

UDC 001:330:334.7

JEL: D83, I23, O15, O34

**THE DUAL-NATURED DIRECTION OF
INTELLECTUAL CAPITAL FORMATION IN THE
SYSTEM OF HIGHER EDUCATION****Julia Yereshko**

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Received: December 9, 2021**Accepted:** February 11, 2022

DOI:10.31520/2616-7107/2022.6.1-4

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Introduction. In a modern world, higher education institutions (HEIs) play a key role in the development of science, technology, industry, economics and, most importantly, the development of humans, their individual and social consciousness, which are key innovative resources for sustainable development. At the same time, the specificity of the HEIs' intellectual capital leads to the formulation of a paradox: higher education is both the most and the least (at least domestic one) intellectualized economic structure. HEIs are a source of knowledge, their staff, students and graduates – its carriers and, at the same time, domestic universities are stagnating in their development, not using this knowledge as a value-generating income factor.

Aim and tasks. The purpose of the study is to develop a model in order to analyze the formation and implementation of HEIs' intellectual capital in the entire structure of their economic activities. The model is proposed in order to identify the motives and ways of its development and the awareness of its main feature – a dual-natured direction, manifested for universities, scientific and teaching staff, students, business and state.

Results. The article deals with an analysis of possible directions for achieving the goals of the HEI in the implementation of its chosen business model, as well as the relationship of elements of intellectual capital, should be based on the proposed model, which allows its management to ensure the synergistic effect of the totality of its components.

Conclusions. The study presents the main sources of innovative advantage, and also describes how the intellectual capital of the HEI is related to its market value. It is a process of commercialization of knowledge, which generates intellectual capital at the HEI, giving it not only scientific and educational value, but also market value. Collaboration between HEIs and industry offers researchers the opportunity to increase the value of their intellectual capital through monetary or contextual support for research, which contributes to their greater scientific productivity. As for students, this allows them, in particular, to gain practice, learn to apply theoretical knowledge in practice and respond to business needs.

Keywords: intellectual capital, sustainable development, higher education, knowledge commercialization, brandbuilding.

1. Introduction.

HEIs are social institutions with a long life cycle. The oldest HEIs in Europe are about 800 years old. The venerable University of Bologna dates from 1088, and the famous Oxford University was established in 1187. In those days, educational institutions were quite different from what we consider to be a university today. The main activities of HEIs then were the accumulation of knowledge, its preservation and transfer. The new knowledge creation was not part of the university's main mission and took place, rather in the process of the aforementioned activities. The professor was mostly a scientist, not a researcher and knowledge was considered complete and static in time. Thus, the professors were supposed basically only to transfer this body of knowledge to students.

The first universities were followed by the second generation of educational institutions founded by religious or political institutions, (Harayama, 1997) the main purpose of which was to create and train the necessary professional elites to serve those state and religious establishments. This is logically explained by the social development of that time and the limited number of members of society who had access to education (Iqbal et al., 2019).

It is fair to theorize that education and HEIs in particular are a litmus test of development: technological, economic and social altogether and the technical order as well as technological paradigm. And that is justified by the fact that higher education acts as a driver of innovation (Rowlands, 2013). In a modern world, HEIs play a key role in the development of science, technology, industry, economics and, most importantly, the development of humans, their individual and social consciousness, which are key innovative resources for sustainable development (Pedro Leitão, Alves, 2020).

2. Problem statement.

It is important to realize that HEIs themselves are big business and independent economic agents. For example, the League of European Research Universities reports that the total product created by UK HEIs alone is more than € 78 billion a year, creating more than 581,000 jobs, representing about 2.5 of the country's total workforce, and public investment

in these enterprises is characterized by the highest rate of return among all types of companies (League of European Research Universities, 2006). These agents have the greatest economic impact on the region of their residence. Basic fundamental research, according to some estimates, despite the long period from initiation to implementation, gives an average annual rate of return on investment ranging from 28 to 50%, which is an extraordinary economic result (League of European Research Universities, 2006).

Another example of the cornerstone economic impact of HEIs on their own region is the Massachusetts Innovation Cluster and the US university education and research system in general. In particular, American universities are not only recognized as the most innovative in the world (Al-Youbi, Zahed, Nahas, & Hegazy, 2021), but also the richest (Statista, 2021).

