

**МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
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TABLE OF CONTENTS

1. GRYSHCHENKO I.	
Using the energy efficiency hub in the university energy management system in the context of preventing a new outbreak of the COVID-19 pandemic	9
2. SCHERBAK V.	
Using the university energy efficiency knowledge hub for energy certification and energy audits of higher education institutions	19
3. YATSENKO V.	
Social responsibility of the educational ecosystem of a higher education institution under conditions of structural and innovative change	32
4. DUDKO P.	
Social responsibility of business in preventing a COVID-19 pandemic	43
5. KOZHUSHKO R.	
Human capital as a key factor in the development of university innovation	52
6. KRAKHMALOVA N.	
Determining whether the prototype Hackathon ecosystem for technology transfer in a higher education institution meets the needs of stakeholders	61
7. GONCHARENKO I.	
Conceptual model of the Hackathon ecosystem of technology transfer in an institution of higher education	74
8. HANUSHCHAK-YEFIMENKO L.	
Using the Hackathon ecosystem as an effective tool for managing the competitiveness of an institution of higher education	85
9. NIFATOVA O.	
Organization of the energy management system on the basis of the university knowledge HUB	94
10. SHCHERBAK V., ARABULI S.	
Methodology and technology of hackathon ecosystem to engage university faculty and students in innovation and entrepreneurship in the context of reducing the impact of the COVID-19 pandemic	105
11. HOTRA V.	
Conceptual principles of hotel and restaurant business development	115
12. BIRIUKOVA Yu.	
Formation of an information technology platform to support and develop the hotel business	123
13. DAWOUD A. D.	
Victory of mathematical model in the management of development of integrated structures of business	132
14. GRECHYSHKIN Yu.	
Mathematical modeling of the development of the potential of integrated business structures	141

ЗМІСТ

1. ГРИЩЕНКО І.	
Використання хабу знань з енергоефективності в системі енергоменеджменту університету в умовах запобігання нового спалаху пандемії COVID-19	9
2. ЩЕРБАК В.	
Використання університетського хабу знань з енергоефективності для проведення енергетичної сертифікації та енергетичного аудиту вищих навчальних закладів	19
3. ЯЦЕНКО В.	
Соціальна відповідальність освітньої екосистеми закладу вищої освіти в умовах структурно-інноваційних перетворень	32
4. ДУДКО П.	
Соціальна відповідальність бізнесу в умовах запобігання пандемії COVID-19	43
5. КОЖУШКО Р.	
Людський капітал як ключовий фактор розвитку інноваційної діяльності університетів	52
6. КРАХМАЛЬОВА Н.	
Визначення відповідності прототипу Хакатон-екосистеми трансферу технологій у закладі вищої освіти потребам стейкхолдерів	61
7. ГОНЧАРЕНКО І.	
Концептуальна модель Хакатон-екосистеми трансферу технологій у закладі вищої освіти	74
8. ГАНУЩАК-ЄФІМЕНКО Л.	
Використання Хакатон-екосистеми як ефективного інструментарію управління конкурентоспроможністю закладу вищої освіти	85
9. НІФАТОВА О.	
Організація системи енергоменеджменту на базі університетського ХАБ знань	94
10. ЩЕРБАК В., АРАБУЛІ С.	
Методологія та технологія хакатон-екосистеми залучення в інноваційно-підприємницьку діяльність викладачів та студентів університету в умовах зменшення впливу пандемії COVID-19	105
11. ГОТРА В.	
Концепційні принципи розвитку готельно-ресторанного бізнесу	115
12. БІРЮКОВА Ю.	
Формування платформи інформаційних технологій для підтримки та розвитку готельного бізнесу	123
13. ДАВУД А. Д.	
Перемога математичної моделі в управлінні розвитком інтегрованих структур бізнесу	132
14. ГРЕЧИШКІН Ю.	
Математичне моделювання розвитку потенціалу інтегрованих бізнес-структур	141

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USING THE ENERGY EFFICIENCY HUB IN THE UNIVERSITY ENERGY MANAGEMENT SYSTEM IN THE CONTEXT OF PREVENTING A NEW OUTBREAK OF THE COVID-19 PANDEMIC

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BACKGROUND AND OBJECTIVES.

The problem addressed by the project is the need to develop a new approach to energy saving and energy efficiency management in higher education institutions (HEI), whose main components are energy management, energy audit, energy certification, monitoring based on the reasonable use of international standards ISO 50001: 2011, which allows reducing or completely eliminating the barriers to energy efficiency measures related to lack of awareness of energy saving potential.

METHODS. The international protocol of efficiency measurement and verification is proposed to be used as a basis for methodological support of energy efficiency analysis and control in the automated information system of energy efficiency analysis. The method of rationing of heat energy consumption, which takes into account the required level of statistical significance of energy resources saving when carrying out energy saving measures, was used to control the energy efficiency of HUB use of knowledge on energy efficiency. The

methodological support of the subsystem of analysis of energy efficiency of heat energy resources consumption is considered.

FINDINGS. A three-part system for improving the energy efficiency of a university based on the HUB of energy efficiency knowledge is proposed: an automated dispatch management system; an automated information system for energy efficiency analysis and a corporate management system for the heat and power complex.

CONCLUSION. Compliance with the consumption rate calculated using the proposed method during the whole study period (second half of 2019 – beginning of 2021) allows to obtain a statistically significant value of thermal energy savings, which will significantly reduce the energy costs of the university in the COVID-19 pandemic crisis. An example of the use of the proposed energy efficiency knowledge HUB for building 4 of the Kyiv National University of Technologies and Design is presented.

KEYWORDS: Energy Efficiency Knowledge HUB; COVID-19; University.

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ВИКОРИСТАННЯ ХАБУ ЗНАНЬ З ЕНЕРГОЕФЕКТИВНОСТІ В СИСТЕМІ ЕНЕРГОМЕНЕДЖМЕНТУ УНІВЕРСИТЕТУ В УМОВАХ ЗАПОБИГАННЯ НОВОГО СПАЛАХУ ПАНДЕМІЇ COVID-19

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ПОСТАНОВКА ПРОБЛЕМИ ТА ЗАВДАННЯ. Проблема, на вирішення якої спрямовано проект, полягає в необхідності розробки інтегративного підходу щодо управління енергозбереженням та енергоефективністю закладів вищої освіти (ЗВО), основними складовими якого є енергоменеджмент, енерго-аудит, енергосертифікація, моніторинг на основі обґрунтованого використання міжнародних стандартів ISO 50001:2011, що дозволяє знизити або повністю ліквідувати стримуючі бар'єри впровадження енергоефективних заходів, які відносяться до недостатньої поінформованості про потенціал економії; недостатньої або фрагментарної інформації про енергоефективність, енергоефективної грамотності серед студентів і науково-педагогічного персоналу, відсутності інтерактивної системи показників енергоефективності; недостатньої уваги до питань енергоефективності існуючих в ЗВО систем та процесів.

МЕТОДИ. В якості основи методичного забезпечення аналізу і контролю енергоефективності в автоматизованій інформаційній системі аналізу енергоефективності пропонується використувати міжнародний протокол вимірювання та верифікації ефективності. Для контролю енергоефективності використання ХАБ знань з енергоефективності використаний метод нормування

споживання теплової енергії, що враховує необхідний рівень статистичної значущості економії енергоресурсів при проведенні енергозберігаючих заходів. Розроблено методичне забезпечення підсистеми аналізу енергоефективності споживання теплоенергетичних ресурсів.

РЕЗУЛЬТАТИ. Запропоновано систему підвищення енергоефективності університету на базі ХАБ знань з енергоефективності з трьох частин: автоматизована система диспетчерського управління; автоматизована інформаційна система аналізу енергоефективності та корпоративна система управління теплоенергетичним комплексом.

ВИСНОВКИ. Дотримання норми споживання, розрахованої з використанням запропонованого методу, протягом усього досліджуваного періоду (друга половина 2019 – початок 2021) дозволяє отримати статистично значущу величину економії теплової енергії, що істотно знизить витрати на енергію університету в умовах кризи пандемії COVID-19. Представлений приклад використання запропонованого ХАБ знань з енергоефективності для будівлі 4 корпусу Київського національного університету технологій та дизайну.

КЛЮЧОВІ СЛОВА: ХАБ знань з енергоефективності; COVID-19; університет.

INTRODUCTION.

Energy saving is a pressing issue for the development of the Ukrainian economy. The problem of efficient use of energy resources is particularly acute in higher education. First of all, it is connected with moral and technological obsolescence of fixed assets of higher education, which are currently worn out by 60–70%. At the same time, a large share of depreciation of fixed assets is represented by buildings and structures, drainage, water and heat supply systems.

In the context of the COVID-19 pandemic, some universities are now introducing energy generation systems operating in certain buildings (miniboilers, cogeneration units) (García *et al.*, 2020), and the installation of individual heating substations is a requirement for new buildings and modernisation of already constructed ones (Nayak *et al.*, 2021). The use of local control systems for energy generation and consumption together with automated monitoring and control systems increases the flexibility of energy supply management and not only saves energy, but also improves the quality of energy supply (Nicola *et al.*, 2020).

University building heating systems are an example of this approach in the COVID-19 pandemic (Werth *et al.*, 2021). As most domestic and foreign universities in the COVID-19 pandemic are focusing on energy conservation, various advanced energy conservation technologies are being introduced and tested as part of their research activities (Di Stefano *et al.*, 2000). Therefore, university building heating systems can use several different types of energy generation and consumption units, operating in different modes and providing electricity and heat to buildings of different purposes (Xing *et al.*, 2019).

However, in a COVID-19 pandemic, the presence of a large number of different types of heat sources and consumers in heating systems significantly complicates the analysis of the efficiency of both the heating system as a whole and its individual elements (Abu-Rayash *et al.*, 2020; Wang *et al.*, 2021). At the same time, under the conditions of the COVID-19 pandemic, the application of automated control and management systems allows processing a large amount of statistical information, which makes it especially relevant to develop the application of modelling, forecasting and rationing methods in the tasks of energy efficiency analysis of complex heterogeneous heat supply systems within the framework of university energy management (Liu *et al.*, 2019; Zhong *et al.*, 2020).

The aim of the study is to propose a mechanism for using Hub knowledge on energy efficiency in a university's energy management system in the context of preventing a new outbreak of the COVID-19 pandemic. The study was conducted in 2020 based on data from the Kyiv National University of Technologies and Design (KNUTD).

MATERIALS AND METHODS.

Energy saving technologies are being introduced in various energy efficiency programmes. An international efficiency measurement and verification protocol has been developed to evaluate the savings from energy saving measures. According to this protocol, the energy savings E_s after energy saving measures are calculated as the difference between the consumption E_{bp} in the base period, calculated under comparable reporting period conditions, and the actual consumption in the reporting period E_{rp} (equation 1):

$$E_s = E_{bp} - E_{rp}. \quad (1)$$

In doing so, a baseline period energy consumption model must be used to calculate energy consumption under comparable conditions, depending on the factors affecting the energy consumption of the system. In particular, to calculate savings in heating systems, the protocol gives an example in which a linear regression on the outdoor temperature is used to construct a base period consumption model. According to the acceptable uncertainty principle of this protocol (Zhong *et al.*, 2020): savings are considered statistically significant if they are larger than the statistical variation of the base period model. Since the standard error of the protocol is used as a measure of variation, savings are assumed to be twice the standard error of the base period model.

In this case, if the calculated consumption of E_{bp} from the base period model is the sum of several independently determined consumption values E_{bpi} , then the total standard deviation of estimated consumption E_{bp} is the geometric sum of the standard deviations of several independently determined values E_{bpi} (eq. 2):

$$RMSE_{bp} = \sqrt{\sum_{i=1}^N RMSE_{bpi}}, \quad (2)$$

where N is the number of independently determined consumption values.

Given that each value calculated from a linear regression model is an independent value, then if the regression was constructed, for example, to determine daily consumption in the reference period, the total standard deviation of the definition of total consumption under comparable conditions for N days in the reference period will also be calculated according to equation (3):

$$RMSE_{bp} = RMSE_{bpir} \sqrt{N}, \quad (3)$$

where $RMSE_{bpir}$ is the standard deviation of the determination of daily energy consumption obtained according to the linear regression model built.

In accordance with the principle of acceptable uncertainty, the total savings E_s obtained for N days of the reporting period will be considered statistically reliable if the following condition (eq. 4) is fulfilled

$$\sum_{i=1}^N E_{s_i} > 2RMSE_{bp_{lr}} \sqrt{N}, \quad (4)$$

where E_{s_i} is the energy savings on the i -th day of the reporting period.

The above inequality (4) implies a new formulation of the rationing problem, related to ensuring the implementation of the principle of acceptable uncertainty at the end of the reporting period. For the problem of operational daily rationing, we reformulate the principle of acceptable uncertainty as follows: the savings will be considered statistically reliable at the end of the reporting period of N days if the savings on each day of the reporting period E_{s_i} is twice the root mean square error $RMSE_{bp_{lr}}$ of the daily energy consumption, divided by the square root of N (eq. 5):

$$E_{s_i} > 2RMSE_{bp_{lr}} \div \sqrt{N}. \quad (5)$$

Thus, compliance with expression (5) for each day of the accounting period is a sufficient condition for the resulting savings to be statistically significant at the end of the accounting period.

RESULTS AND DISCUSSION.

The general scheme of automated energy management of university energy complexes based on the Energy Efficiency Knowledge Hub (the result of the calculations of Equations 1 to 5) is presented in Figure 1.

