Identifying the Gaps in the Preparing of a Business Analyst between the Requirements of the Labor Market and the Standards of Study Programs: Case of Ukraine

Vitaliy Kobets[1][0000-0002-4386-4103], Valeria Yatsenko[2][0000-0002-2925-7470], and Lesia Buiak[3][0000-0002-7115-6497]

[1] Kherson State University, 27, Universitetska st. Kherson, 73000, Ukraine
vkobets@kse.org.ua
[2] Taras Shevchenko National University of Kyiv, 90-A, Vasulkivska st., Kiev, 03022 Ukraine
ValeriaYatsenko5@gmail.com
[3] Ternopil National Economic University, 11 Lvivska st., Ternopil, 46001 Ukraine
lesyabuyak@ukr.net

Abstract. Efficient human resource management needs accurate assessment and representation of available competences as well as effective mapping of required competences for specific jobs and positions. Thus, definition and identification of competence gaps express differences between acquired and required competences using a mathematical approach to support accurate competence analytics. Lack of skills and insufficient qualifications of employees are cited as major barriers to the adoption of new technologies in the context of Industry 4.0. These changes require skills for data analytics tasks. The purpose of this paper is to investigate gaps in the preparing of a business analyst between the requirements of the labor market and the standards of study programs. For the IT and other industries, the most important competencies from study program of Ukrainian High Educational Institutes, which correspond to labor market requirements, were revealed using RStudio.

Keywords. IT Education, Business Analyst, Generic Competencies, Subject Specific Competencies, Study Programs.

1 Introduction

The European Higher Education Area promotes the design of curricula focused on the acquisition of competences. Efficient human resource management needs accurate assessment and representation of available competences as well as effective mapping of required competences for specific jobs and positions. Thus, definition and identification of competence gaps express differences between acquired and required competences using a mathematical approach to support accurate competence analytics. Lack of skills and insufficient qualifications of employees are cited as major barriers to the adoption of new technologies in the context of Industry 4.0. These changes require skills for data analytics tasks. Business analytics (BA) becomes increasingly important under rapidly changing business environment. It requires conceptual model for the professional profile of a Data

Scientist in the field of Information and Communications Technology (ICT), namely in the European e-Competence (e-CF) framework and the Skills Framework for the Information Age (SFIA) are related with ICT competences/skills, including programming, machine learning and databases. The Data Scientist professional profile combining contributes from different areas, such as computer science, statistics and mathematics. To analyze impact of competences on employment we subcategorized competencies into generic and specific subject competencies for different job types.

The results show that data management capability fully mediates between IT competence and BA use. The paper analyses how individual job competences requirements impact on wage changes.

The purpose of this paper is to investigate gaps in the preparing of a business analyst between the requirements of the labor market and the standards of study programs.

The remainder of our paper is organized as follows: in section 2 we analyze Ukrainian IT market and the imbalance of quality in the IT labor market in Ukraine. In section 3, we present and discuss experimental model where we investigates specific subject competences from high education institutes of Ukraine which significantly impact on average wage of a business analyst. Finally, last section concludes.

2 Related works

2.1. Ukrainian IT market

Ukrainian IT market is actively growing and developing over the past few years. It has reached the point of 3.473 USD billion, which is 3.9% of GDP and 22% of service export in 2018. According to IT Ukraine Association estimation, export of IT services grew by 30.2% in 2019 and tot up 4.17 USD billion, and got the better of the traditional product for Ukrainian export – wheat, becoming second export industry [1] and the largest exporter of IT services in Europe [2] (fig. 1). Moreover, according to UNIT.City forecast, Ukrainian exports of IT services will be $5.4 billion in 2020 and $8.4 billion in 2025 [2].

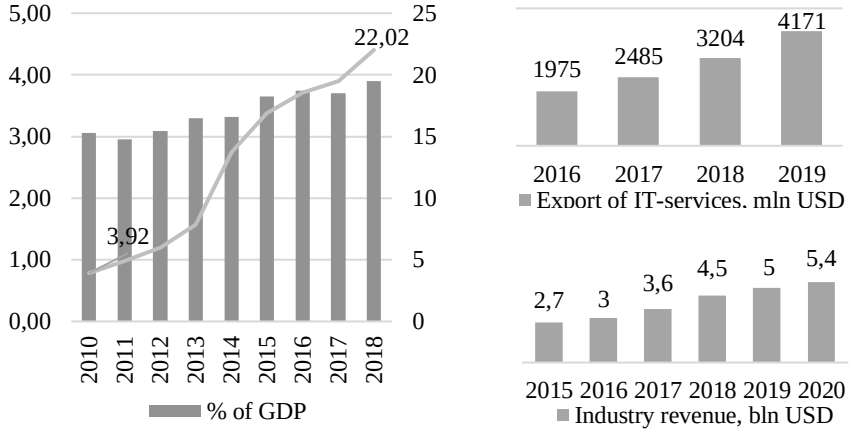

Fig. 1. Dynamics of IT sector development in Ukraine [1,4,5]

According to IT Outsoursing News, Ukraine became the first country in Europe within IT outsourcing and software development in 2016 [5] and is still the first outsourcing market in Eastern Europe [6] (fig. 2). In 2017-2018 Ukrainian and with Ukrainian roots companies and startups made 44 deals for a total of $265 million, namely Gitlab ($130 million), Grammarly and BitFury ($110 million everyone). Unit.City also ranked the most promising Ukrainian startups, such as People.ai, monobank, Allset, Solar Gaps and Kwambio [2].