At the same time, the specificity of the HEIs' intellectual capital leads to the formulation of a paradox: higher education is both the most and least (at least domestic) intellectualized economic structure. Universities are a source of knowledge, their staff, students and graduates – its carriers and, at the same time, domestic universities are stagnating in their development, not using this knowledge as a value-generating income factor.

Thus, the purpose of the study is to develop a model in order to analyze the formation and implementation of HEIs' intellectual capital in the entire structure of their economic activities.

The model is proposed in order to identify the motives and ways of its development and the awareness of its main feature – a dual-natured direction, manifested for HEIs (brand, reputation, demand of applicants, government and program funding, international projects, grants, charitable contributions, etc.); scientific and teaching staff (remuneration, royalties, educational and methodological materials fees, publications, income from the licenses, technologies, inventions etc., mobility, participation in international projects, etc.); students (acquired knowledge and connections, diploma rating, competitive advantages in the labor market, quality of the workforce, participation in innovative activities of the university, in particular: development of startup

projects, research and development activities); business (qualified personnel, developments, technologies and inventions, etc.); state (taxes, social development, innovation, human resources, etc.).

3. Results.

HEIs’ revenues are formed mainly from public funding, in particular ordering research and educational services, private funding in the same areas, as well as participation of institutions and their research and teaching staff in research projects, sales of licenses and technologies, activities for technology parks and enterprises established by the HEIs, etc.

For example, the University of Oxford (2021) in the 2018/19 fiscal year received £ 2.45 billion in total revenue, 25% of which was the funding for research from charities and organizations, research trusts and associations, industrial companies; 16% – tuition fees; 8% – state grants and scholarship programs; the remaining 51% – other income related to activities other than teaching and research: educational publication, commercialization of developments and investment income from university funds.

The university has a property fund of £ 1.2 billion, as well as the funds of individual colleges, which amount to £ 4.9 billion (University of Oxford, 2021). The vast majority of the HEI's income is the embodiment of its intellectual capital. And the emphasis on intellectual capital is due to the fact that:

1. In modern conditions, it determines all the trends and the results of the HEI’s development;
2. Its formation requires each stakeholder to form growing costs;
3. It has a specificallity in a way it accumulates, becomes obsolete and is updated;
4. Its essence is determined not only by obvious features, but also by the environment and socio-cultural features;
5. It is not always separable from the carrier (person) and its growth should bring the owner a long-term socio-economic effect;
6. The embodiment of intellectual capital is fundamentally different – competencies are constantly expanding and transforming, intellectual products can quickly become obsolete.

Intellectual capital is the cornerstone of the HEI’s competitive advantages (Fig. 1).