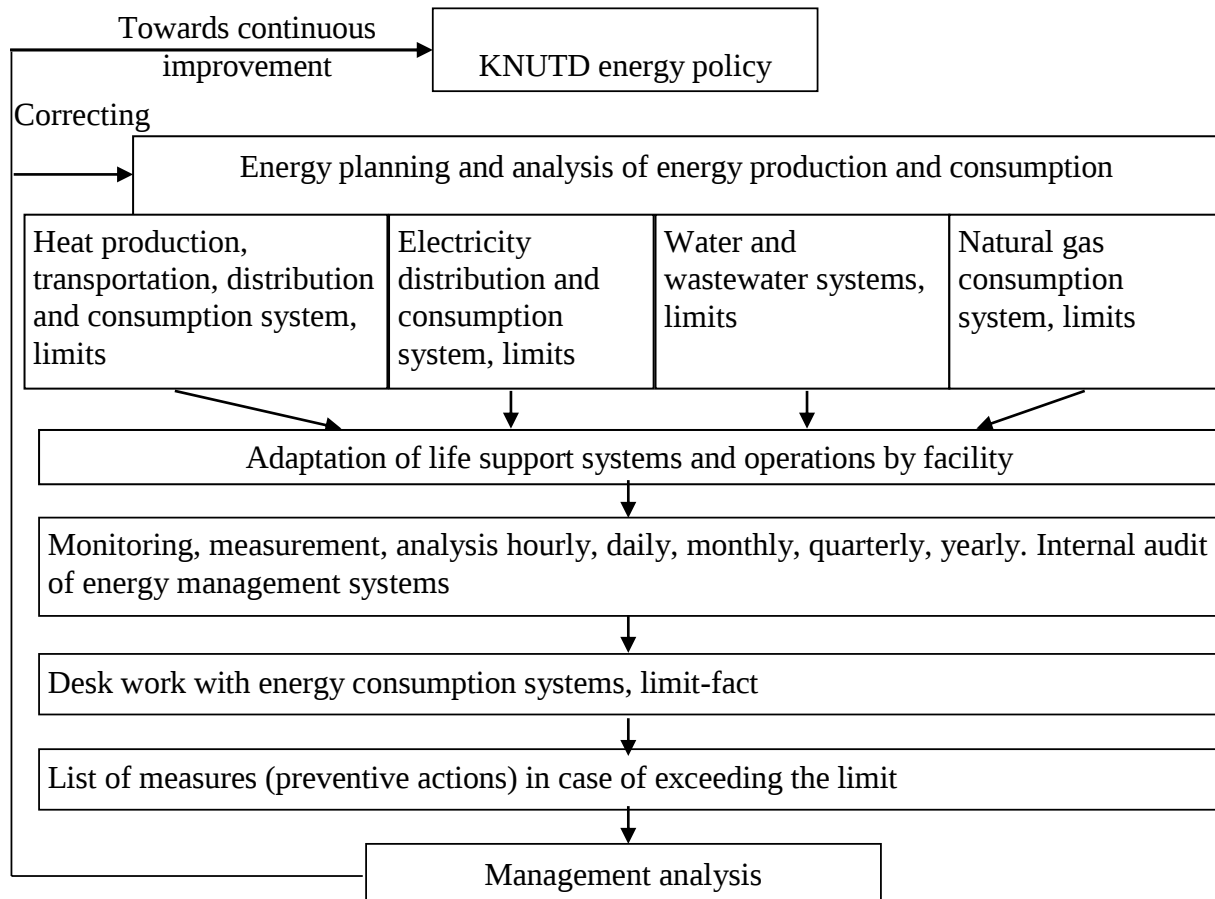
The basis for the proposed automated energy management system is the ISO 50001 Energy Management Systems standard (Vieira *et al.*, 2020; Shaposhnikova *et al.*, 2016).

According to the above scheme, the automated system of automated energy management of university energy complexes based on the Energy Efficiency Knowledge Hub should include 3 subsystems:

1. Automated system of dispatch control of fuel and energy complex. The main functions of the subsystem are operational control, analysis and management of generation and consumption of energy resources (Gryshchenko *et al.*, 2017).

2. Automated information system for energy efficiency analysis of the fuel and energy complex (AIS for energy efficiency analysis of the fuel and energy complex). The main functions of the subsystem are modelling, energy efficiency analysis, rationing and optimal management of energy generation and consumption. Modelling makes it possible to calculate different modes of fuel and energy complex operation as well as to optimise these modes according to

the criteria of minimum energy consumption. Based on the simulation results, calculation of corrective impacts for the operational management system is carried out. Using the results of simulation, as well as operational and design data to control the selected modes of operation, the daily heat consumption rates are calculated. Based on operational results, energy savings are calculated for the power complex as a whole and for consumers connected to it.



Source: suggested by the author.

Fig. 1. Block diagram of the energy management system of KNUTD

3. Corporate Information System for Fuel and Energy Complex (CISFEC). The main function of this subsystem is to support decision making of the manager or energy management group in energy planning, energy policy development and implementation. The CISFEC analyses the results of the university's energy management activities on the basis of internal energy audits, adjusts the university's energy policy and plans energy efficiency measures.

An automated system, the main objective of which is to improve energy efficiency, should use objective methods for evaluating and monitoring energy consumption. Therefore, it is proposed to use the International Performance Measurement and Verification Protocol (IPMVP) (Kaplun *et al.*, 2016), which describes the methodology for assessing the effectiveness of energy saving measures, as a methodological and regulatory support for this automated system.

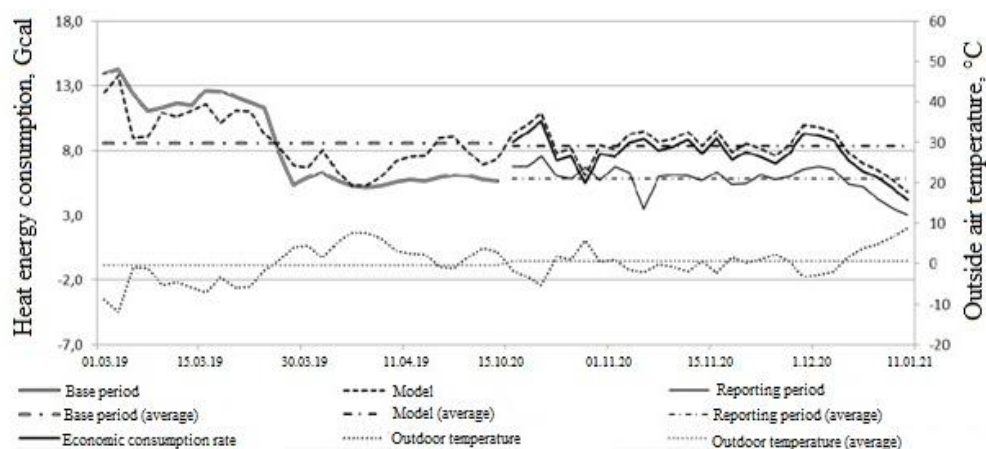
However, it is worth noting that the methodology described in the protocol can be used not only to assess the energy efficiency of energy complexes, but also to monitor energy efficiency during operation. At the same time, the purpose of such control should be the detection of inefficient modes of operation that prevent the achievement of the required level of energy savings.

A system of energy management has been developed for each energy resource (heat, electricity, natural gas, wastewater and water consumption). For this purpose, four working groups should be established: production planning and analysis, development and adjustment, implementation and operation, monitoring and measurement – these systems should be fine-tuned and aimed at optimal use of the resources consumed.

The energy policy developed by the university should ensure the main activities of the university – academic, research and production, social, maintenance of the sanitary condition of the university territory, creation of comfortable conditions for the teaching staff and students.

In implementing it, we must first of all increase energy productivity – to increase energy efficiency through more efficient use of the energy consumed, to reduce energy consumption in general. In doing so, it is also necessary to reduce emissions and other environmental impacts (Kaplun *et al.*, 2016). In addition, with the energy resources saved, the university will put in place new energy-consuming facilities.

Once the system was commissioned, the energy efficiency of the university's thermal energy facilities was assessed and monitored (Shcherbak *et al.*, 2019). As an example of energy efficiency analysis and monitoring, consider monitoring the effectiveness of the implementation of an automated energy efficiency knowledge HAB at KNUTD (Kaplun *et al.*, 2016; Shcherbak *et al.*, 2021).



Source: constructed by the author.

Fig. 2. Savings in thermal energy consumption of building 4 of KNUTD after implementation of the automated energy efficiency knowledge HUB

Figure 2 shows a graph of heat consumption before and after energy saving measures based on the automated energy efficiency knowledge HUB. A statistical model (dashed line) of heat consumption as a function of outdoor temperature was built using the operational data of the base period (double solid line). After implementation of energy saving measures using the statistical model, consumption in the reporting period under comparable temperature conditions was calculated. The thick solid line indicates the effective heat consumption rate calculated according to the above method, exceeding which may lead to no savings or its low statistical significance in the reporting period. During system operation during the COVID-19 pandemic period (second half of 2019–2020), the inefficient consumption mode was promptly identified and its causes were eliminated. At the beginning of 2021, when comparing the norm of efficient heat consumption with the actual consumption (thin solid line), the minimum savings was 25%.

CONCLUSION.

The paper proposes the structure of an automated energy management system for a thermal power complex based on the KNUTD energy efficiency knowledge HUB. The described structure includes three interacting with each other subsystems. Each subsystem can be implemented separately at different management levels in the university. The automated system of dispatching management on the basis of HUB knowledge allows the service of operation to operatively manage the objects of the heat and power complex. The corporate information system of the fuel and energy complex, through which energy planning is carried out, is recommended to be implemented as part of the corporate management system of the organisation. At the same time, an automated information system for energy efficiency analysis of the university is proposed as a link between these subsystems, which allows controlling the efficiency of heat consumption in the heat and power complex. As a basis of methodological support for energy efficiency analysis and control in the automated information system of energy efficiency analysis it is proposed to use the international protocol of efficiency measurement and verification. A method of rationing heat energy consumption, taking into account the required level of statistical significance of energy resources saving when carrying out energy saving measures, is proposed to control the energy efficiency of the heat and power complex. Application of this method in the automated information system of university energy efficiency analysis is expedient, which was confirmed in the process of operation of the implemented automated system of energy management of thermal energy complex on the basis of HUB of knowledge on energy efficiency in Kyiv National University of Technologies and Design.

ACKNOWLEDGEMENT.

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ABBREVIATIONS:

%	Percentage
CISFEC	Corporate Information System for Fuel and Energy Complex
COVID-19	Corona Virus Disease 2019, corona virus infection 2019-nCoV
Eq.	Formula of calculation
Fig.	Figures
HEI	Higher education institution
HUB	Common connection point
IPMVP	International Performance Measurement and Verification Protocol
KNUTD	Kyiv National University of Technologies and Design

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USING THE UNIVERSITY ENERGY EFFICIENCY KNOWLEDGE HUB FOR ENERGY CERTIFICATION AND ENERGY AUDITS OF HIGHER EDUCATION INSTITUTIONS

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BACKGROUND AND OBJECTIVES.

The general problem of the research is to define the essence of university energy efficiency as a special type of management of higher educational institution activity, increase of its energy autonomy level, scientific research on economical use of energy resources. University energy efficiency management is a special type of management, which is based on finding new opportunities to save energy resources based on innovations, ability to attract resources from a variety of sources.

METHODS. Logic, system and statistical analysis, and multiple regression methods were used to conduct energy monitoring of HUB use of energy efficiency knowledge. The method of cluster analysis was used for energy audit and energy certification of university buildings. The average value, value of mode and median, indicators of variation (variation range, average linear deviation and variation coefficient) of daily electricity consumption of building No.4 of Kyiv National University of Technologies and Design were calculated, statistical analysis of obtained data was made.

FINDINGS. Existing automatic energy accounting systems in university buildings were reviewed, a comparative table was compiled and the systems were ranked according to the sum of the scores obtained.

The comparative analysis is carried out according to a set of criteria, including the unique features that distinguish these systems from each other. Based on the ranking results, the best model is selected and its advantages and disadvantages are identified. A simplified list of requirements and necessary functionality for the use of energy efficiency knowledge HUB for energy monitoring, energy audits and energy certification of university buildings has been developed.

CONCLUSION. The obtained asymmetry coefficient made it possible to conclude that there is a right-hand asymmetry in the amount of energy used in the university. The selected main factors influencing energy consumption allowed to monitor the energy efficiency of the university in 2020. The use of multiple regression equation allowed to take into account the main factors of energy consumption, the extent of their influence, to compare the obtained results with the actual consumption, to build energy profiles and to carry out energy certification of all buildings of Kyiv National University of Technologies and Design.

KEYWORDS: Energy efficiency knowledge HUB; university; energy monitoring; energy auditing; energy certification.

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
17	6	3

JEL Classification:
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681.5.08

DOI: 10.30857/2415-
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ВИКОРИСТАННЯ УНІВЕРСИТЕТСЬКОГО ХАБ ЗНАНЬ З ЕНЕРГОЕФЕКТИВНОСТІ ДЛЯ ПРОВЕДЕННЯ ЕНЕРГЕТИЧНОЇ СЕРТИФІКАЦІЇ ТА ЕНЕРГЕТИЧНОГО АУДИТУ ВИЩИХ НАВЧАЛЬНИХ ЗАКЛАДІВ

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ПОСТАНОВКА ПРОБЛЕМИ ТА ЗАВДАННЯ.