Fig. 2. Rating position of Ukraine at global IT market [2; 6; 7]

Ukrainian outsourcers cooperate mainly with parties from the USA (fig. 3), including worldwide-known companies, such as Cisco, IBM, Atlassian, Travelport, OpenText, Fluke Corporation, etc [7]. However, operations with European businesses, mainly from the UK and Germany, have grown significantly over the years as well [8].

The key areas of domestic IT specialization are: data management, telecommunications, cloud, gaming, e-commerce, media, fintech, healthcare, and others (fig. 4) [9; 10].

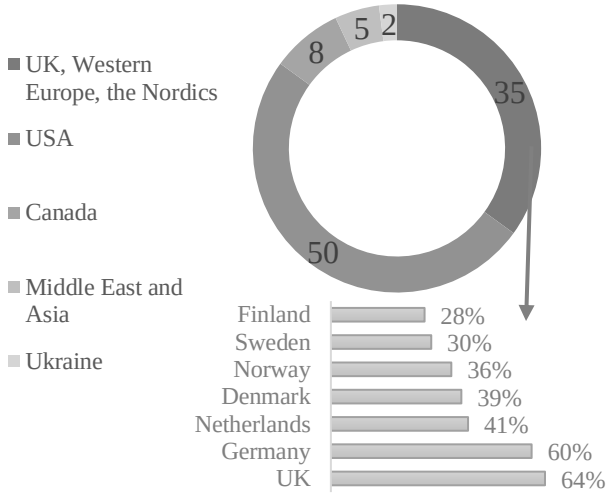

Fig. 3. Geographical structure of IT services export, % [9; 10]

Key factors of the rapid growth of Ukrainian IT sector in the recent years include [12]: stable tax policy; the refusal of regulatory barriers; Ukrainian brand promotion at the international market; and the most important, talent pool and advanced IT education, which, however, is on the verge of a structural crisis. For instance, World Economic Forum named Ukraine among the top 10 countries globally by the number of engineering, manufacturing, and construction graduates [6].

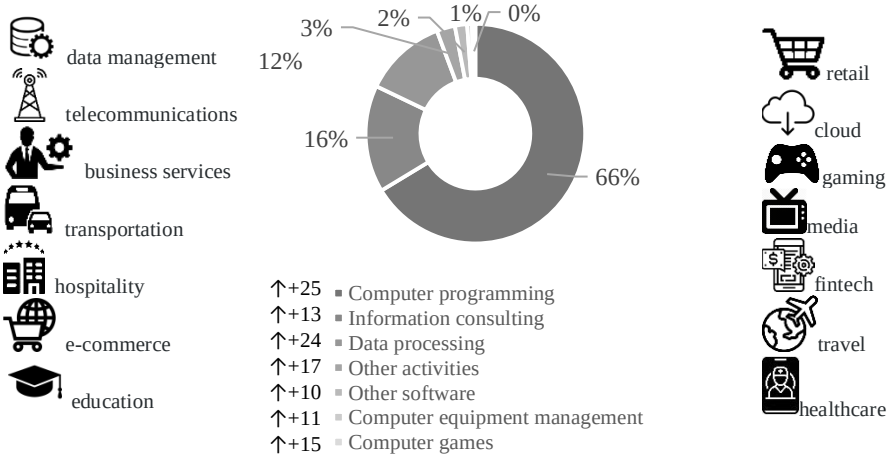

Fig. 4. Structure of services of the domestic IT sector [11]

Highly developed education and the increase of demand for IT services have led to the rapid growth of specialists in this field in the domestic market (fig. 5). According to the Ukrainian IT-company N-iX, in 2018 this number has already reached 184-185 thousand people, and according to estimates will reach 200 and 220 thousand people in 2019 and 2020, respectively [6; 7].

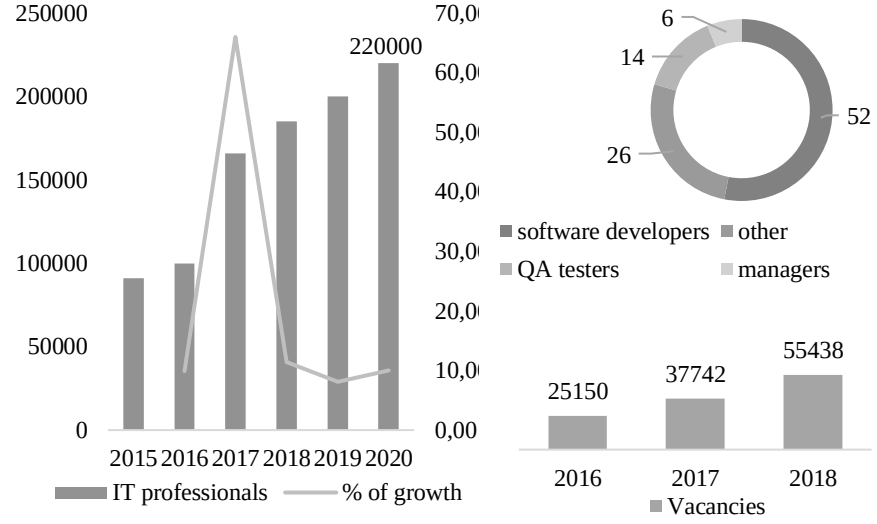

Fig. 5. The IT labor market in Ukraine [7]

However, despite the supply steadily climbs, it can not meet the demand for IT professionals and it has created a quantitative imbalance in the labor market - 23,000 annual graduates from IT majors at more than 150 universities, unable to meet existing demand in more than 55 thousand job places [13].