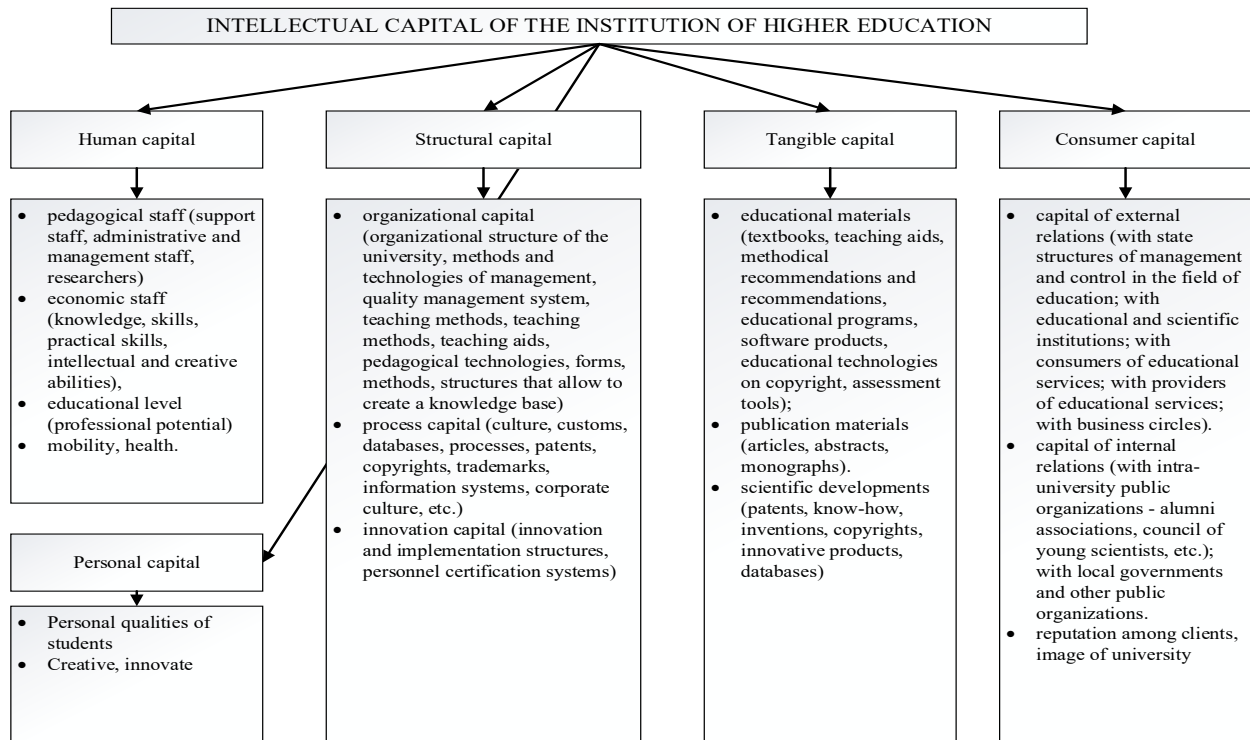


Figure 1. The structure of the HEI’s intellectual capital.

Source: built by the autors

Intellectual capital, unlike physical capital, does not automatically increase by adding its components, which is a feature of its intangible nature, but grows and multiplies based on those components' interaction and thus, emerging synergistic effects. In this case, there is a cross-influence of certain types of assets on other ones. For example, consumer capital can strengthen prestige, facilitate the acquisition of new consumers. Organizational (or structural) – through the transfer of knowledge, reduces the organization's dependence on the human factor; employee competence and quality of personal capital development contribute to the formation of new ideas and new projects; tangible capital in the form of technology, innovation, works, publications etc. is embodied in HEI income through its commercial implementation.

Intellectual capital is transformed into financial through interaction with structural and human capital. At the same time, it should be borne in mind that the efficiency and cost of intellectual capital, as well as its consumer value are dynamic categories that do not have universal properties.

The presented specificity of the HEI's intellectual capital confirms the leading role of professors and academic staff in its formation and necessitates: a) continuous improvement of their qualifications; b) creation of conditions for the intellectual capital development; c) improvement of intellectual capital management. HEIs administrations and other stakeholders evaluate technology transfer by 1) revenue generated, 2) licenses issued, 3) startups created, 4) invention disclosure forms (IDF) and 5) patents issued. In the United States alone in 2018, more than \$ 71 billion was spent on federal research at universities. Approximately \$ 2.94 billion licensing revenue was generated in 2018 directly as a result of bringing scientific inventions to market, also known as "technology transfer". STATT reports a total revenue of US HEIs from licensing in 2018 in the amount of \$ 2.94 billion. Assuming that the average royalty rate is 2%, sales of products based on academic technology will potentially be about \$ 147 billion (Nag, Turo, 2020).

Theoretically, HEIs should be considered the main knowledge-intensive organizations. Teaching and learning are processes of

knowledge transfer, and research is a necessary background for their acquisition and accumulation (Bodnar Mirkovich, Koval, 2019). Also, professors and students are the most important resources of mental knowledge. Taking into account the above arguments, the level of individual knowledge and intellectual capital should logically reach its maximum and be embodied in innovative developments. At the same time, the vast majority of domestic higher education institutions do not even produce a sufficient level of intellectual products and knowledge.