Загальною проблемою дослідження є визначення сутності енергоефективності університету як особливого типу управління діяльністю вищого навчального закладу, підвищення рівня його енергоавтономії, наукових досліджень щодо економного використання енергоресурсів. Управління енергоефективністю університету є особливим типом управління, в основі якого – пошук нових можливостей економії енергоресурсів на основі інновацій, вміння залучати ресурси з найрізноманітніших джерел.

МЕТОДИ. Для проведення енергетичного моніторингу використання ХАБ знань з енергоефективності були використані методи логіки, системного і статистичного аналізу, множинної регресії. Для проведення енергоаудиту і енергосертифікації будівель університету був використаний метод кластерного аналізу. Використано середнє значення, значення моди і медіани, показники варіації (розмах варіації, середнє лінійне відхилення і коефіцієнт варіації) добового електроспоживання будівлі корпусу №4 Київського національного університету технологій та дизайну, проведений статистичний аналіз отриманих даних.

РЕЗУЛЬТАТИ. Розглянуто існуючі системи автоматичного обліку використання енергії в університетських будівлях, складена порівняльна таблиця

і вироблено ранжування систем за сумою отриманих балів. Порівняльний аналіз проведено по набору критеріїв, включаючи унікальні можливості, що відрізняють ці системи один від одного. За результатами ранжування обрана найкраща модель, виявлені її переваги і недоліки. Складено спрощений список вимог і необхідного функціоналу для використання ХАБ знань з енергоефективності для проведення енергетичного моніторингу, енергоаудиту і енергосертифікації будівель університету.

ВИСНОВКИ. Отриманий коефіцієнт асиметрії дозволив зробити висновок про наявність правобічної асиметрії кількості використовуваної енергії в університеті. Визначені основні фактори, що впливають на електроспоживання, що дозволило зробити моніторинг енергоефективності університету в 2020 році. Використання рівняння множинної регресії визначило основні фактори енергоспоживання, ступінь їх впливу, порівняння отриманих результатів з фактичним споживанням, побудувати енергопрофілі і здійснити енергосертифікацію всіх будівель Київського національного університету технологій та дизайну.

КЛЮЧОВІ СЛОВА: ХАБ знань з енергоефективності; університет; моніторинг енергоспоживання; енергоаудит; енергосертифікація.

INTRODUCTION.

One of the most important main priorities of modernisation and technological development of the country's economy is to increase its energy efficiency. The current situation of inefficient and irrational use of resources in the system of higher education requires the development of an integrative approach to energy saving and energy efficiency management of higher education institutions (hereinafter HEI), the main components of which are energy management, energy audit, energy certification and monitoring based on reasonable use of international standards ISO 9000; ISO 50000 (Shaposhnikova *et al.*, 2016; Vieira *et al.*, 2020). This reduces or eliminates the barriers to the implementation of energy efficiency measures, such as a lack of awareness of the savings potential (García *et al.*, 2020); insufficient or fragmented information on energy efficiency and the absence of a common system of energy efficiency indicators (Nayak *et al.*, 2021); and a lack of attention to the energy efficiency of the HEI's systems and processes (Nicola *et al.*, 2020).

Modern university buildings use a large number of resources, such as heat, cold and hot water, and electricity, which is the main energy consumed and is used for lighting, office equipment, ventilation and air conditioning systems (Werth *et al.*, 2021). The embedded electricity metering systems of these buildings have a rather simple structural organisation, with analogue and digital meters of different manufacturers installed on aggregated consumer groups (Di Stefano, 2000). This metering system does not allow a qualitative analysis of energy consumption, nor does it allow for measures to reduce it (Xing *et al.*, 2019). In order to improve the energy efficiency of university buildings, it is necessary to implement an automatic energy metering system (Abu-Rayash *et al.*, 2020; Wang *et al.*, 2021), capable of working with a large number of metering equipment manufacturers, with manual data entry and export capabilities from related systems (Liu *et al.*, 2019). The implementation of such a system will allow for more internal billing and qualitative consumption analysis, which facilitates rapid decision-making to optimise energy use. With more data and its analysis results, the university can more accurately predict energy consumption (Zhong *et al.*, 2020).

The aim of the study is to propose the use of a university energy efficiency knowledge hub for energy certification and energy audits of higher education institutions. The study was conducted in 2020 based on data from the Kyiv National University of Technologies and Design.

MATERIALS AND METHODS.

Data description.

Most existing automatic energy accounting systems use software products (Table 1). They are compared based on expert evaluations. After summing up the scores obtained from the experts, we will rank the systems and choose the

most suitable one for the implementation of energy monitoring of university buildings.

Table 1

**Comparative analysis of automatic energy accounting systems
in universities**

Parameters	Name									
	Energy software	EASDKiU	RDM	Energy control	I-ems	Simatic	1C Cascade	Energy metering	Marcel	Energy
Software type	1	1	1	1	2	0	0	1	1	1
Need for third party software	2	2	2	2	1	1	0	2	2	1
Supported manufacturers	2	1	0	2	2	2	2	2	1	1
Communication standards	2	2	2	1	1	1	1	1	2	0
Energy Resources to be Accounted for	2	0	0	2	2	2	1	0	0	0
Parameters to be monitored	2	2	2	0	0	2	2	0	0	0
Manual input	0	0	0	0	0	2	2	1	0	0
Multi-tariff metering	0	2	0	0	2	0	0	2	0	0
Forecast	0	0	0	0	0	1	1	1	0	0
Displaying data in reports	2	2	2	2	2	1	2	2	2	1
Diagnosis of metering devices	2	1	2	1	0	2	0	0	0	1
Remote control	2	2	2	2	0	2	0	0	0	0
Recording of personnel actions	2	1	1	1	1	0	1	0	0	0
Automatic calculation	1	2	2	1	2	0	1	0	2	0
Document management system	1	0	0	0	1	0	2	1	0	0
Automatic distribution	0	2	1	0	1	0	1	0	1	0
Code openness	0	0	0	2	0	0	0	1	0	1
Amount of points	21	20	17	17	17	16	16	14	11	6

Source: based on (Gryshchenko *et al.*, 2017; Kaplun *et al.*, 2016).

The scores in Table 1 are as follows: 2 points if the function is fully implemented, 1 point if only part of the function is implemented, and 0 points if the function is not implemented at all or only a small part of it is implemented. When scoring the software type, 2 points were given to modular and modular software, as these types are the most advanced at the moment due to the fact that they allow gradual integration, selecting a set of necessary functions for each specific university building and extending the functionality as needed (Zhong *et al.*, 2020). One point was given to stand-alone software that does not require basic software to be installed. Zero points were given to integrated systems requiring third-party software for installation and operation. A comparison of automatic accounting systems using the 'ranking' method revealed that the most

functional system currently on the market is Energo software, but even though it has great functionality, it is not able to fully meet the needs of individual higher education institutions (Liu *et al.*, 2019). For example, the system does not allow for manual data entry, which rules out gradual integration. The system is not able to organise tariff calculation, which does not allow reducing the cost of electricity consumption without changing the amount of electricity consumption. Also, the system does not have any electricity forecasting functionality and is not capable of automatic notification of stakeholders. To address this issue, the system should be modular, which would not only make it more affordable and allow for gradual implementation, but also allow universities to tailor the necessary functionality to specific needs (Kaplun *et al.*, 2016). It would be most convenient to divide the functionality into categories, such as predictive module, accounting module, remote management module, document management module, quality control module. As a result, the modular system should be able to form a unified information space (Ganushchak-Efimenko *et al.*, 2018). In addition, the maximum expansion of devices available for reading and control is required, as well as the implementation of device-specific manual data entry functionality, which will allow enterprises to make gradual integration of automatic energy metering systems (Shcherbak *et al.*, 2019). The system should be easily scalable and capable of receiving data both via wired and wireless technologies without losing the quality of the data received. The system should be able to acquire data, automatically analyse it and produce forecasts, as well as optimise energy consumption, especially in the context of the Covid-19 pandemic (Shcherbak *et al.*, 2021). It is necessary to have a module for quality control of consumed resources, as well as to notify about abnormal situations both the operator and a certain circle of persons of the enterprise not only by e-mail, but also by SMS or autoinformer (Shcherbak *et al.*, 2021). This will increase the reliability and responsiveness of the system. At the same time, there should be functionality in the area of document management and employee monitoring (Shcherbak *et al.*, 2019). Currently, the market does not have a system that meets these requirements. This study proposes the use of a university energy efficiency knowledge HUB as a centralised point of personal energy metering for energy certification and energy audits of higher education institutions.

Method description.

As a result of daily monitoring we have consumption data for a day, collected at 30-minute intervals. The data obtained are shown in figure 1.

Find the indicators of the centre of distribution, such as the simple mean, mode and median. First, we find the simple average by summing the values and dividing by their number (eq. 1):

$$\bar{x} = \frac{\sum x_i}{n}. \quad (1)$$

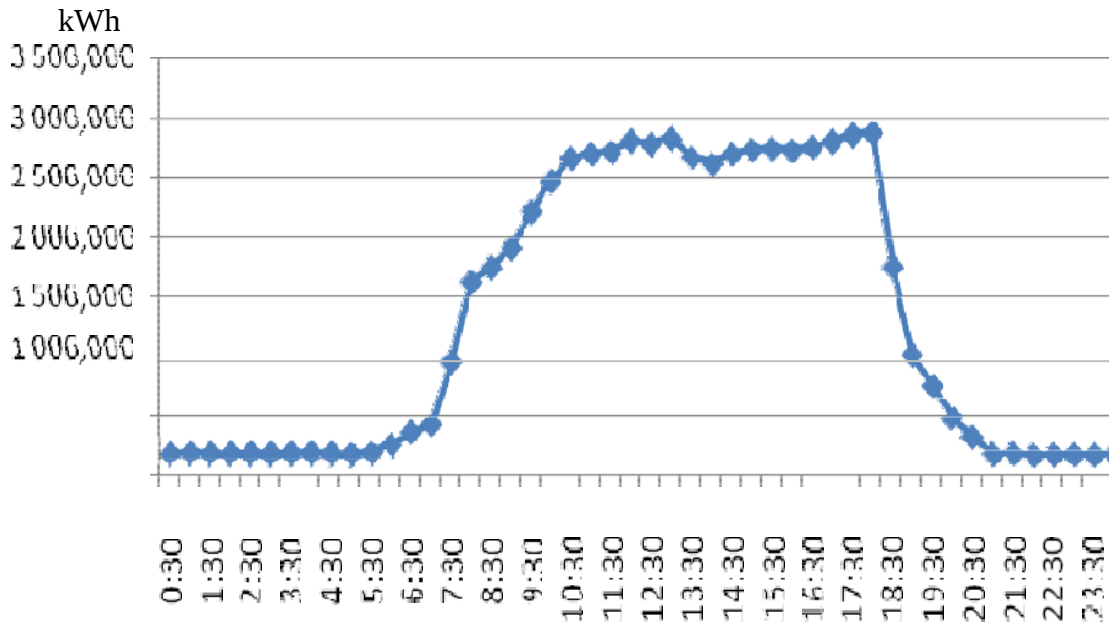


Figure 1. Diagram of the daily electricity consumption of KNUTD Building 4

Next, find the modulus of our series. The result is two values occurring with the same highest frequency. From the results, we can conclude that the series is multimodal and does not follow the law of the normal distribution. The median is a good proxy for asymmetric distribution, because even in the presence of outliers, the median is more robust to outliers. As the number of values in the series is even, it is necessary to take the two central values of the ranked series and find their mean.

It is also necessary to find measures of variation, such as variance, dispersion, and linear mean deviation. The range of variation is the difference between the maximum and minimum values of the series (Eq. 2):

$$R = x_{\max} - x_{\min}. \quad (2)$$

The linear mean deviation is calculated to account for the differences of all units in the population under study (Eq. 3):

$$d = \frac{\sum |x_i - \bar{x}|}{f}. \quad (3)$$

The variance is a measure of the deviation from the mean. The calculation will be done by the method of moments (Eq. 4):

$$D = \frac{\sum x_i^2}{n} - \bar{x}^2. \quad (4)$$

In this case, the standard deviation is determined by Eq. 5:

$$\sigma = \sqrt{D}. \quad (5)$$

The coefficient of variation is a measure of the relative dispersion of population values, showing what proportion of the mean value of that value constitutes its mean dispersion (Eq. 6):

$$\gamma = \frac{\sigma}{\bar{x}}. \quad (6)$$

The linear coefficient of variation, or relative linear deviation, characterises the proportion of the average value of a trait that is absolute deviations from the mean (Eq. 7):

$$K_d = \frac{d}{\bar{x}}. \quad (7)$$

The most accurate and common measure of asymmetry is the moment coefficient of asymmetry: $As = M3/s^3$, where $M3$ is the third-order central moment, s is the standard deviation. The estimation of the significance of the asymmetry index is given by the mean square error of the asymmetry coefficient.

RESULTS AND DISCUSSION.

As a result of statistical analysis of the data, it was found that electricity consumption data in KNUTD buildings does not follow the law of normal distribution, hence there is no possibility to make a qualitative assessment and build an accurate prediction of electricity consumption (Kaplun *et al.*, 2016). For a more qualitative analysis, the main factors affecting electricity consumption were identified. KNUTD has unregulated central heating, individual air conditioning systems, and central and individual lighting (Kaplun *et al.*, 2016). Therefore, we selected the following main factors: average outdoor air temperature, average daylight hours, heating period, and average number of people working per day during the month (Gryshchenko *et al.*, 2017). The following data were obtained from the year-long monitoring, as presented in Table 2.