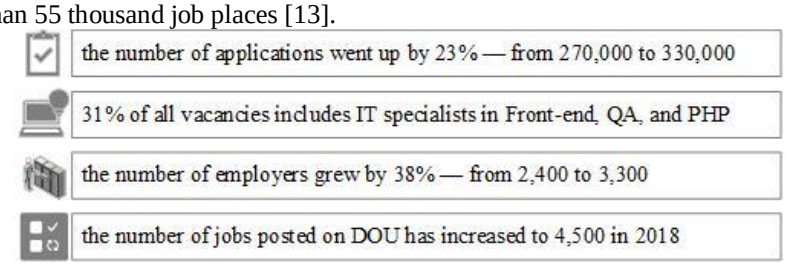

Fig. 6. Key parameters of the Ukrainian labor market within IT industry in 2018 [7]

Moreover, the qualifications of current employees do not meet the requirements of the modern labor market. It makes IT companies spend resources on additional training and retraining of their staff. The reason for the quality imbalance is the gap between educational components of educational programs and real requirements of employers to the professional competencies of students and graduates, which are verified during their first job interview.

2.2. The imbalance of quality in the IT labor market in Ukraine

Based on a survey of 8,638 questionnaires of IT sector workers, a portrait of a modern Ukrainian IT specialist was drawn up. Thus, 87% of women and 82% of men working in this field, have higher education. It is interesting to note that 58% of women and 64% of men, who hold technical positions, have higher field-specific education [14]. Moreover, IT majors are also popular among second higher education students. "Information Systems" is becoming more and more popular in recent years [15].

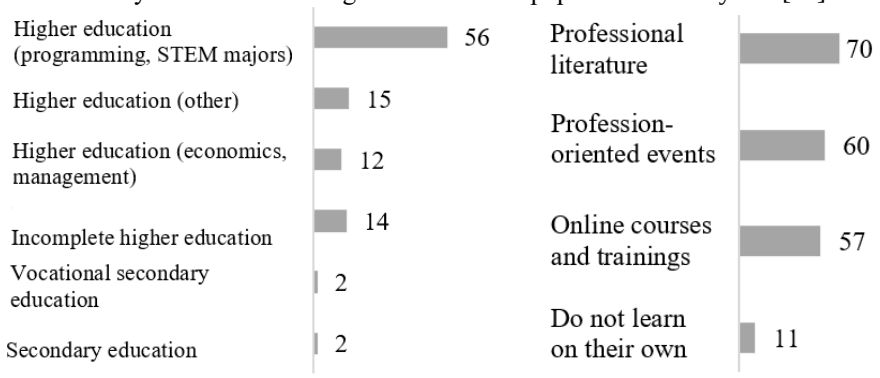

Fig. 7. Types of formal and non-formal education of IT specialists, % [14]

However, the interest in higher education within technical majors (especially at the second level degree) gradually declines. The reasons are: the irrelevance of some

educational components and neglecting of the diploma importance in the real labor market. Consequently, formal education hands to work experience and non-formal /informal education guaranteeing certificates, which are usually more significant for employers to compare with a prestigious university diploma. In long term orientation, this tendency hides the risk to tear down fundamental basics of training of specialists within technical majors at classical universities, in favor of professional or informal trainings. As a result, universities can transform into a networking platform rather than being an educational providers. For instance, a common report of the Western NIS Enterprise Fund and UNIT.City on the topic of IT ecosystem in Ukraine profiles 7 leading universities within technical majors and 18 IT courses and schools. Moreover, the general number of students in IT courses and schools is 46.5 times bigger than at universities.

In 2018, 10% of employed and hired people in the Ukrainian IT sphere did not have a university diploma [16]. According to HeadHunter, around 56% and ITUkraine Association - 36% of domestic IT professionals do not have university diploma and this indicator is gradually increasing both in Ukraine and all over the world [17]. Apple CEO Tim Cook has officially stated that half of the 2018 hires do not have a college degree because most colleges do not teach their students skills which are required by large corporations [17]. In spite of old mathematical and IT schools, historically formed in Ukraine, modern systems of secondary and higher education in Ukraine are focused more on the acquisition and reproduction of fundamental knowledge, rather than skills and competencies: professional (ability to solve case studies), as well as soft skills (communication, presentation, organizational, teamwork), which are priorities for employers when being hired. Consequently, the government spends resources irrationally to teach future specialists, while business has been preparing their corporate roster for 3-6 months before hiring (table 1).