The largest and, in our opinion, the most innovative HEI in Ukraine, Igor Sikorsky Kyiv Polytechnic Institute reports the following: as a result of scientific and research activities in 2019 it had received about UAH 39 million in income, its dominant sources were (National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", 2021): scientific and technical developments (2b5%); international projects (5.6%); basic research (6.5%); scientific services (7.8%); state order (9.2%); economic contract issues (19.8%); applied research (33.9%). At the same time, a singularity of the Igor Sikorsky Kyiv Polytechnic Institute is an innovative ecosystem created by said university and the Scientific Park "Kyiv Polytechnic". Over the years, the Sikorsky Challenge Ukraine (2021) has launched more than 150 technologies and products, and more than 40 startups have received funding of more than UAH 30 million. Today, the Sikorsky Challenge innovation environment includes more than 120 high-tech companies from Ukraine, the United States, Europe, Israel, China and other countries, and KPI's innovation activities are not funded by the state budget. Examples of successful projects are, in particular: satellites PoliTan -1 (2013, investors – Academician Mikhalevich Ukrainian Venture Fund and Boeing) and PoliTan-2 (2017, venture fund named after the outstanding aircraft designer Konstantin Kalinin – KPI alumnus and Boeing); reconnaissance unmanned aerial vehicle Spectator (investor – Academician Mikhalevich Ukrainian Venture Fund) (Sikorsky Challenge Ukraine, 2021).

The idea of Kyiv Polytechnic's rector is not entirely new – founding startups based on universities' knowledge and ecosystem is a well-known and well-working practice: Stanford

University alone had spawned such giants as Google, Cisco and HP. By the way, the indicators of "survival", investment accumulation and successful exit into a world of big business are relatively higher for startups based on universities / alumni and on technologies licensed by universities. In addition to high technology, startups from American HEIs include a number of influential biotechnology and gene therapy companies, such as Juno Therapeutics (Fred Hutchison Cancer Research Center, Sloan Kettering Memorial Center and Children's Research Institute of Seattle) (Nag,Turo, 2020).

And for KPI, examples of the success of the world's leading innovative universities have proved effective – the HEI not only earns money and independently finances innovation, it regularly holds the position of leader in higher education in the country. For example, in the ranking of the 100 best faculties from Forbes (2021), KPI is presented 16 times with 4 best results. In total, the ranking covers the faculties of 25 HEIs from eight Ukrainian cities and the competition for Kyiv Polytechnic is only Taras Shevchenko National University of Kyiv and Vasyl Karazin Kharkiv National University (Forbes, 2021). However, in terms of innovation indicators across all rating systems of domestic universities (including the top 200 Ukraine), KPI is significantly ahead of others.

In general, domestic higher education is rather slow in its innovative development, not only against the background of the United States and Europe, but also in comparison with other post-Soviet countries. The vast majority of domestic educational institutions, with some exceptions, have a business model which specificity stems from the Soviet past of the higher education system and traditionally the main source of income is the state budget, which they receive for the state order for training (Yashchuk, 2018).

According to the Budget Code, the general structure of finances of state-owned HEIs provides for two main revenue funds: general – revenues from the state budget and special – the whole set of revenues from other sources, for example: revenues from fees for services provided by budgetary institutions for the main (ordering educational services at the expense of legal entities and individuals) and additional business activities; property sale and lease income; charitable contributions, grants, other transferred funds; income from investment activities, revenues on depositing the funds in the banks; income from the scientific, research and development implementation; intellectual property rights sale (Table 1).

Table 1. Financial structure of some Ukrainian HEIs (excluding theones, based in capital), 2015-2017.

Year	General fund, UAH million			Special fund, UAH million		
	2015	2016	2017	2015	2016	2017
<i>Classic HEIs</i>						
Oles Honchar Dnipro National University	214,46	217,44	278,73	60,20	67,51	69,52
Kryvyi Rih National University	144,41	118,27	73,15	73,46	56,83	26,54
Sumy National University	144,60	167,20	233,08	167,51	208,86	242,3
Fedkovych Chernivtsi National University	132,66	140,80	198,65	97,18	242,40	144,38
<i>Technical HEIs</i>						
Vinnitsia National Technical University	81,29	88,47	81,19	37,02	34,12	32,07
Zaporizhzhia Polytechnic National University	102,23	15,56	201,92	61,38	67,22	74,30
The National Technical University "Kharkiv Polytechnic Institute"	266,27	265,32	284,61	111,88	111,67	128,49
Admiral Makarov National University of Shipbuilding	93,17	104,87	149,52	43,62	43,25	50,32
<i>Agricultural HEIs</i>						
Poltava State Agrarian Academy	37,42	42,14	46,60	31,88	34,12	35,21
Tavriya State Agrotechnological University	55,45	55,82	62,69	23,59	18,39	26,87
Kharkiv Petro Vasilenko National Technical University of Agriculture	55,85	62,46	68,12	29,79	27,64	34,39
Kherson State Agrarian University	31,51	32,67	42,05	12,64	13,10	14,61
<i>Pedagogical HEIs</i>						
Berdyansk State Pedagogical University	36,78	37,60	48,67	17,20	17,95	21,85
Ternopil Volodymyr Hnatiuk National Pedagogical University	73,00	74,89	77,93	30,62	33,53	38,24
Pavlo Tychyna Uman State Pedagogical University	61,91	66,16	61,58	32,91	33,50	44,49
H.S. Skovoroda Kharkiv National Pedagogical University	66,05	67,92	68,24	15,34	16,96	17,25