To assess the impact of each factor on energy consumption, we construct a multiple regression equation for the 4 factors. The linear multiple regression equation is as follows (Eq. 8):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_m X_m + \varepsilon, \quad (8)$$

where β_0 – free term; β_n – values of the coefficients of influence of each specific factor on the final result; X_n – quantitative value of the factor.

The result is a regression equation:

$$Y = -1341024,7002 + 110,5904X_1 + 3638,9134X_2 - 2518,0966X_3 - 7304,7214X_4.$$

Table 2

Data from the monitoring of KNUTD Building No.4 in 2020

Parameter	January	February	March	April	May	June	July	August	September	October	November	December
Electricity consumption, kWh	186808	160339	141634	97250	56985	35941	22192	43904	58684	122035	173193	211063
Heating period, days	31	29	31	28	0	0	0	0	5	31	30	31
Personnel, pers.	425,1	427,5	426,8	427,2	427	425	422	424	418,3	421,2	423,5	427
Average air temperature, °C	-12,9	-6,8	-2,2	6,2	16,09	26	28,3	26,5	17,4	1,2	-1,15	-6,71
Average duration of daylight hours, h	7,16	9,2	11,4	14,2	16,4	18,3	17,4	15,2	12,52	10,21	8	6,36

To assess the quality of the resulting equation, calculate for each month and calculate the variance as a percentage. The results of the calculation are presented in the Table 3.

Table 3

**Results of calculations of energy consumption
in building No.4 of KNUTD in 2020**

Month	Actual electricity consumption, kWh	Estimated electricity consumption, kWh	Deviation, kWh	Rejection, %
January	186808	189573,69	2729,69	1,46
February	160339	167838,34	7499,24	4,67
March	141634	137347,22	4286,77	3,02
April	97250	97200,84	49,15	0,05
May	56985	59958,95	2973,95	5,21
June	35941	33519,82	2421,17	6,73
July	22192	22582,19	390,19	1,76
August	43904	39211,83	4682,16	7,79
September	58684	61524,31	2840,31	4,84
October	122035	123554,43	1519,44	1,24
November	173193	167975,65	5217,35	3,01
December	211063	201766,60	9296,39	4,40

The actual and estimated energy consumption data are also presented as a graph in Figure 2.

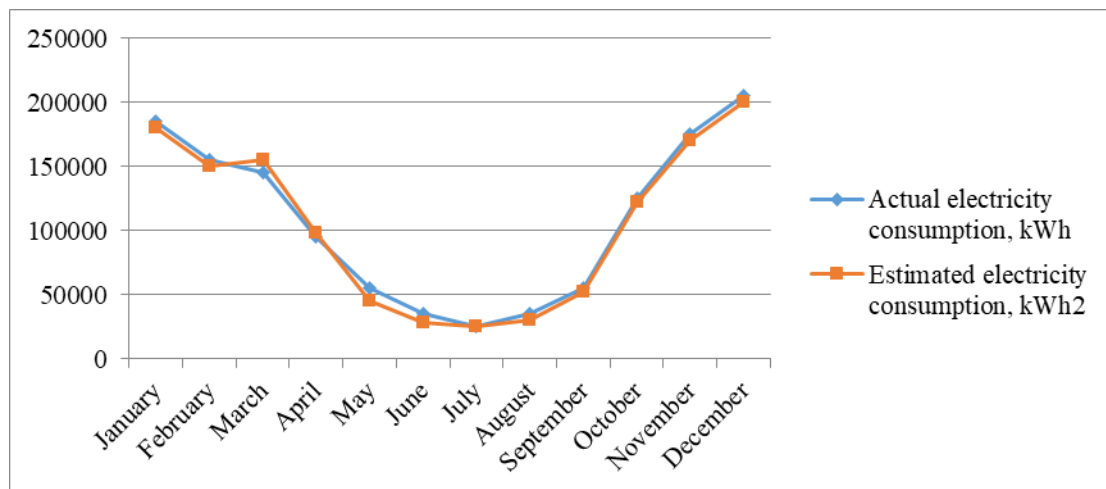
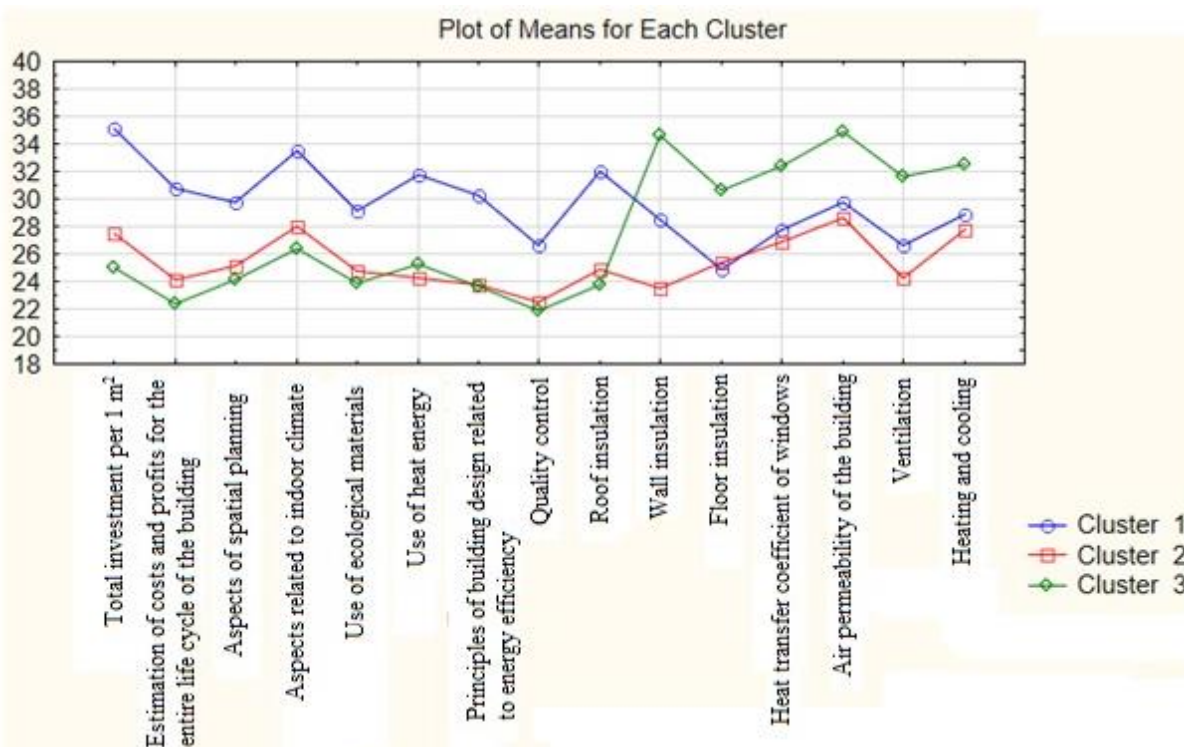


Figure 2. Schedule of actual and estimated electricity consumption in building No.4 of KNUTD in 2020

The evaluation shows that the deviation of the calculated electricity consumption from the actual electricity consumption in the peak values does not exceed 7.8%, and the average deviation is 3.68%, which is a good indicator of the accuracy of the model. Due to the high accuracy of the model, knowing the values of the coefficients, it is possible to construct a sufficiently accurate forecast of energy consumption.

The energy profile of KNUTD buildings is defined as follows: the total investment is evaluated against the national average (100%); expenses and profits are evaluated against the invested funds or the obtained effects over the whole life cycle of the building. Energy consumption is assessed similarly. The best results correspond to passive house or zero energy consumption standards. The quality control assessment is based on a given degree of quality control during the construction of the house. A high rating can be obtained if a building inspection has been carried out or is planned, but the highest rating is given if, in addition to the building quality check, an energy certification by an independent company has also been carried out. The parameters of the building are characterised by numerical values. Thermal insulation of the roof, walls and floor is assessed by measuring the thickness of the thermal insulation material in centimetres. The thermal conductivity of windows is indicated by the heat transfer coefficient. The air permeability of the building is determined by the degree of compaction. To assess energy systems, the ventilation system and its energy efficiency, heating and cooling systems, and the use of renewable energy for heat and electricity are analysed. The results of the cluster analysis of the energy efficiency status of the 15 KNUTD buildings for the 16 assessed indicators are shown in Figure 3.



Source: calculated from expert assessments.

Figure 3. Results of a cluster analysis of the energy efficiency status of KNUTD buildings (STATISTICA10 listing)

The data in Fig. 3 confirms the fact that all KNTUD buildings can be divided into 3 classes (clusters) according to the level of energy consumption and energy efficiency achieved. The definition of the objects that fell to each of the obtained clusters is given in Fig. 4–6. The first cluster includes the buildings of the academic building №1 (B1) and the academic building №4 (B4) (Fig. 4). These objects are characterised by a rather high level of energy consumption.

Members of Cluster Number 1 and Distances from Respective Cluster contains 2 cases	
	Distance
B1	11353,57
B4	11353,57

Source: calculated from expert assessments.

**Figure 4. List of KNUTD buildings in cluster 1
(High level of energy consumption)**

The second cluster includes buildings of the academic building № 2 (B2), the academic building № 3 (B3), the academic building № 2 (B2), dormitory № 2 (B9), dormitory № 3 (B10), dormitory № 4 (B11), dormitory № 5 (B12), dormitory № 6 (B13), dormitory № 7 (B14), dormitory № 8 (B15) (Fig. 6). These facilities are characterized by an average level of energy consumption.

Members of Cluster Number 2 and Distances from Respective Cluster contains 9 cases		
	Distance	
B2	475,96	
B3	731,18	
B9	2234,42	
B10	2328,99	
B11	538,98	
B12	2307,67	
B13	2151,33	
B14	10295,95	
B15	1487,82	

Source: calculated from expert assessments.

**Figure 5. List of KNUTD buildings in cluster 2
(Average energy consumption)**

In the third cluster were the buildings of Training Building 5 (B5), Training Building 8 (B6), Building 6 (B7) and Building 7 (B8) (Figure 7).

Members of Cluster Number 3 and Distances from Respective Cluster contains 4 cases		
	Distance	
B5	1036,916	
B6	444,261	
B7	231,782	
B8	378,972	

Source: calculated from expert assessments.

**Figure 6. List of KNUTD buildings in cluster 3
(Below average energy consumption)**

These facilities are characterized by relatively low energy consumption, which is explained by high roof, wall and floor insulation, low thermal conductivity of windows and air permeability of the buildings. Thus, by using cluster analysis tools it was possible to unambiguously determine the level of energy consumption in the studied buildings and the achieved level of energy management.

CONCLUSION.

Electricity consumption is a specific function that does not follow the laws of normal distribution and has a significant asymmetry, which indicates that standard statistical methods cannot be used to estimate and predict electricity consumption. Electricity consumption depends on many factors, the influence of which can be taken into account by a multiple regression equation. Thanks to this equation, we can make forecasts with an accuracy of 3.68%. The modern market offers a significant number of automatic energy accounting systems. The existing systems have great functionality not only in the area of metering, but also in the area of quality assessment of the consumed resource, SCADA-

systems, as well as in the area of electronic document management and forecasting. To date, although the market has promising accounting systems, it is not able to meet all the individual needs of higher education institutions. The use of an automated metering point of the university's Energy Efficiency Knowledge Hub has enabled the energy certification and energy audit of the Kyiv National University of Technologies and Design.

ACKNOWLEDGEMENT.

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ABBREVIATIONS:

%	Percentage
COVID-19	Corona Virus Disease 2019, corona virus infection 2019-nCoV
Eq.	Formula of calculation
Fig.	Figures
HEI	Higher education institution
HUB	Common connection point
KNUTD	Kyiv National University of Technologies and Design

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3206.2021.1.3

SOCIAL RESPONSIBILITY OF THE EDUCATIONAL ECOSYSTEM OF A HIGHER EDUCATION INSTITUTION UNDER CONDITIONS OF STRUCTURAL AND INNOVATIVE CHANGE

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BACKGROUND AND OBJECTIVES.

Problems of social responsibility of higher education institution gain particular relevance not only due to changes in the content and conditions of its functioning, but also due to the transformation of many fundamental tenets of higher education institutions' activities. The close relationship between the concepts of "corporate social responsibility" and "educational organisation" manifests itself as the responsibility of the state for the state of the educational system in the country and the responsibility of the educational organisation for the quality of education to its stakeholders.

METHODS. The study was based on the principles of corporate social responsibility, sustainability theory and stakeholder theory.

FINDINGS. We propose an innovation ecosystem model for higher education institutions, which represents a new organisational integrity and modern way of producing innovation, implemented within a dynamic and adaptive

mechanism that creates, consumes and transforms knowledge into innovative products, using a common innovation infrastructure and common rules among system participants, oriented towards their mutual benefit.

CONCLUSION. The identified close relationship between the concepts of ecosystem, innovation ecosystem and business ecosystem made it possible to propose a model of innovative educational ecosystem of higher education institution as a complex self-organizing, self-regulating and self-developing system. The provisions on the need to integrate the principles of corporate social responsibility and the principles of innovative ecosystem functioning implemented in higher education institutions have been substantiated.

KEYWORDS: corporate social responsibility; higher education organisation; ecosystem; business ecosystem; university innovation ecosystem.