Table 1. Institutional support for IT education in Ukraine [13]

	Formal education			Nonformal education				
#	Institutions	Students	#	Institutions	Students	#	Institutions	Students
1	Kharkiv National University of Radio Electronics	2,968	1	Blockchain-Hub Academy	30	10	Main Academy	6,000
2	Lviv Polytechnic National University	2,675	2	BrainBasket Foundation	6,000	11	Projector	1,500
3	National Technical University of Ukraine “Ihor Sikorsky Kyiv Polytechnic Institute”	4,314	3	CyberBionic Systematics	3,000	12	Prometheus	700,000
			4	GoIT	2,000	13	QALight	8,000
4	National Technical University “Kharkiv Polytechnic Institute”	2,105	5	“STEP” computer academy	95,000	14	Sigma Software University	600
5	National University “Kyiv-Mohyla Academy”	3,500	6	UNIT Factory	900	15	Ukrainian IT School	1,600
6	Taras Shevchenko National University in Kyiv	1,324	7	ITEA	11,000	16	SkillUP	18,850
			8	uData Schoo	90	17	iTalent	6,000
7	Zhukovsky National Aerospace University “Kharkiv Aviation Institute”	1,692	9	LITS (Lviv IT School)	2,000	18	SoftServe IT Academy	1,600
	SUM	*18,578*		*SUM*				*864,170*

Thus, in order to meet the current challenges of the labor market, IT representatives are

forced to actively engage in self-education mostly aimed at learning foreign languages (often English) and developing soft skills through psychological and management trainings (most often in time management, team-building, leadership, project management, promotion, marketing) rarely in hard skills (different programming languages) [15.]. Sufficient system of motivation for the IT work based on an assessment of their competence level should be a tool for solving the problems of IT education development [18].

In 2015, the reform of higher education in Ukraine began. It was aimed at acquisition competencies - Generic Competencies, closely connected with soft skills, and Subject Specific Competencies.

To investigate the gap between the quality of higher education and the requirements of employers, we have selected a job position "Business Analyst". Both IT specialists and economists with analytical thinking and basic knowledge of programming can apply for this position (fig. 8). As a consequence, graduates of three majors are able to work as business analysts: systems analysis (124), economics (051, specialization: economic cybernetics) and information systems and technologies (126).

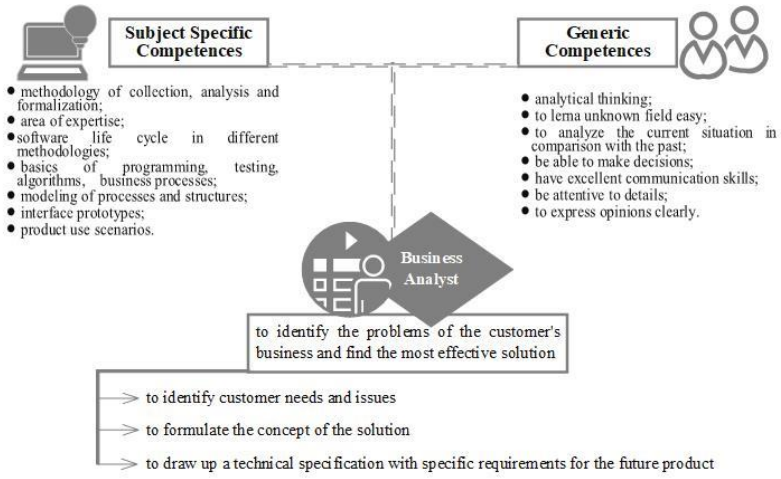

Fig. 8. Basic characteristics of a business analyst

3. Experimental Model

Higher education institutions in business analysts training should develop an educational program and frame educational process to form generic (GC) and subject specific Competencies (SC) of graduates in a line with standards of the Ministry of Education and Science of Ukraine in System Analysis (124), Economics (051, economic cybernetics), Information Systems and Technologies (126) [19].

We have carried out a comparative analysis of generic and subject specific competencies according to the Ministry of Education and Science of Ukraine for majors 051, 124, 126 essentials to become a business analyst. As a result, we obtained 18 common generic (Table 2) and 22 common subject specific competencies (Table 3).

Table 2. Generic Competencies of Business Analyst by higher education institutions

№	Generic competencies for Business Analyst
1	Ability to be critical and self-critical
2	Ability to learn and become proficient in modern knowledge
3	Ability to generate new ideas (creativity)
4	Ability to act socially responsible and consciously
5	Ability to abstract thinking, analysis and design
6	Ability to adapt and act in a new situation
7	Ability to search, process and analyze information from various sources
8	Ability to apply knowledge in practical situations
9	Ability to evaluate and ensure the quality of work performed
10	Ability to plan and manage time
11	Ability to work independently
12	Ability to work in a team
13	Ability to make informed decisions
14	Ability to develop and manage projects
15	Ability to communicate in the official language orally and in writing
16	Ability to communicate in a foreign language and work in an international context
17	Information and communication technology skills
18	Interpersonal skills

Table 3. Subject specific competencies of Business Analyst by higher education institutions

№	Subject specific competencies of a Business Analyst
1	Ability to identify knowledge and understand the problems of the subject area, the basics of the modern economy at the micro, meso, macro and international levels.
2	Ability to explain economic and social processes and phenomena through theoretical models, to analyze and interpret the results.
3	Ability to formalize problems described in natural language, through mathematical methods as well, to apply common approaches to mathematical modeling of specific processes.
4	Ability to build correct models of static and dynamic processes, and systems with distributed and lumped parameters, taking into account the uncertainty of external and internal factors.
5	Ability to use modern information technology to implement machine-assisted realization of mathematical models and predict behavior of specific systems, namely: object-oriented approach in the design of complex systems of different types, applied mathematical packages, use of databases and knowledge.
6	Ability to identify the main impact factors of the development of physical, economic, social processes, pick out stochastic and indeterminate indicators, formulate them in random or fuzzy quantities, vectors, processes and to study the dependencies between them.
7	Ability to analyze and design complex systems, crate relevant information technologies and software.
8	Ability to design experimental and observational studies and analyze the results.
9	Ability to analyze, synthesize and optimize information systems and technologies using mathematical models and methods.
10	The ability to perform simulation experiments, to compare the results of experimental data and the solutions obtained.
11	Ability to use computer technology and data processing software to solve economic problems, analyze information, and prepare analytical reports.
12	Ability to analyze and solve problems in the field of economic and social-labor relations.
13	Ability to predict socio-economic processes based on standard theoretical and