Source: based on (Yashchuk, 2018).

From the table we can conclude that the business model of most domestic HEIs is based on the provision of educational services through government procurement (Kvitka et al., 2019).

Thus, for all the HEIs represented, budget funding is the predominant source of income, with the exception of Sumy National University. For most educational institutions, the special fund income is in the range of 20-33%, with the exception of Sumy National University (50.97%), Fedkovich Chernivtsi National University (42.09%), Poltava State Agrarian Academy (43.04%) and Pavlo Tychyna Uman State Pedagogical University (41.94%).

At the same time, the lion's share of revenues to HEIs' special funds is not an income from research and innovation activities, but rather from operating activities, namely: the provision of educational services at the expense of individuals and legal entities. At the same time, the relatively low innovativeness of the studied HEIs does not eliminate the fact that their income anyway is generated by intellectual capital, although with rather low efficiency.

The specificity of the intellectual capital of HEIs leads to the formulation of a paradox: higher education is both the most and the least (at least domestic) intellectualized economic structure. HEIs are a source of knowledge, their staff, students and graduates are its carriers and, at the same time, domestic universities stagnate in their development, not using this knowledge as a value-generating income factor. If we change the perspective in analyzing the formation and implementation of universities' intellectual capital, putting it at the center of synergy, then its embodiments in the entire structure of the HEIs' economic activities become obvious, the motives and ways of its development seem logical, and its main feature becomes clear – a dual-natured direction in the formation and incarnation.

An analysis of possible directions for achieving the goals of the HEI in the implementation of its chosen business model, as well as the relationship of elements of intellectual capital, should be based on the proposed model (Fig. 2), which allows its management to ensure the synergistic effect of the totality of its components.