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
20	1	1

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СОЦІАЛЬНА ВІДПОВІДАЛЬНІСТЬ ОСВІТНЬОЇ ЕКОСИСТЕМИ ЗАКЛАДУ ВИЩОЇ ОСВІТИ В УМОВАХ СТРУКТУРНО- ІННОВАЦІЙНИХ ПЕРЕТВОРЕНЬ

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ПОСТАНОВКА ПРОБЛЕМИ ТА ЗАВДАННЯ. Проблеми соціальної відповідальності вищої школи набувають особливої актуальності в зв'язку не тільки зі зміною змісту та умов її функціонування, але і з трансформацією багатьох основоположних постулатів діяльності закладів вищої освіти. Тісний взаємозв'язок понять «корпоративна соціальна відповідальність» і «освітня організація» проявляється як відповідальність держави за стан системи освіти в країні та відповідальність освітньої організації за якість освіти перед її зацікавленими сторонами.

МЕТОДИ. Дослідження базувалося на принципах корпоративно-соціальної відповідальності, теорії сталого розвитку, теорії зацікавлених груп.

РЕЗУЛЬТАТИ. Запропоновано модель інноваційної екосистеми закладу вищої освіти, що представляють собою нову організаційну цілісність і сучасний спосіб виробництва інновацій, що реалізується в рамках динамічного і

адаптивного механізму, який створює, генерує і трансформує знання в інноваційні продукти при використанні учасниками системи загальної інноваційної інфраструктури та загальних правил, орієнтованих на отримання ними взаємних вигод.

ВИСНОВКИ. Виявлений тісний взаємозв'язок понять екосистеми, інноваційної екосистеми і бізнес-екосистеми дозволив запропонувати модель інноваційної освітньої екосистеми закладу вищої освіти як складної системи, яка самоорганізується, саморегулюється і саморозвивається. Обґрунтовано положення про необхідність інтеграції принципів корпоративної соціальної відповідальності і принципів функціонування інноваційних екосистем, впроваджуваних в закладах вищої освіти.

КЛЮЧОВІ СЛОВА: корпоративна соціальна відповідальність; заклад вищої освіти; екосистема; бізнес-екосистема; інноваційна екосистема закладу вищої освіти.

INTRODUCTION.

Problems of social responsibility of higher education institution become especially relevant due not only to changes in the content and conditions of its functioning, but also due to transformation of many fundamental postulates of higher education institution (HEI) activity. The specificity of the principles of social responsibility of higher education institution is largely determined by its dual role in the market. On the one hand, HEI as a social institution performs the functions defined for it by the state, and its social responsibility fully depends on the standards and regulations established by the state, the level of development of public administration system (Savitska, 2015). The main criteria for effective implementation of this policy are the quality and accessibility of education; the demand for university graduates in the labour market; the demand for scientific research carried out within the higher education system; ensuring state guarantees of human rights and freedoms in education, freedom to choose the form and place of study; guarantees of adequate living conditions for students, including international students, with appropriate stipends; formation of a socially active personality (Gudzinski et al., 2013).

The HEI is responsible to the state for the results of its activities as a social institution serving as an instrument of inheritance of culture, aggregate social experience, their transmission from one generation to another and fulfilling the social order of society, its various social groups (including students themselves, their parents, employers) to implement an effective system of continuing professional education (Grishnova et al., 2014). They are based on the methodological principles of higher education (Grischenko et al., 2015), on the key principle of recognising further vocational education as a catalyst for renewal processes, on the methodology and tools of anticipatory education (Osaulenko et al., 2018).

The state also has an obligation to the higher education institution to comply with the principles of state policy and legal regulation of relations in the field of education, to carry out qualitative and effective legal regulation of relations in the field of education and to guarantee the right of every person to education (Sandul, 2015). On the other hand, as a full-fledged participant of market relations and an independent economic entity, HEI imposes on itself voluntary responsibility to employees, service consumers, partners, public (Yakovenko et al., 2011). Social responsibility, unlike legal responsibility, implies a certain level of voluntary response of an organization to real social problems. In general, it is about rethinking the role of higher education institution in the development of socio-economic space (Shevchenko, 2016). With the rapid development of information and communication technologies and the digitalisation of systems and resources for use in HE, there is a rethinking of the learning process itself, developing new concepts and

paradigms for HE, based on the assumption that nowadays, a time of extensive use of ICT and cyber services that define new types of integrative relationships and interactions, the main overarching construction that defines learning is the environment (Sarioglo, 2016). This approach, in turn, makes use of the basic assumptions inherent in natural (and artificial) ecosystems (Timchenko, 2018).

The aim of the study is to form and adapt proposals to improve the program of social responsibility development of educational ecosystem of higher education institution under conditions of structural-innovative transformations on the basis of analysis of theory and practice of corporate-social responsibility implementation in higher education institutions. The research was conducted in 2020 on the basis of data of Kyiv National University of Technologies and Design.

MATERIALS AND METHODS.

Literature review.

Transformation processes in the research and education sphere predetermine the necessity to develop the system of research and innovation management in universities and to form their innovation ecosystems. HEIs conducting research in the field of innovation management link research, design, educational activities and business in a common network of cooperation in order to influence the formation of a complex ecosystem of knowledge and its effective use. The concept of ecosystem was introduced into science by the English botanist A.G. Tansley in 1935 to refer to any set of organisms living together and their environment (Tansley, 1935). In this regard, the relevant idea of the educational approach is that new types of relationships and interactions in the educational system are shaped by the educational environment, which is constantly changing in line with scientific and technological (technological) advances (Mercan et al., 2011). It is necessary to systematize the interpretations of "ecosystem", "entrepreneurial ecosystem", "innovation ecosystem", "business ecosystem" (Table 1), which allows to clarify the essence of these concepts, to consider individual elements of ecosystem.

Table 1

Interpretations of the categories "ecosystem", "entrepreneurial ecosystem", "innovation ecosystem", "business ecosystem"

Definition	Sources
"Ecosystem"	
A single natural complex formed by living organisms and their habitat (atmosphere, soil, water, etc.), in which the living and non-living components are linked by the exchange of matter and energy.	O. Gudzenski, T. Gurenko, 2013
Energy exchange system, interconnections between its participants. Applying the concept of ecosystems to problems of the innovation process reveals their causes, as well as modelling perspectives	E. Ugnich, M. Izotov, I. Voloshchenko, 2015

End of table 1

Definition	Sources
Any community of living beings and its habitat combined into a single functional unit based on interdependence and cause-effect relationships	J. Moore, 1998
A concept describing the evolution of the nature of interactions of economic agents, the patterns of their innovation activity and their relationship with the operating environment	B. Mercan, D. Goktas, 2011
"Business ecosystem"	
The notion of an ecosystem is closely related to that of a business model, as it recognises the need to move beyond the boundaries of the focal organisation and adopt a more systems perspective that emphasises interdependence and complementarity between the organisation and third parties in order to properly understand how value (and value) is created. However, unlike the business model, the ecosystem is not tied to the parent organisation; different organisations can use the same ecosystem, even with very different business models	D. Timtchenko, 2020
Systemic dynamic and co-evolving communities composed of diverse actors creating and gaining new content through both interaction and competition. Formed at the intersection of technology, open standards and architecture, providing a platform for industry development	H. Savitska, 2015
A set of conditions that enable successful creation and development of organizations; a key feature of such an association is self-organization	A. Grozin, N. Tretiak, H. Sarukhanyan, 2016
A set of production, innovation infrastructure and external environment	A. Shilyaev, 2013
A system where products and services connect to platforms which in turn can integrate with other platforms or services	M. Sandul, 2015
A dynamic economic model of the complex relationships formed between actors whose activities are related to the realisation of entrepreneurial ideas	O. Geshko, 2017
"Innovation ecosystem"	
An entrepreneurial (innovation) ecosystem is a set of conditions for the successful creation and development of an organisation. The key feature of such an association is self-organisation. Such an ecosystem can consist of four main components: the idea, the entrepreneurial expertise, the funding source and the community that brings them together into a coherent whole. Any entrepreneurship is inherently innovative, as it is focused on the constant search for new, more efficient ways to organise activities. Innovation, therefore, is about finding, activating, developing and managing resources and is inherent in the entrepreneurial activity itself.	A. Grozin, N. Tretiak, H. Sarukhanyan, 2016
A variety of entrepreneurial (innovation) ecosystems are mobile ecosystems (or ecosystems of mobile technologies), which may include developers of information product (mobile platforms, management security systems, business service applications, etc.), manufacturers and suppliers of devices, consulting and integration services, users (consumers), etc., and all participants (partners) are linked and the association functions on a mutually beneficial (for all participants) basis.	I. Moshkin, 2009.

End of table 1

Definition	Sources
A set of relations between the subjects of the innovation process for the purpose of commercialisation of innovations. This is an open system, which has a certain place in the larger ecosystem, where the partnership relationship with the university is formed. The innovation ecosystem is based on the principle of interaction between the competencies of its participants.	E. Ugnich, M. Izotov, I. Voloshchenko, 2015
A structure, arrangement, set of elements, a part of the institutional environment that provides the conditions for the organization of innovation activities in different areas of the economy	J. Deborah, 2011
A community based on both formal and informal relationships between its participants, the purpose of which is cooperation for the exchange, distribution and dissemination of knowledge and its transformation into commercial innovative products	L. Yakovenko, O. Pashchenko, 2011
A dynamic economic model of complex relationships formed between actors or organisations whose functional purpose is the development of technology and innovation	H. Chesbrough, 2011
A set of virtually "greenhouse" conditions that will ensure the successful creation and sustainable development of small venture capital ventures	I. Osaulenko, 2018
A complex self-organizing system based on the relationships between the elements of the innovation infrastructure.	O. Grishnova, S. Bekh, 2014
Integral characteristic of the quality of the environment of innovation activity, determining the level of favourable (or unfavourable) existing conditions affecting the efficiency of innovation activities	H. Savitska, 2015
IES is a self-organising, self-regulating, self-developing open system characterised by the input flows of ideas, costs, people, information, other resources; its functionality can be described as a set of functions and assignments (search for investors, exchange of ideas and critique of ideas, commercialisation of innovations, creation of functional structures that will implement these innovations).	I. Osaulenko, 2018

The term "business ecosystem" was coined by J. Moore (1998). M. Rothschild has applied biological concepts to real economic phenomena, using the concept of an "ecosystem" and setting up his approach in a separate line of research, bionomics. Moore defines a business ecosystem as an economic community made up of a collection of interlinked institutions and individuals. A. Tansley (2019) shifts the focus from interactions within the business ecosystem to the decentralized decision-making and self-organization of such systems, treating them as extended systems of complementary organizations, communities of customers, suppliers, lead producers and other stakeholders, financial communities, trade associations, trade unions, government and quasi-public institutions that are centered around a key product. In our view, ecosystem equilibrium can be used as one of the key criteria for delineating and studying business ecosystems, which will allow to separate business ecosystems

from various forms of associations of organisations that are temporary and non-systemic in nature. The equilibrium of the business ecosystem can also be used as a key criterion in assessing various types of regulatory effects, consequences of management decisions, which will make it possible to analyze their impact not only on key stakeholders, but also on all elements of the system. The concept of innovation ecosystem was proposed by H. Chesbrough (2003). It offers a tool for creating an environment that enhances the competitiveness of organisations in national and regional economies. At the heart of the concept is the notion of innovation as a process of transforming an idea into a marketable product or service, which requires the collective efforts of multiple actors: manufacturing companies, universities, research companies, venture capital funds. Participants of open IES purposefully use flows of incoming and outgoing knowledge in implementing the innovation process, thereby accelerating internal innovation and expanding markets for its external use.

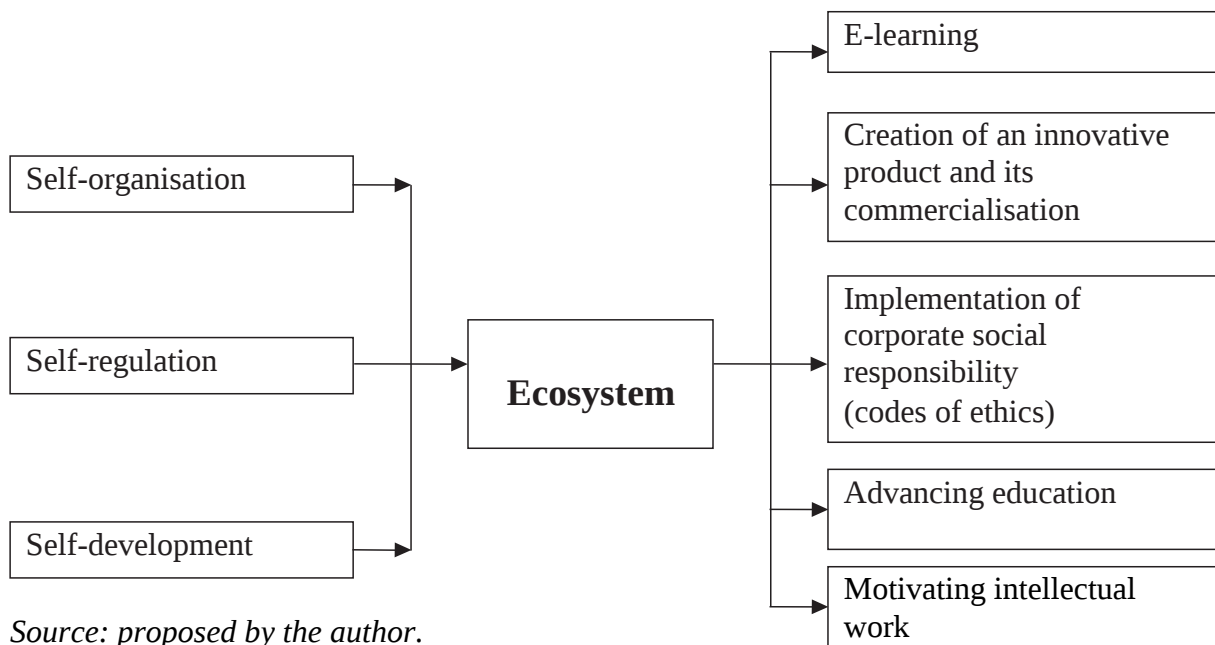
Method description.