	econometric models.
14	Ability to use modern sources of economic, social, management, accounting information to prepare official documents and analytical reports.
15	Ability to conduct economic analysis of the operation and development of business entities, assess their competitiveness.
16	Ability to identify economic problems in the analysis of specific situations, to offer ways to solve them independently.
17	Ability to formulate optimization problems in the design of systems of management and decision making, namely: mathematical models, optimality criteria, constraints, management goals, choose rational methods and algorithms for solving optimization and optimal management.
18	Ability to apply information technologies to create, implement and utilize quality management system and estimate the costs of its development and maintenance.
19	The ability to manage the quality of products and services of information systems and technologies throughout their life cycle.
20	Ability to develop business decisions and evaluate new technology offers.
21	Ability to manage and use modern information and communication systems and technologies (including Internet based).
22	Ability to create new competitive ideas and implement them in projects (startups).

We have analyzed the general requirements of employers for the competencies of applicants for the position of the business analyst on the sites for job search: work.ua, rabota.ua, djinni.co, linkedin.com, hh.ua, it-stars.ua, jobs.ua. Then, we have compared them with standards of the Ministry of Education and Science of Ukraine (tables 2 and 3). As a result, we identified generic (table 4) and subject specific (table 5) competencies common both for the labor market and higher education institutions.

Table 4. Common generic competencies of a Business Analyst for higher education institutions and labor market

GC	GC by higher education institutions	GC by labor market
GC1	Ability to learn and become proficient in modern knowledge	Desire to learn
GC2	Ability to generate new ideas (creativity)	Creativity
GC3	The ability to act socially responsible and consciously	Responsibility
GC4	Ability to abstract thinking, analysis and design	Analytical and logical thinking, systems thinking
GC5	Ability to search, process and analyze information from various sources	Attention to Detail
GC6	Ability to apply knowledge in practical situations	Problem Solving
GC7	Ability to plan and manage time	Time Management
GC8	Ability to work in a team	Teamwork
GC9	Ability to develop and manage projects	Organizational skills
GC10	Ability to communicate in a foreign language and work in an international context	English skills
GC11	Information and communication technology skills	Presentation Skills
GC12	Interpersonal skills	Communication
GC13	NA*	Self-motivation

*NA – not announced

Table 5. Common subject specific competencies of a Business Analyst for higher education institutions and labor market

SC	SC by higher education institutions	SC by labor market
SC1	Ability to explain economic and social processes and phenomena through theoretical models, to analyze and interpret the results.	Development of use-cases and user-stories
SC2	Ability to formalize problems described in natural language, through mathematical methods as well, to apply common approaches to mathematical modeling of specific processes.	Requirements collection, negotiations with stakeholders, UML/BPMN
SC3	Ability to use modern information technology to implement machine-assisted realization of mathematical models and predict behavior of specific systems, namely: object-oriented approach in the design of complex systems of different types, applied mathematical packages, use of databases and knowledge.	Hands-on experience with data visualization via reports and dashboards, Flow charts, Lucidchart MS Access, MS SQL Server, Oracle
SC4	Ability to analyze and design complex systems, crate relevant information technologies and software.	Experience in the development of technical documentation, requirements, software development processes (UML, Use Cases, Business Rules, Functional Non-Functional Specifications, User Interface Design Specifications, User Stories, Backlogs)
SC5	Ability to analyze, synthesize and optimize information systems and technologies using mathematical models and methods.	Information systems
SC6	The ability to perform simulation experiments, to compare the results of experimental data and the solutions obtained.	Data analysis, Database Management System, DBMS
SC7	Ability to use computer technology and data processing software to solve economic problems, analyze information, and prepare analytical reports.	BA technics (interview, workshop, document analysis, estimation, mind mapping, etc)
SC8	Ability to use modern sources of economic, social, management, accounting information to prepare official documents and analytical reports.	Management accounting, corporate finance and financial statements / 1C
SC9	Ability to formulate optimization problems in the design of systems of management and decision making, namely: mathematical models, optimality criteria, constraints, management goals, choose rational methods and algorithms for solving optimization and optimal management.	Algorithms, data structures, client-server application architecture, web application architecture, service-oriented architecture (SOA)
SC10	Ability to apply information technologies to create, implement and utilize quality management system and estimate the costs of its development and maintenance.	CRM
SC11	The ability to manage the quality of products and services of information systems and technologies throughout their life cycle.	Project management, Software Development, Software Development Life Cycle and MVP
SC12	Ability to develop business decisions and evaluate new technology offers.	Business processes modeling, MS Visio
SC13	Ability to manage and use modern information and communication systems and technologies (including Internet based).	MS Access, MS Excel, MS Power Point
SC14	Ability to create new competitive ideas and implement them in projects (startups).	JIRA Confluence, MS Project
SC15	NA*	Understanding of agile development processes (e.g. Scrum, SDLC, Kanban)

*NA – not announced

Based on open Internet sources of websites for job search, a data set of 118 vacancies for the position of the business analyst was created. This data set includes the

name of the employer, vacant position the average salary and required generic and subject specific competencies (Table 6).