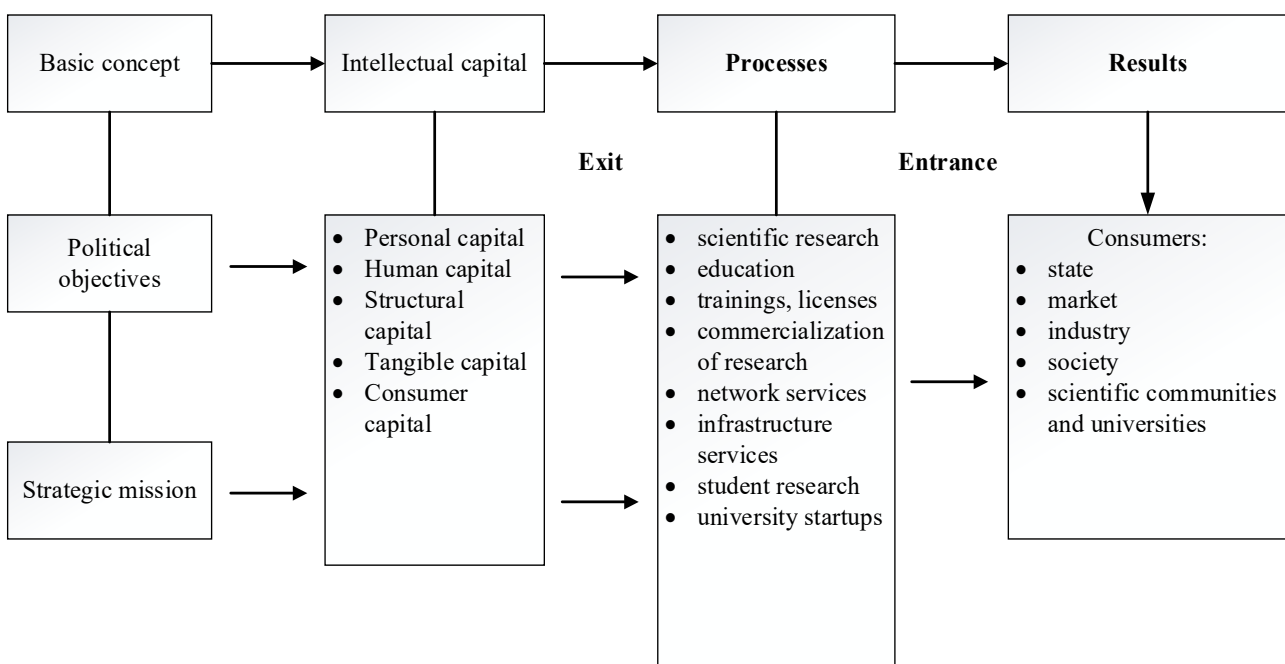


Figure 2. Intellectual capital model for HEIs.

Source: built by the authors.

The intellectual capital of HEIs is embodied in the form of income, economic and competitive advantages not only for universities, but also for the whole set of relevant economic agents:

I. HEIs. For universities, in addition to the basic resource of income from core operations and technology transfer and commercialization of research and development, intellectual capital also results in reputation, brand and popularity,

which in turn directly affect contract value and number of applicants (Table 2).

II. For scientific and pedagogical staff the main embodiment of integrated intellectual capital is their personal income in the form of wages (Table 3), royalties, fees for educational and methodological materials, publications, income from the licenses, technologies, inventions etc.

Table 2. Number of entrants and tuition fees, selected HEIs (2021).

Ukraine	USA
Leaders in the number of applications	
Taras Shevchenko National University of Kyiv, 53530	University of California, 111332
Ivan Franko National University of Lviv, 47301	Berkeley, 87398
National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", 46222	New York University, 79462
Lviv Polytechnic National University, 37331	Pennsylvania State University, 71903
V. N. Karazin Kharkiv National University, 32016	San Diego State University, 69842
Leaders in tuition fees (US dollars)	
IT STEP University, 2627	Yale University (Connecticut), 71290
National Academy of State Administration, 1854	Harvard University (Massachusetts), 69600
Ukrainian Catholic University, 1826	Stanford University (California), 69109
Taras Shevchenko National University of Kyiv, 44200	Massachusetts Institute of Technology (Massachusetts), 67430
Dnipro State Medical University, 1557	Princeton University (New Jersey), 66150

Source: based on Statista (2021); Infourcesource (2021); Abiturientsinfo (2021).

Table 3. Salaries of university professors*, selected countries of the world, euro/year, 2021.

Country	Average	Top universities
Ukraine ***	3180-10764	Taras Shevchenko National University of Kyiv, 26873**
USA	59171-87553	Princeton University, 159449
Germany	49548- 57373	Ludwig-Maximilians-Universität München, 137000
Great Britain	50772- 96063	Oxford University, 132631
Sweden	42996-70836	University of Gothenburg, 90677
Switzerland	116701- 256565	IMD Business School, 245040
France	25225-73343	ESCP Europe, 125000
Denmark	61872-93972	Copenhagen university, 121429
Belgium ****	29914-84260	KU Leuven, 115000
Canada	60755-106295	University of Waterloo, 116600

Note: * for the positions of associate professor and professor; ** for the position of head department taking into account the special fund; *** in Ukraine salaries of teaching staff are calculated according to a single tariff grid; **** in Belgium salaries are calculated according to the state scale

Source: based on Academic Positions (2021); Glassdoor (2021); Taras Shevchenko National University of Kyiv (2021); Cabinet of Ministers of Ukraine (2021).

In addition, the bilateral influence of the HEIs and teaching staff intellectual capital is manifested in the involvement of both in international programs and projects, increasing the income of the former and the mobility of the latter. The reputation of scientists increases the reputation of universities, they bring funds for the HEIs' development and form an employer brand. At the same time, the prestige of the HEI enhances the prestige of its staff, opening the way for them to the great scientific world, contributing to the possibility of forming a personal brand – the name of a famous scientist.