The study was based on the principles of corporate social responsibility, sustainability theory and stakeholder theory. The main methods of scientific research were: comparison, analysis, synthesis, historical and logical, retrospective, dialectical, structural and functional, comparative, systemic, statistical. The authors analyzed and studied the profile, periodicals and magazines, Internet-portals, monographic publications on social responsibility of business and higher education.

RESULTS AND DISCUSSION.

Here is the definition of the university ecosystem provided on the official website of the Massachusetts Institute of Technology <http://web.mit.edu/>: "The university ecosystem is an innovation system, the elements of which are a marketing centre, a business incubator, a technology base, a centre for verification of conceptual technological solutions". In our opinion, the scheme of interaction between the subjects of the MIT ecosystem somewhat violates the logic of the implementation of this process. We believe it is possible to improve the mechanism of interaction between its participants by adjusting the following key points: the startup community should submit information about startup projects to entrepreneurial contests; entrepreneurial contests should select the best projects; based on the corporate investment programme, information about the project should be communicated to corporate investors (venture capitalists, direct investors and accelerators) about the possibility to invest money in this project; the role of business school and education and corporate investors, which will enable the startup community to generate new ideas based on the knowledge gained, and corporate investors to understand where the prospects for investing their funds are better.

The proposed HEI ecosystem model is shown in Fig. 1.



Source: proposed by the author.

Fig. 1. Model of an innovative educational ecosystem in a higher education institution

The main characteristics of the proposed educational model of the university ecosystem:

- a closed and complete cycle of training in project-innovation management, starting from entry at the stage of applicants (schools) to graduates (teams or managerial leaders capable of managing a team (creative team leader, technical director of an innovation project);

- the transversal and interdisciplinary nature of the educational model, both vertically (learning through all levels of training) and horizontally (students, faculties, research centres and university innovation environment are involved/involved);

- interdisciplinary nature of the educational model due to: (1) inclusion of students, including undergraduates, in project activities of different training areas (engineer with knowledge of technology features, lawyer, managerial manager, marketer, economist, etc.); (2) use of interdisciplinary projects obtained / formed by centres of excellence, interdisciplinary research laboratories in teaching and practice;

- the learning process allows proper and consistent formation of a set of competences in the field of innovation-project management;

- practice-oriented through the involvement of future specialists, undergraduates, young researchers in real science and technology (innovation) projects.

There is an obvious need for gradual involvement of students in the innovation ecosystem environment. But only with the involvement of other

participants in the ecosystem will the innovation ecosystem be able to function fully and, most importantly, through the chain "basic research – applied research – development – production of innovative products", fulfill its main goal – to commercialize the innovative product, bringing it to the end consumer.

CONCLUSION.

Increased attention to the problems of social responsibility of HEIs requires defining new strategic priorities of higher education system actors, taking into account the interests of all their partners and stakeholders. Development of the triad relationship "state – university – (employees and students)" as a basic element of socially responsible university is possible only in case of forming a qualitatively new innovative culture of university based on social responsibility and innovative activity of teachers, students and all employees. At the same time, corporate social responsibility is interpreted in two aspects:

- as a philosophy of university behaviour in society, a fundamental concept of relations between the organisation and other entities (as social groups), individuals, specifying the goals, principles, methods, tools used by the university to meet the needs and expectations of its stakeholders, determining the possibility of ensuring sustainable development given the limited resources and organisational capabilities available;

- as a systematic and multidimensional activity of HEI that affects the quality of life of society members through the consistent implementation of economic, social, environmental measures aimed at meeting the needs and expectations of stakeholders.

ACKNOWLEDGEMENT.

The authors are grateful to the heads of institutions of higher education for their help in carrying out these studies.

ABBREVIATIONS:

HEI	Institutions of higher education
CSR	Corporate social responsibility

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SOCIAL RESPONSIBILITY OF BUSINESS IN PREVENTING A COVID-19 PANDEMIC

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BACKGROUND AND OBJECTIVES. To build an effective market economy and democratic society, Ukraine needs to create a platform for dialogue between the government, business and civil society. Social responsibility of business is one of the key factors for building such a dialogue. The main problem of modern information support of social responsibility of business is the lack of a mechanism for its formation, which served as the basis for the improvement of methodological foundations for the formation of information support of social responsibility of business.

METHODS. The proposed system of parameters and criteria is the basis of a survey (using the method of hierarchy analysis), to assess the state of information support for social responsibility of business in the enterprises of the Kyiv region (Ukraine).

FINDINGS. A conceptual approach to the development of social responsibility in business has been formed, the implementation of which is based on the development of a methodological framework in three areas. The first one is implemented in the work by adapting the provisions of international standards of social responsibility. The second direction is represented by the development of the mechanism of formation of information support of social responsibility of business, which provides, on the one hand, monitoring in the implementation of quality assessment of information support of social responsibility

of business, and, on the other hand, optimization of the process of formation of information on social responsibility of the enterprise for stakeholders. The third direction of the conceptual approach is implemented in the work through the formation of the relationship between financial and social reporting indicators, which promotes consistent disclosure of non-financial and financial information in social reporting for stakeholders, which in the context of the COVID-19 pandemic is of particular importance.

CONCLUSION. The formation of information support for social responsibility of business should be seen as a combination of three pillars: theoretical, structural and process. The implementation of the mechanism is aimed at unifying the structure and content of social reporting and meeting the information needs of stakeholders, the implementation of international standards of social responsibility of business, based on the results of evaluation of their provisions and the development of terminology of the fundamental categories of the "open society". Implementation of the methodological approach will allow to form the enterprise's development priorities in terms of social responsibility of business, minimise conflicts of stakeholders and ensure the formation of interrelation between financial and social reporting indicators.

KEYWORDS: social responsibility of business; COVID-19.

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
10	3	1

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СОЦІАЛЬНА ВІДПОВІДАЛЬНІСТЬ БІЗНЕСУ В УМОВАХ ЗАПОБІГАННЯ ПАНДЕМІЇ COVID-19

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ПОСТАНОВКА ПРОБЛЕМИ ТА ЗАВДАННЯ. Для побудови ефективної ринкової економіки та демократичного суспільства Україні необхідно створити платформу для діалогу між Урядом, бізнесом і громадянським суспільством. Соціальна відповідальність бізнесу є одним з ключових чинників для побудови такого діалогу. Основною проблемою сучасного інформаційного забезпечення соціальної відповідальності бізнесу є відсутність механізму його формування, що послужило основою для вдосконалення методичних основ формування інформаційного забезпечення соціальної відповідальності бізнесу.

МЕТОДИ. Запропонована система параметрів і критеріїв покладено в основу анкетування (із застосуванням методу аналізу ієрархій), проведення оцінки стану інформаційного забезпечення соціальної відповідальності бізнесу на підприємствах Київського регіону (Україна).

РЕЗУЛЬТАТИ. Сформовано концептуальний підхід до розвитку соціальної відповідальності бізнесу, в основу реалізації якого покладено розробку методичних основ за трьома напрямками. Перший напрям реалізований за допомогою адаптації положень міжнародних стандартів соціальної відповідальності. Другий напрямок представлено розробкою механізму формування механізму формування інформаційного забезпечення соціальної відповідальності бізнесу, який забезпечує з одного боку моніторинг в здійсненні

оцінки якості інформаційного забезпечення соціальної відповідальності бізнесу, а з іншого – оптимізацію процесу формування інформації про соціальну відповідальність підприємства для зацікавлених сторін. Третій напрям концептуального підходу реалізовано в роботі за допомогою формування взаємозв'язку показників фінансової і соціальної звітності, що сприяє послідовному розкриттю інформації нефінансового і фінансового характеру в соціальній звітності для зацікавлених сторін, яке в умовах пандемії COVID-19 набуває особливої значущості.

ВИСНОВКИ. Формування інформаційного забезпечення соціальної відповідальності бізнесу слід розглядати як сукупність трьох основ: теоретичної, структурної та процесної. Реалізація механізму спрямована на уніфікацію структури і змісту соціальної звітності та задоволення інформаційних потреб зацікавленими сторонами, реалізацію міжнародних стандартів соціальної відповідальності бізнесу, заснований на результатах оцінки їх положень і розвитку термінології основних категорій «відкритого суспільства». Реалізація методичного підходу дозволить сформувати пріоритети розвитку підприємства в умовах соціальної відповідальності бізнесу, мінімізувати конфлікти зацікавлених сторін і забезпечить формування взаємозв'язку показників фінансової і соціальної звітності.

КЛЮЧОВІ СЛОВА: соціальна відповідальність бізнесу; COVID-19.

INTRODUCTION.

The development of socio-economic relations in Ukraine leads to the need to adapt the functioning of enterprises to modern economic conditions (Bay et al., 2011). The activity of any enterprise relies on the readiness of society to develop this kind of activity (Baiura, 2009). In order to have constant public support, enterprises need to carry out certain social activities (financing of charitable projects, social protection of employees, taking care of the environmental situation) (Voronchak, 2009), thus emphasizing their social importance (Berezina, 2016). Achieving a balance of economic and social goals of the enterprise (Gerasimchuk et al., 2014) is the basis on which the process of development of socially-oriented economy in general and social responsibility of business in particular is based (Boretska, 2013). This problem should be considered from the perspective of improving both the areas of social responsibility (Getman et al., 2006) and their information support to improve the performance of enterprises (Butko et al., 2010). The relevance of the research topic is determined by: the need to study stakeholders' needs for information on social responsibility of business (Gogulya et al., 2008); development of scientific and methodological approach to implementation and testing the provisions of international standards of social responsibility of business (Hetman et al., 2014); formation of directions of social responsibility of enterprises and development of appropriate information support (Schaefer et al., 2014).

The aim of the study is to comprehensively address the development of corporate social responsibility in an entrepreneurial environment in the context of COVID-19 pandemic prevention. The study was conducted in 2020 based on data from the Kyiv region (Ukraine).

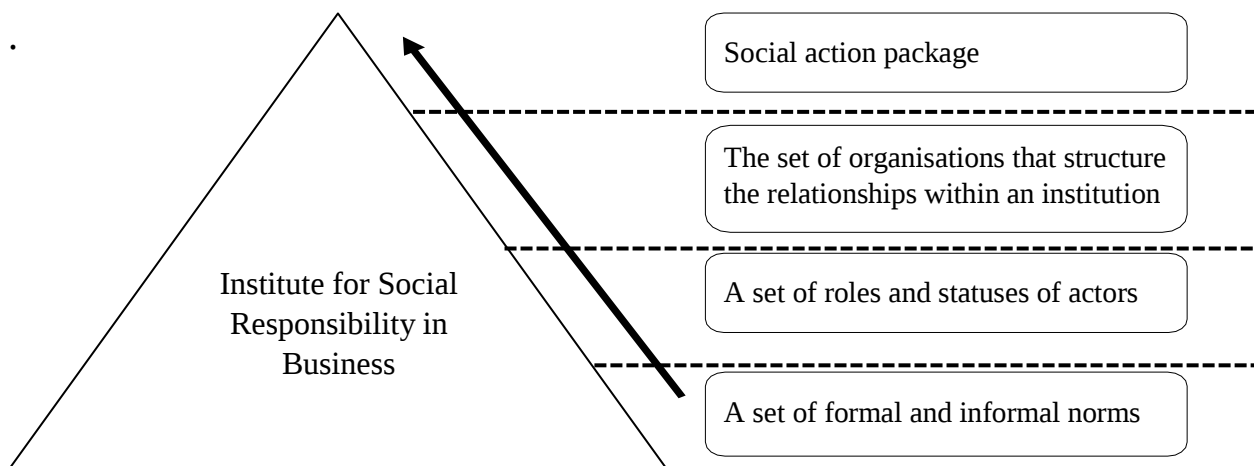
MATERIALS AND METHODS.

The following general scientific and special methods were used to achieve the set goal and to solve the relevant tasks: analysis and synthesis, induction and deduction – to study the conceptual framework; institutional approach – to improve the hierarchical structure and content of the elements of social responsibility of business; comparative analysis and questionnaires – to study the experience of global companies and domestic enterprises in social responsibility; logical – to study the modern process of information formation; and methodological approach – to study the process of social responsibility formation. The data were processed using a personal computer using the EXCEL for Windows package.

RESULTS AND DISCUSSION.

The study of the role of the institution of social responsibility of business in the entrepreneurial environment, which consists in the formation of norms of behaviour (the so-called "rules of the game"), allowed to improve the hierarchical structure and content of the elements of social responsibility of

business, whose interrelation and interdependence underlie the coordination of the interests of stakeholders in the entrepreneurial environment (Figure 1).