Table 6. Vacant position profile of business analyst competencies on the labor market

№	Employer	Position	Wage, $	GC1	…	GC13	SC1	…	SC15
1	IT Specialist, Ltd	System analyst	35000	0	…	0	0	…	0
2	INNOWARE	Junior Business Analyst	35000	0	…	1	0	…	0
3	Proxima International	Business Analyst	50225	0	…	0	0	…	0
4	Betinvest Ltd	Business Analyst	18000	0	…	0	0	…	1
5	Linkos Group	System analyst	18000	0	…	0	0	…	0
6	Deep Consulting Solutions	Business Analyst	36000	1	…	1	0	…	0
7	PMLAB	Data/Business Analyst	44000	0	…	0	0	…	0
8	Paymentwall	Business Intelligence Analyst	35000	0	…	0	0	…	0
9	EPAM / Epam Systems	Senior Business Analyst	31000	1	…	0	0	…	0
…	…	…	…	…	…	…	…	…	…
118	Lifecell	System analyst	30000	0	…	0	0	…	0

All vacancies can be classified by following industries: IT consulting (48), Banks (23), Retail (12), Government Institution (6), Others (29) (include mobile operators, agriculture, oil, etc.).

To determine the relevance of the impact of generic and specific subject competencies on the average wage, we consider a multiple regression model:

$$w_i = b_0 + \sum_{j=1}^{13} GC_j + \sum_{k=1}^{15} SC_k + u_i \quad (1)$$

where w_i – average wage for a job i, GC_j – generic competence j, SC_k – specific subject competence k, u_i – error term.

```
f <- read.csv("HEI and LM.txt", sep="\t", header=TRUE, dec=".")
model1 <- lm(data=f, Wage~.)
summary(model_1)
f2<- read.csv("IT consulting.txt", sep="\t", header=TRUE, dec=".")
model2 <- lm(data=f2, Wage~.)
summary(model2)
```

It has been obtained that by sampling of all positions of business analysts:

1) use of information and communication technologies or Presentation Skills (GC11) can increase the average monthly wage by +$9361.9;

2) the ability to apply knowledge in practical situations or Problem Solving (SC6)

causes an average wage increasing on $10009.

Table 7. Statistically significant Competencies for the labor market

Model	Explanatory Competencies	Marginal effect of parameters ($)	R^2 (%)
All	GC11 SC6	+9361.9 +10009	22,56
IT consulting	SC8 SC14	+23376 -9062	23,83
Banks	NA	NA	NA
Retail	NA	NA	NA
Others	SC13 SC14	+29896 +36683	87,3

Among BA job applicants with GC11 competence, only 10% have SC6 specific subject competence simultaneously, and vice versa: if a candidate has SC6 competence, only every tenth has GC11 competence (fig. 9):

```
mosaic(data=f, ~GC11+SC6, shade=TRUE)
```

For the IT industry, the most important competencies were revealed as follow:

1) SC8 Management Accounting, Corporate Finance and Financial Statements / 1C determined an average monthly wage increase of +$23376;

2) SC14 The ability to form new competitive ideas and implement them in projects (start-ups) for graduates does not meet the requirements of the IT industry (JIRA Confluence, MS Project), and therefore leads to a decrease in salary by $9062, which confirms the lack of competence in the HEA.

Among BA job applicants with SC8 competence, only 20% have SC14 specific subject competence at the same time. If the applicant has SC14 competence, only 10% have SC8 competence. Among BA job applicants with GC11 competence, only 10% have SC6 specific subject competence, and vice versa: if a candidate has SC6 competence, only every tenth has GC11 competence (fig. 10):

```
mosaic(data=f2, ~SC8+SC14, shade=TRUE)
```

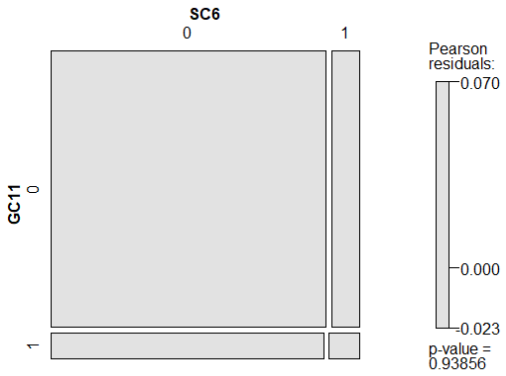

Fig. 9. Relationship between GC11 and SC6 competencies

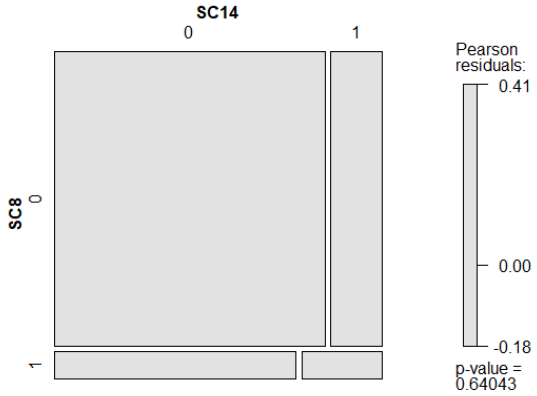

Fig. 10. Relationship between SC8 and SC14 competencies

As well as if the applicant has SC8 competency for the BA vacancy, his/her average wage remains lower than in the case of other competencies required:

```
g2 + facet_grid(SC8~SC14)
```
(fig. 11)

```
gg0 + stat_smooth(method="lm") + facet_grid(~SC14)
```
(fig. 12)

