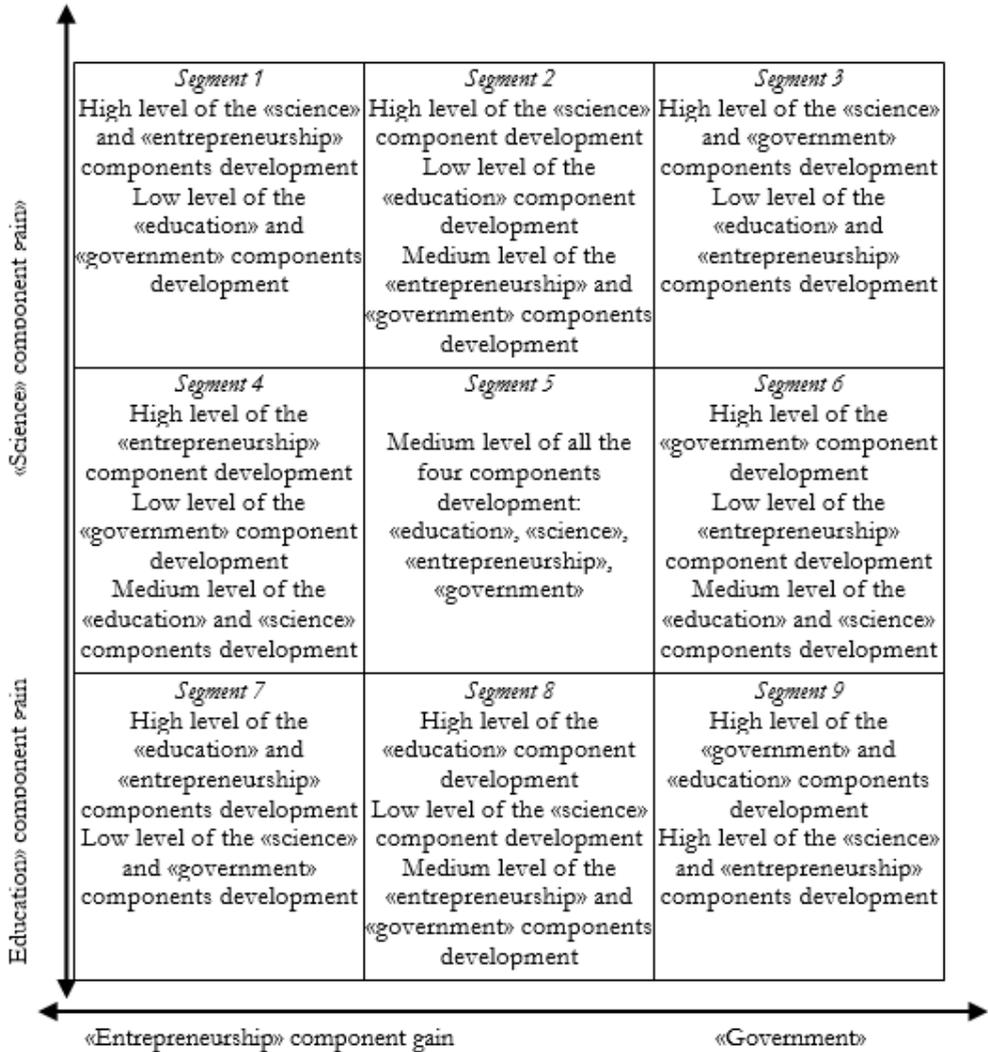
Figure. 7: The positioning results for the HEIs under study by the level of the knowledge quadrangle components development (constructed by the authors)

HEI representatives from each cluster: *Cluster 1 – National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (high level for science development, medium – entrepreneurship, government regulation); Cluster 2 – Taras Shevchenko National University of Kyiv (high level for science and government regulation, medium level – entrepreneurship, government regulation); Cluster 3 – National University of Life and Environmental Sciences of Ukraine (high level of entrepreneurship development, medium – for science and education); Cluster 4 – Simon Kuznets Kharkiv National University of Economics (medium level for all components development); Cluster 5 – H. S. Skovoroda Kharkiv National Pedagogical University (high level of science development, medium level for entrepreneurship and government regulation); Cluster 6 – Odessa National Medical University (high level for government regulation and education development); Cluster 7 – Dnipropetrovsk State University of Internal Affairs (high level for government regulation, medium – for science and education development); Cluster 8 – Ukrainian Catholic University (high level of education development, low level for government regulation); Cluster 9 – National University of "Kyiv-Mohyla Academy" (high level of science and entrepreneurship development).*