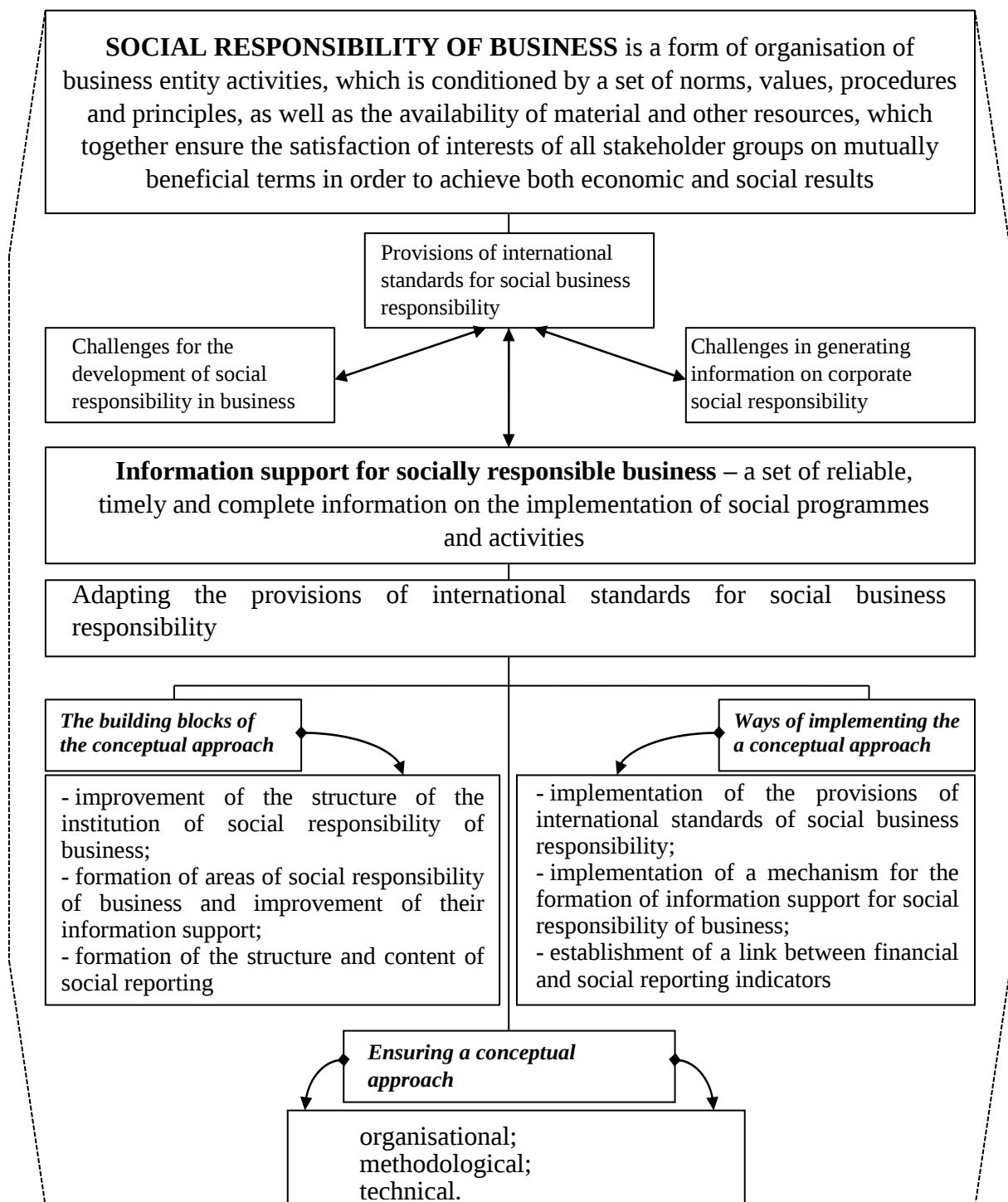


Source: Boretska (2013).

Fig. 1. Hierarchical structure of the elements of the institution of social responsibility of business

It has been established that international standards for social responsibility of business are aimed at the development of social responsibility practices both at the enterprise level (as instructions) and at the national, international level (as regulatory documents). Coverage by international standards of all areas of social responsibility of business, as well as the commonality and unity of the recommendations that they present, should be based on the necessary information support of social responsibility of business. Interpretation of the essence of social business responsibility in the conditions of modern business environment development is the basis for development of the conceptual approach to development of social business responsibility (Figure 2).

In order to form directions for improvement of methodological foundations for development of social responsibility of business, its current state at the enterprises of Kyiv region (Ukraine) was studied by means of questionnaire survey. This made it possible to identify and systematise the problems of business entities in the implementation of social programmes (activities, projects) and the formation of reporting information. It was found that the main problem is the lack of a mechanism for the formation of information provision of social responsibility of business in the enterprises of the region. The survey involved 17 enterprises (405 respondents) from different sectors of the economy: trade, metallurgy, mechanical engineering, chemical, light and food industries. The respondents included: heads of departments and services (63.9%), leading specialists (24.9%), and employees of departments and services (11.2%).

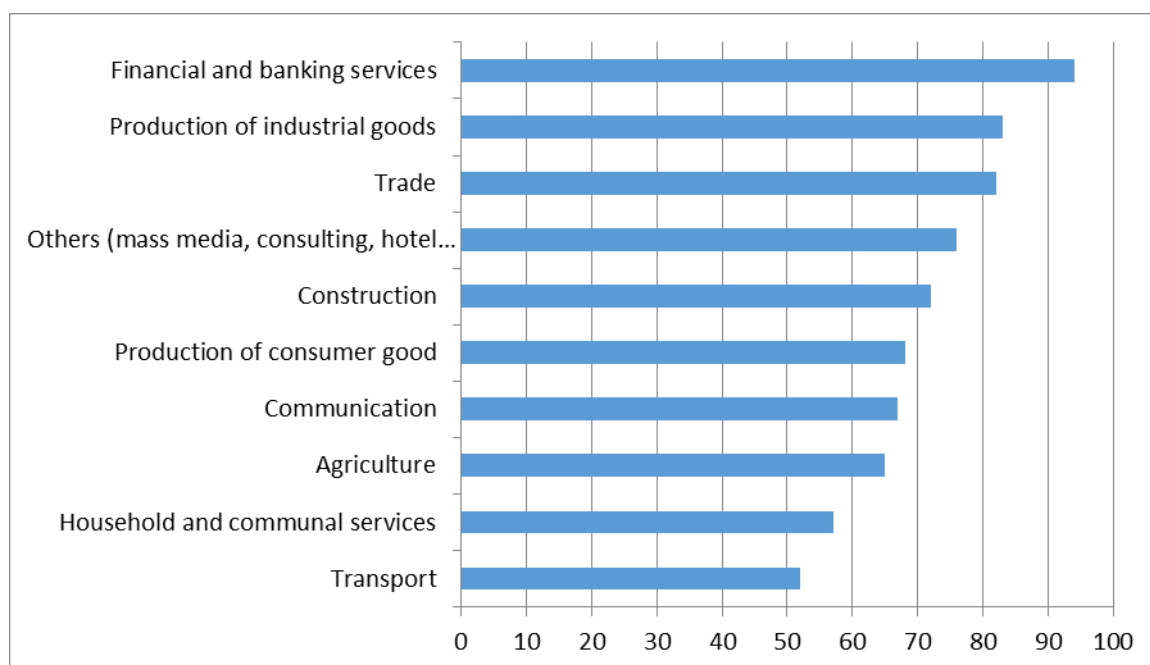


Source: (Butko, 2010; Getman et al., 2014).

Fig. 2. A conceptual approach to the development of corporate social responsibility

The formation of the areas of the social responsibility of business is based on the monitoring of the implementation of social programs and activities of the enterprises in the Kyiv region (Ukraine): 58.82% of the surveyed enterprises

regularly conduct activities in the field of labor protection; 52.94% implement social programs for clients to protect their interests; 64.71% are actively involved in training their employees through training courses by themselves or with the help of outside organizations; 29.41% conduct activities related to the improvement of the environmental protection. It has been established that the formation of information support for social responsibility of business should be based on object-subject approach, which is considered by the author as a set of sequential actions for the formation of objects, subjects and information about social responsibility. Parameterization of the elements of information support for social responsibility of business served as the basis for improving the methodological approach to assessing the state of information support for social responsibility of business (Figure 3).



Source: compiled by the author on the basis of survey data and the Ukrstatistika website.

Fig. 3. The state of information support for social responsibility in businesses in the Kyiv region (Ukraine)

The results of the assessment showed that the majority of surveyed enterprises of Kyiv region have medium and low level of information support of social responsibility of business, which served as the basis for improvement of methodological framework of formation of information support of social responsibility of business. The essence of the proposed methodological approach to the implementation of the provisions of international standards of social responsibility of business lies in the possibility of formation of enterprise development priorities in terms of business socialization, which will minimize stakeholder conflicts. The implementation of the methodological approach is a

set of measures of theoretical and practical nature aimed at the formation of relevant results and carried out within the framework of the identified areas. The implementation of the mechanism for the formation of information support for social responsibility of business helps stakeholders to obtain necessary and sufficient information for making managerial decisions and allows the unification of the structure and content of social reporting, which was developed by the author. The content of the sections of social reporting allows to meet the information needs of all stakeholders to the maximum extent, and also fully demonstrates the results of the social activities of the enterprise.

The results of the study of the stages of social reporting are the basis for the regulation and unification of the process of formation of information support for social responsibility of the business. The author has developed an internal corporate standard "Information support of social responsibility of business" (Table 1).

Table 1

Structure of the internal company standard "Information support for corporate social responsibility"

1.	GENERAL PROVISIONS (purpose, objectives, basis for development, scope, duration, etc.)
2.	BASIC TERMS AND DEFINITIONS
3.	CONTENT OF THE INTERNAL COMPANY STANDARD (factors influencing the development of a methodology, principles and stages of development of a methodology, elements of a methodology)
4.	APPLICATIONS (periodicity and technique of formation of information, route maps of information flows, methodological recommendations for interrelation of indicators of social and financial reporting)

The main feature of the standard is the comprehensiveness in addressing organisational, methodological and technical issues in the formation of information support and the unification of approaches to the procedure for reflecting information on social responsibility and the relationship between financial and social reporting indicators.

CONCLUSION.

The study of the essence of the institutional approach and peculiarities of its application to the study of social responsibility of business, allowed to improve the hierarchical structure and content of the elements of the institute of social responsibility of business. The hierarchical structure is based on the elements of social responsibility of business, aimed at the formation of norms of behavior in the business environment, based on the interests of enterprise stakeholders. The directions of improvement of methodological foundations for the development of social responsibility of business were preceded by the

assessment of its current state in the enterprises of the region, which allowed us to identify and systematize the problems of business entities in the implementation of social programs (activities, projects) and in the formation of reporting information (internal analytical reports, social reporting). An approach to the formation of information support of social responsibility at the enterprise was developed, the practical implementation of which was reflected in the development of an internal corporate standard "Information support of social responsibility of business". The main feature of the standard is its focus on regulating and unifying the approach to the formation of information support and to the procedure for reflecting information on social programmes and activities and the relationship between financial and social reporting indicators, which will optimise the process of making managerial decisions concerning the social responsibility of the enterprise.

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The author is grateful to the managers of enterprises in the Kyiv region for their help and assistance in the fieldwork.

ABBREVIATIONS:

%	Percentage
COVID-19	Corona Virus Disease 2019, corona virus infection 2019-nCoV
Fig.	Figures
SRB	Social responsibility of business

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HUMAN CAPITAL AS A KEY FACTOR IN THE DEVELOPMENT OF UNIVERSITY INNOVATION

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BACKGROUND AND OBJECTIVES. The transition to a digital economy as a vector for the development of multiple social institutions is forced to shift towards multi-dimensional integration. As a consequence, for a modern university, innovative activities are no less important than educational ones. At the same time, the key resource in the process of generating innovative solutions is the human resource. The multidisciplinary orientation of universities allows combining specialists with unique competencies in a single environment, complementing each other and allowing to achieve a synergistic result, and since innovation invariably implies generation of a certain innovation, it is this property of a university that allows us to talk about the presence of a unique innovative potential – human capital

METHODS. The article uses methods of system analysis, scientific analogy and abstraction – to study the category "human capital"; methods of grouping and systematisation – when systemising the main classification features of human capital and factors of influence on its development with account of globalisation trends; statistical analysis – to assess the state of development of human capital at university; indicative methods – when diagnosing human capital development in globalisation conditions; graphic methods – to visualise.

FINDINGS. The following categories were defined: 1) "human capital" as a complex

category, the main component of which is the development of non-standard human thinking, capable of self-organization, renewal, self-perfection and acts as an intellectual, creative factor and a key resource in building a socio-innovative model of economic development; 2) "innovative human capital of the university in conditions of globalization" which is viewed from an integrated approach, with the main emphasis on self-perfection, self-actualization of the human capital of the university; 3) "innovation human capital of the university" which is viewed from an integrated approach.

CONCLUSION. The development of human capital as the main condition for the formation of the structure of economy of innovative type, based on information and intellectual production technologies, causes the need to reform and improve the systemic state policy, focused on providing the basic conditions for comprehensive human development. It is the active impact of the state in complex economic conditions to increase the efficiency of human capital development both at the macro level (economy as a whole) and at the micro level (university) that will improve the economic situation in the country and enhance the competitiveness of the national economy in the global world.

KEYWORDS: human capital; university; research and development work.

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
14	0	3

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ЛЮДСЬКИЙ КАПІТАЛ ЯК КЛЮЧОВИЙ ФАКТОР РОЗВИТКУ ІННОВАЦІЙНОЇ ДІЯЛЬНОСТІ УНІВЕРСИТЕТІВ

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ПОСТАНОВКА ПРОБЛЕМИ ТА ЗАВДАННЯ. Перехід до цифрової економіки як вектор розвитку безлічі громадських інститутів вимушено зміщується в бік багатовимірної інтеграції. Внаслідок цього, для сучасно університету інноваційна діяльність стає не менш значущою, ніж освітня. При цьому ключовим ресурсом в рамках процесу генерації інноваційних рішень є людський ресурс. Багатопрофільна спрямованість університетів дозволяє в єдиному середовищі об'єднувати фахівців, що володіють унікальними компетенціями, які доповнюють один одного і дозволяють досягти синергетичного результату, а так як інновація незмінно має на увазі генерацію певного нововведення, то саме ця властивість університету дозволяє говорити про наявність унікального інноваційного потенціалу – людського капіталу.