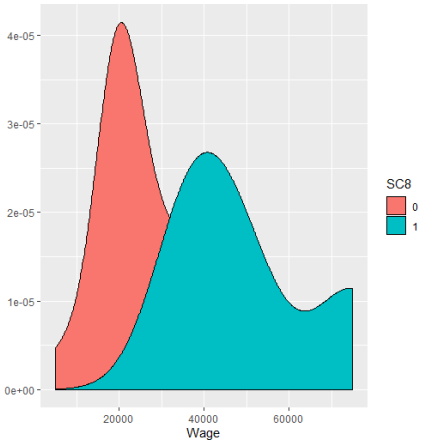

Fig. 11. Wage distribution for SC8 competence

SC8's competence slightly increases the average wage, while in its absence the wage increases much faster. Therefore, the skills of an accountant in the labor market are worth much less than the skills of a business analyst (fig. 12).

For other positions not covered by IT consulting, Banks Government Institutions, the most required competencies were revealed:

1) SC13 Ability to manage and use state-of-the-art information and communication systems and technologies (including Internet-based ones, MS Access, MS Excel, MS Power Point) adds +$29996 each month;

2) SC14 The ability to form new competitive ideas and implement them in projects (startups), JIRA Confluence, MS Project proves that this competence is formed for

other industries and raises wages by an average of $36683.

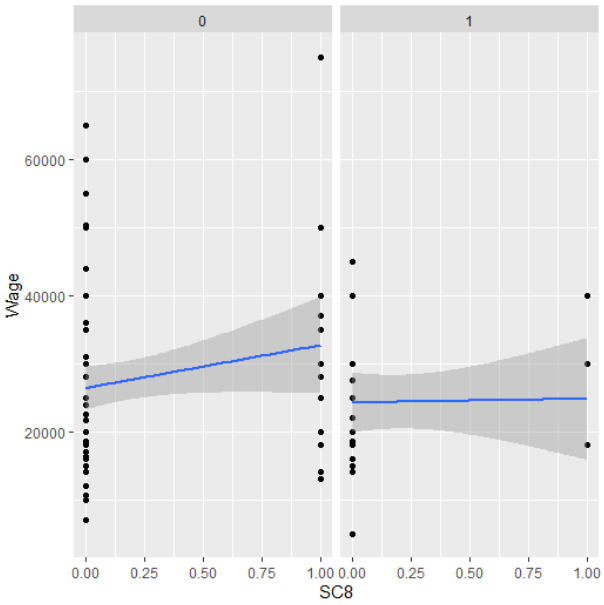

Fig. 12. Wage dynamics in the absence and availability of SC8 competence

Thus, the wage distribution is set out as follows (fig. 13), where the average wage per year is $ 20,000 and has a significant potential to increase when additional required specific subject competencies in the labor market are presented.

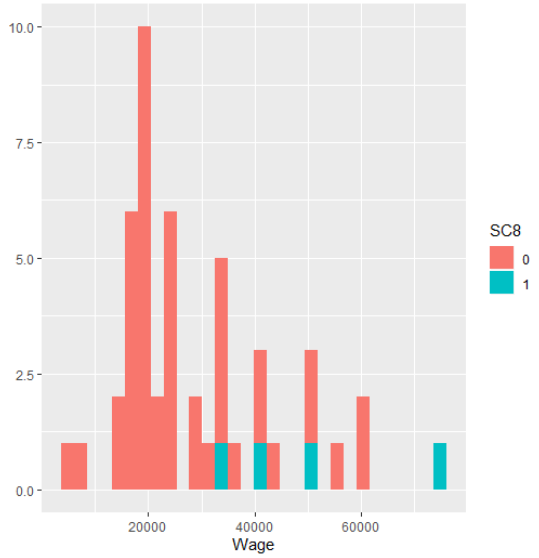

Fig. 13. Wage distribution for BA position

A system of certificates can be an effective tool to overcome a gap between educational programs [20-23] and employers' requirements [24-25]. This system should be developed jointly by university representatives and companies and will certify the students' competence in certain highly specialized fields of knowledge and confirm the quality of the education obtained through professional qualifications (fig. 14).

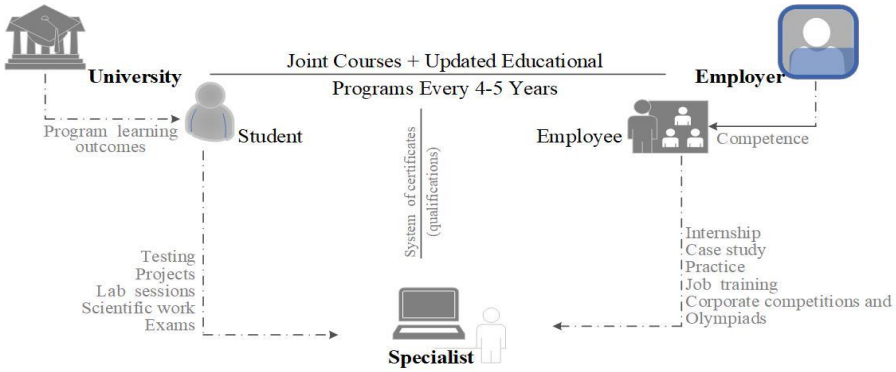

Fig. 14. Scientific-educational-practical complex of students teaching at IT majors

4. Conclusions

To cope with the gap in the quality of higher education and the real labor market requirements, the system of higher education should be reformed. Moreover, all stakeholders should involve this process, which can be guided by the successful practice of European countries and focusing on the development of soft skills. However, it is important to note that soft skills, despite their general nature, depending on the major, should be adapted for IT professionals.