In addition, HEIs create specific scientific communities and provide scientists with the opportunity to use their own infrastructure and accumulated knowledge.

III. For students, the main manifestations of the bidirectional development of intellectual capital, their personal and university's, are the

quality and breadth of knowledge, diploma rating among employers (Table 4) and the corresponding chances for employment, as well as the effect in the form of additional income from higher education. Important for the development of personality and consciousness are the connections and relationships of the student and scientific community, which are formed in the university environment by their participation in HEI's innovative activities, including: startup projects, research and development, experimental design activities etc. The brand of the HEI and its reputation extends to students and quite a number of employers have certain preferences among graduates of selected universities and even compete with each other for a high-quality future workforce, concluding agreements with universities, participating in job fairs, inviting students to internships, organizing student work competitions, trainings, hackathons, etc.

Table 4. Consolidated ratings of selected HEIs according to employers (top 10), 2021.

Ukraine	USA	Europe
Taras Shevchenko National University of Kyiv	California Institute of Technology	University of Cambridge, United Kingdom
National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"	Massachusetts Institute of Technology	Technische Universität München, Germany
National University of Kyiv-Mohyla Academy	Harvard University	University of Oxford, United Kingdom
Ivan Franko National University of Lviv	Stanford University	Eidgenössische Technische Hochschule Zürich, Switzerland
Kyiv National Economic University	Yale University	École polytechnique fédérale de Lausanne, Switzerland
Yaroslav Mudryi National Law University	New York University	Hautes Études Commerciales de Paris, France
National Aviation University	Princeton University	Instituto de Empresa, Spain
Lviv Polytechnic National University	Columbia University	Ludwig-Maximilians-Universität München, Germany
The National Technical University "Kharkiv Polytechnic Institute"	Johns Hopkins University	Imperial College London, United Kingdom
V. N. Karazin Kharkiv National University	University of California, Berkeley	École Polytechnique, France

Source: based on National Aviation University (2021); IDP Education (2021); Times Higher Education (2021).

In the countries under consideration, the development of HEIs' intellectual capital is based on a synergy of higher education and business with the support and assistance of the state. The basis of innovativeness for HEIs is, first of all, their own needs and motives for the development and intellectual

transformation of the material, technical and scientific base. These needs push them to find partners and investors, mediating an effective business model of HEIs. However, the synergistic development of science and business is not possible without a rational public policy.

4. Conclusions.

HEIs as economic agents are the most specific in terms of the formation and implementation of an intellectual capital: in addition to directly creating aggregate product and jobs, these agents have the greatest economic impact on the region of their residence – in particular, British and American HEIs create innovative ecosystems around them.

Basic fundamental research, according to some estimates, despite the long period from initiation to implementation, gives an average annual rate of return on investment ranging from 28% to 50%. Revenues of HEIs are formed mainly from public funding, in particular: ordering research and educational services, private funding in the same areas, as well as participation of HEIs and their research and teaching staff in research projects, licenses and technologies, technology parks, etc. The vast majority of the university's income is the embodiment of its intellectual capital, the latter is also the cornerstone of the HEI's competitive advantages. In contrast to leading European and American HEIs, the vast majority of domestic educational institutions, with some exceptions, have a business model whose

specificity stems from the Soviet past higher education system and traditionally their main source of income is the state budget and the income of the special fund is within 20-33% of the total. The lion's share of the special fund for most HEIs is also formed from the main operational activities for the provision of educational services. In general, the business model of business entities is defined as inefficient. At the same time, the comparatively low innovativeness of the studied HEIs does not eliminate the fact that income for them is created by an intellectual capital, although with a rather insignificant efficiency.

The study presents the main sources of innovative advantage, and also describes how the intellectual capital of the university is related to its market value. Collaboration between HEIs and industry offers researchers the opportunity to increase the value of their intellectual capital through monetary or contextual support for research, which contributes to their greater scientific productivity. As for students, this allows them, in particular, to gain practice, learn to apply theoretical knowledge in practice and respond to business needs.

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