3. Results and Discussions

3.1 The results of the multiple factor analysis of the level of knowledge development

Thus, the results of the multivariate analysis on the development level of each of the components of the knowledge quadrangle in the HEIs under study demonstrated that the greatest load has a component of "science" – 45,65%, next in significance belongs to the "government" – 18,16%, followed by "education" – 16,84% and "entrepreneurship" – 13,64% (see Fig. 3).

According to other results of the multivariate analysis, integral indicators of the competitive advantages development for each of the quadrangle components have been obtained.

The formula for calculating the integral indicator for "science" is as follows:

$$I_{sc} = \frac{1}{7,306108}(0,713137X_2 + 0,911252X_3 + 0,911283X_4)$$

The formula for calculating the integral indicator for "government" is as follows:

$$I_g = \frac{1}{1,787039}(0,819058X_{15} + 0,795426X_{16})$$

The formula for calculating the integral indicator for "education" is as follows:

$$I_e = \frac{1}{1,345084}(0,844690X_5 + 0,82416X_6 + 0,868557X_7)$$

The formula for calculating the integral indicator for "entrepreneurship" is as follows:

$$I_{ent} = \frac{1}{1,015326}(0,926159X_9 + 0,851991X_{312})$$

Thus, the findings revealed that 10 out of 16 indicators have significant effects upon shaping and development of competitive advantages of HEIs. With these indicators a cluster analysis has been performed that provided evidence for the presence of 9 clusters (Fig. 5), their hierarchy dendrogram is presented in Fig. 6.

The calculations of the integral indicators' values for each of the quadrangle components according to the data from 200 HEIs have enabled to build a positioning matrix for the HEIs under study by the development level of their knowledge quadrangle components. Apart from the level of competitive advantages development for each of the constituent element, this matrix also presents the most relevant variant of strengthening competitive advantages.

3.2 The proposed concept of "quadrangle of knowledge"

The key research objective was to provide scientific rationale and empirical testing of platform usability within the University education innovation cluster to enhance competitive advantages of universities in the market of educational services. The findings have revealed that competitive advantages translate into the development of each of the knowledge quadrangle components. The study presents certain scientific results as well as a range of practical implications for further research and application.

In the context of developing competitive advantages of HEIs, previous studies didn't focus on the relationship and effects of the University education innovation cluster in

enhancing the competitiveness of HEIs in the market of educational services.

Primarily, most publications were focused on studying the impact of "knowledge triangle" on the degree of University competitive advantages development. The proposed concept of a "knowledge quadrangle" offers a new element – the "government". Adding this fourth component as a regulatory tool has enabled a new look on exploring the role of University education innovation cluster in building the interaction among all four components: education – science – entrepreneurship – government.

The most challenging result from mathematical modelling methods application (multivariate and cluster analyses) is the opportunity to provide matrix visualization for the development level of competitive advantages of 200 HEIs on the market of educational services, to identify their current competitive position and to suggest the most appropriate areas to boost sustainable competitive advantages. The need to build a forecasting trend as to changes that will occur in the case of the proposed recommendations application triggers further research, subject to all of the above indicators charge dynamics.

4. Conclusions

Ukraine's transition to a new post-industrial economic type – knowledge economy – challenges the effective use of its basic resource – new knowledge along with the need to create University education innovation clusters which integrate innovative development of regional entrepreneurship, capacity building on generating intellectual capital and delivering a wide range of intellectual services to small businesses within the cluster. These clusters have a pronounced focus and contribute to innovative development of universities and gaining new competitive advantages on the market of educational services.

This study demonstrates the feasibility and the economic efficiency of implementing the mechanism of University education innovation clusters in the context of maintaining the overall competitiveness of a HEI. The current study has also significant implications for management of HEIs by providing empirical evidence that can improve understanding of the need to implement the "knowledge quadrangle" concept that even today resonates with the community and academia. The findings emphasize a need for further research and development of the above conceptual provisions.

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