For the IT industry, the most important competencies were revealed as follow: Management Accounting, Corporate Finance and Financial Statements determined an average monthly wage increase of +$23376; the ability to form new competitive ideas and implement them in projects (start-ups) for graduates does not meet the requirements of the IT industry (JIRA Confluence, MS Project), and therefore leads to a decrease in salary by $9062, which confirms the lack of competence in the HEA.

For other positions not covered by IT consulting, Banks Government Institutions, the most required competencies were revealed: the ability to manage and use state-of-the-art information and communication systems and technologies (including Internet-based ones, MS Access, MS Excel, MS Power Point) adds +$29996 each month; the ability to form new competitive ideas and implement them in projects (startups), JIRA Confluence, MS Project prove that this competence is formed for other industries and raises wages by an average of $36683.

References

1. Export of Ukrainian IT increased by 30% in 2019. Available at https://itukraine.org.ua/eksport-ukrainskogo-it-za-2019-rik-zris-na-30.html
2. UNIT.City presented a report on the IT sector of Ukraine: main figures and indicators. Available at https://ain.ua/en/2019/01/30/unit-city-report-on-the-it-sector-of-ukraine/
3. Government statistics in Ukraine. Available at http://www.ukrstat.gov.ua/
4. List of services exported by Ukraine. Available at https://www.trademap.org/Service_SelCountry_TS.aspx?nvpm=1%7c804%7c%7c%7c%7c%7c%7cS00%7c1%7c3%7c1%7c2%7c2%7c1%7c5%7c1%7c1
5. Ukraine is the first in Europe in the field of IT outsourcing. Available at https://www.epravda.com.ua/news/2016/03/21/586212/
6. 12 Reasons to Hire Ukrainian Developers for IT Outsourcing. Available at https://www.daxx.com/blog/outsourcing-ukraine/why-ukraine-best-it-outsourcing-destination
7. Ukrainian IT Industry 2019-2020: $5 billion and 200,000 specialists. Available at https://ain.ua/en/2019/08/30/ukrainian-it-industry-2019-2020/
8. IT market report: The Country That Codes. Available at https://nucc.no/software-development-in-ukraine-2019-2020-it-market-report/
9. Ukraine the Country that Codes IT Industry in Ukraine. 2019 Market Report. Available at https://eufordigital.eu/wp-content/uploads/2019/10/Ukr-report-29.pdf
10. IT Cluster. IT Research. Available at https://itcluster.lviv.ua/en/projects/it-research/
11. How many IT specialists in Ukraine. Available at https://dou.ua/lenta/articles/how-many-devs-in-ukraine-2018/
12. Infographics. Ukrainian IT Industry: General Data. Available at https://itukraine.org.ua/.../infografika-ukrayinska-it-industriya-zagalni-dani-ta-profesiynyy-p..
13. Tech Ecosystem Guide to Ukraine 2019. Available at https://data.unit.city/tech-guide/Tech_Ecosystem_Guide_To_Ukraine_En-1.1.pdf
14. Portrait of an IT Specialist - 2018. Infographics. Available at https://dou.ua/lenta/articles/portrait-2018/
15. Yakubiv, V.: Competent and social portrait of it-specialist in Ukraine: results of gamehub research. Management of development of complex systems, 35, 140 – 146, (2018).
16. In IT without a diploma. Available at https://dou.ua/lenta/articles/it-without-diploma-1/
17. Does a successful specialist need a diploma? Available at https://dan-it.com.ua/uk/chi-potriben-diplom-uspishnomu-specialistu/
18. Sokolova, L. V., Kolisnyk O. V., Sokolov, O. Y.: Scientific and methodological approach to the assessment of specialists motivation at IT-enterprises based on competencies, 1, 266-272 (2018)
19. Approved higher education standards. Available at https://mon.gov.ua/ua/osvita/visha-osvita/naukovo-metodichna-rada-ministerstva-osviti-i-nauki-ukrayini/zatverdzheni-standarti-vishoyi-osviti
20. Maximum use of our potential: consolidation of the European higher education space. Available at http://euroosvita.net/prog/data/attach/1851/bucharest_com.pdf.
21. The Association for Computing Machinery. Available at http:// info.acm.org
22. Institute of Electrical and Electronic Engineers. Available at http://www.ieee.org
23. Standarts CC2001. Available at http:// ampl77.spb.ru/ publications/
24. Kravtsov, H., Kobets, V. (2017) Implementation of Stakeholders' Requirements and Innovations for ICT Curriculum through Relevant Competences. In: Proc. 13-th Int. Conf. ICTERI 2017, Kyiv, Ukraine, May 15-18, 2017, vol. 1844, pp. 414--427.
25. Kravtsov, H., Kobets, V. (2019) Evolutionary Revision Model for Improvement of Computer Science Curriculum. In: Ermolayev V. et al. (eds) Information and Communication Technologies in Education, Research, and Industrial Applications. ICTERI 2018. Communications in Computer and Information Science, vol 1007. pp 127--147.