МЕТОДИ. Використано методи системного аналізу, наукової аналогії і абстракції – для дослідження категорії «людський капітал»; методи групування і систематизації – при систематизації основних класифікаційних ознак людського капіталу та факторів впливу на його розвиток з урахуванням тенденцій глобалізації; статистичний аналіз – для оцінки стану розвитку людського капіталу університету; індикативні методи – при діагностуванні розвитку людського капіталу в умовах глобалізації; графічний – для наочного відображення матеріалу; абстрактно-логічний метод – для формулювання висновків і теоретичного узагальнення результатів.

РЕЗУЛЬТАТИ. Визначено категорії 1) «людський капітал» як комплексна категорія, головною компонентою якої є розвиток нестандартного мислення людини, здатного до самоорганізації, поновлення, самовдосконалення і виступає інтелектуальним, творчим чинником і ключовим ресурсом побудови соціально-інноваційний моделі розвитку економіки; 2) «інноваційний людський капітал університету в умовах глобалізації», яка розглядається з позиції інтегрованого підходу, де головний акцент на самовдосконаленні, самореалізації та інноваційної праці, тим самим підвищує рівень конкурентоспроможності університету в умовах розвитку інноваційно-інформаційної економіки і створює цінності в глобальній економічній системі.

ВИСНОВКИ. Розвиток людського капіталу як головної умови формування структури економіки інноваційного типу, заснованої на інформаційних та інтелектуальних технологіях виробництва, викликає необхідність проведення реформування і вдосконалення системної державної політики, орієнтованої на забезпечення базових умов для всебічного розвитку людини. Саме активний вплив держави в складних економічних умовах підвищення ефективності розвитку людського капіталу як на макрорівні (економіки в цілому), так і на мікрорівні (університету) сприятиме поліпшенню економічної ситуації в країні і підвищенню конкурентоспроможності національної економіки в глобальному світі.

КЛЮЧОВІ СЛОВА: людський капітал; університет; науково-дослідні та дослідно-конструкторські роботи.

INTRODUCTION.

The modern theory of human capital as a separate scientific direction began to form in the second half of the twentieth century, and the following new socio-economic conditions of economic management contributed to it (Azmuk, 2014): considerable theoretical and methodological material in the form of human capital concepts in world science was accumulated, which gave prerequisites for the emergence of a new scientific direction – human capital theory (Amosov et al., 2011); new and accelerated existing processes of humanization of socio-economic A specific feature of today's global economy is the widespread use of universities as drivers of innovative development (Andreychikov, 2010). The higher education system is the foundation for building up and using the country's intellectual potential. A competitive system of this reproduction based on intellectual capital is necessary for effective reproduction of highly qualified personnel (Voloshina, 2014). Intellectual capital, which includes knowledge, professional experience, competences, and reputation level, plays a particularly significant role in developed countries. The development and accretion of this capital has largely predetermined the formation of the most influential and economically powerful countries of the current era (Gvozdu, 2012). Intellectual capital is a form of fixation, preservation, accumulation, development of human experience: its basis is the "objectification" of human qualities and forces in the form of means of activity and cooperation of people, as well as in the form of a system of things, which conditions the reproduction of social life (Gorban et al., 2013); Some scholars define types of human capital in accordance with the types of investment in it. Thus, L. Golovko notes that human abilities can be developed through specific activities that have investment parameters (Golovko, 2014). Investment activities aimed at creating certain groups of human capabilities that have a capital base and are used as human capital are singled out: pre-school and school education and upbringing; higher education; training; professional development and retraining at work; health promotion; development of intellectual abilities; assimilation of volumes of necessary information in economic activity (Andreychikov, 2010). Particular attention is paid to higher education. In terms of perspective, new trajectories, vectors set by universities in the conditions of modern challenges become not just pointers, but also markers, locomotives for development, the consequence of movement along which will be the increase of intellectual capital. Against the background of increasing competition from comfort and stability through virtualization of everything possible, departure to social networks, the value of ideas, innovation in the broadest sense is increasing exponentially over time. Consequently, the question of personification of support of person's innovative potential from centres of development of innovative activity of youth to realization of own innovative project, which is the author's definition of the term "individual

trajectory", is especially acute. A great deal of research has been devoted to the development and improvement of individual trajectories of human innovative development, but in this study, it was necessary to highlight the following principle innovations that are eventually accumulated in the prepared and implemented innovative projects.

The purpose of the study is to substantiate the role of human capital as a key factor in the development of innovative activities of universities. The study was conducted in 2020 on the basis of data from Kyiv National University of Technologies and Design (Ukraine).

MATERIALS AND METHODS.

Theoretical and methodological basis is provided by fundamental provisions of economic theory, modern concepts of systems and management theory, methodology of state regulation of human capital development and scientific achievements of scientists on the effective reproduction of human capital and problems of economy and national economy management. In order to achieve the set goal and solve the set tasks, a set of principles, methods of scientific knowledge, general theoretical, special and interdisciplinary methods of scientific research, namely: system analysis, scientific analogy and abstraction – to deepen the definition of the essence of such conceptual categories as "human capital", "investment in human capital"; functional system method – when analyzing domestic and foreign experience of human capital development, to build the system of indicators.

RESULTS AND DISCUSSION.

The university is a kind of foundation for the development of intellectual capital. The university intellectual capital is used by the economic actors at the output and is a key factor that determines the competitiveness of the country's economy. Table 1 shows a diagram of the components of university intellectual capital.

The development of intellectual capital in foreign practice is directly linked to state support for research and innovation activities in HEIs, in particular R&D funding. R&D is the most significant part of intellectual capital. Thus, through public or private funding of R&D, it is possible to directly influence the development of intellectual capital in higher education institutions. The development of intellectual capital in developed foreign countries, although there is a difference in approach, is done precisely through R&D funding, either indirectly or directly. In the UK, funding of intellectual capital is done in a "dual support" format. On the one hand, the government gives one-off subsidies, on the other hand, university innovation departments fund research councils, which then also invest in R&D on a project basis. The experience of intellectual capital development in continental Europe can be considered on the example of Norway. All Norwegian universities in carrying out research and training of

scientific personnel must use the work of their graduates and doctoral students. The specificity is that conducting basic research is not the final goal: Norwegian universities need to achieve commercial use of the results of their inventions. Thus, the development of intellectual capital in developed countries is directly linked to the financing of R&D and its further commercialisation. The state plays a central role in funding universities and, accordingly, has the main leverage on the development of intellectual capital in them. In addition to the state, universities are also financed by private firms, which are interested in using the results of research activities of universities, usually in order to gain a competitive advantage or to improve their business processes. Table 2 shows the countries with the highest levels of investment in R&D.

Table 1

University intellectual capital scheme

University intellectual capital		
Market capital	Organisational capital	Human capital
Consumer base of educational services (capacity of consumers, their loyalty, development of relations with consumers (participation in product and technology development), standards of work with consumers of educational services)	Mission, vision, goals, management paradigm	Personality traits and psychophysiological characteristics
Reputation/image of the educational institution (fulfilment of obligations, relationships with suppliers, competitors, other stakeholders)	Level of strategic management Key competences and their development	Motivational characteristics Value orientations
Uniqueness of educational products, technologies, services (patent/authorship rights to intellectual property)	R&D and its impact	Universal competences (capacity for self-learning)
Business process methods, models and technologies used in the organisation	Level of financial management	Corporate competences (including knowledge management competences)
Organisational culture (moral values, work culture, general approach to business, attitude towards change)	Level of communication management Human resource management system	The competencies of the post
Strategic partners, effectiveness of stakeholder engagement	Level of project management Organisational structure	Skills

Source: Nikiforova, 2010.

Table 2

Top 10 countries with the most investment in R&D

Country	2018			2019		
	GDP, \$ billion	R&D, \$ billion	Share of R&D in GDP, %	GDP, \$ billion	R&D, \$ billion	Share of R&D in GDP, %
1. USA	19921,0	565,76	2,84 %	20458,9	581,03	2,84 %
2. China	24646,0	485,53	1,97 %	26223,3	519,22	1,98 %
3. Japan	5469,9	191,45	3,50 %	5519,1	193,17	3,50 %
4. Germany	4253,8	120,81	2,84 %	4338,9	123,22	2,84 %
5. India	10146,1	86,24	0,85 %	10937,5	94,06	0,86 %
6. South Korea	2087,8	90,19	4,32 %	2148,4	93,46	4,35 %
7. France	2885,4	64,92	2,25 %	2943,1	66,22	2,25 %
8. Russia	4068,0	61,83	1,52 %	4129,0	61,94	1,50 %
9. Great Britain	2926,1	50,33	1,72 %	2970,0	51,38	1,73 %
10. Brazil	3293,0	38,53	1,17 %	3375,3	39,15	1,16 %

Source: Pisarenko, 2019.

Ukrainian investment in R&D in 2019, according to the Global R&D Funding forecast 2019, was projected at 61.94 bn dollars, which would amount to 1.5% of GDP. Ukraine is not among the largest investors in terms of the share of R&D spending in GDP. The average R&D expenditure in developed countries is approximately 3% of GDP. The concept for long-term socio-economic development of Ukraine until 2025 envisages that R&D expenditure should increase to 2.5–3% of GDP by 2025, but compared to 2018, the share of investment in R&D to GDP has decreased by 0.02 p.p. Thus, it seems unlikely that an R&D investment level of 2.5% of GDP will be achieved by 2025. In addition to the Global Innovation Index, countries are ranked according to the Innovation Performance Index, which characterises the creation of favourable conditions for innovation performance. On this indicator, Ukraine is in 5th place in 2018, 6 positions higher than in 2017 (Table 3). This indicates an increase in the efficiency of innovation activity in the country.

Undoubtedly, the stagnation of the Ukrainian economy has had a negative impact on the possibility of reaching the level of developed countries in terms of R&D investment. Overcoming stagnation requires modernization of the Ukrainian economy, but the foundation of modernization is largely based on the scientific potential generated by investment in R&D. Hence, a major reorientation of the state budget towards scientific development by cutting expenditures in the least priority areas is required. The most important event in the transformational development of higher education in Ukraine came in 2003, when the state signed the Bologna Declaration. This act is based on the rapprochement and unification of different educational systems to create a single educational space for different states. With the signing of the declaration, higher education policy was oriented to the following objectives: the organization of

the domestic education system at the first stage of two-stage educational programmes (bachelor and master), and then the establishment of three-stage programmes – postgraduate studies; transition to new educational standards; development of new educational programmes; the introduction of comparable qualifications and competences; organization of defence of graduate qualifications instead of diplomas; use of point-rating systems Of course, the link between intangible assets and sustainable growth is objective and has classical examples. In Brazil, for example, intangible assets are becoming a key success factor for sustainable growth, increasing the surplus value of the intellectual capital of educational institutions (Fernandez, 2012). Modern challenges shape new trajectories, the vectors set by universities become not just signposts for people, but also markers, locomotives for development. A consequence of moving along the trajectory of development will be an increase in intellectual capital. Against the background of increasing competition from comfort and stability through the virtualisation of everything possible, the departure to social networks, the value of creations in the broadest sense is increasing exponentially over time.

Table 3

Trends in some countries' rankings on the Innovation Performance Index from 2010 to 2018

Country	Rating according to the Innovation Efficiency Index						
	2010	2012	2014	2015	2016	2017	2018
Ukraine	54	14	14	15	12	11	5
RF	30	43	49	60	69	75	77
Kazakhstan	77	131	118	124	108	116	111
China	14	1	2	6	7	3	3
USA	63	70	57	33	25	21	22
Germany	56	11	19	13	9	7	9
Poland	85	80	76	93	66	48	42
India	101	2	31	31	63	53	49
Japan	18	88	88	78	65	49	44
Switzerland	15	5	6	2	5	2	1
Luxembourg	5	8	9	3	1	1	2

Source: The Global Innovation Index 2010–2018 URL: <http://www.globalinnovationindex.org>.

CONCLUSION.

The development of intellectual capital in universities is an investment in the future of the country and society. R&D funding is a crucial determinant of intellectual capital development, so we face a difficult choice between a conservative approach to R&D investment and an increase in R&D expenditure to the level of developed countries, which would require a significant financial injection from the state at the expense of other state budget expenditure items. But only the development of an innovation economy based on knowledge-

intensive industry can give Ukraine a chance to join the cohort of developed countries, so conservatism is inappropriate.

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ABBREVIATIONS:

%	Percentage
GDP	Gross domestic product
HEI	Institutions of higher education
R&D	Research and development work

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DETERMINING WHETHER THE PROTOTYPE HACKATHON ECOSYSTEM FOR TECHNOLOGY TRANSFER IN A HIGHER EDUCATION INSTITUTION MEETS THE NEEDS OF STAKEHOLDERS

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BACKGROUND AND OBJECTIVES. The development of the innovation ecosystem is one of the main vectors of development of the Ukrainian economy. One of the main elements of such policy are higher education institutions. Organizational method is an effective transition to the project approach of technology transfer management. The use of the organizational method implies the creation of a new organizational structure in the higher education institution. Such structure can be the creation of organizational unit – Hackathon-ecosystem of technology transfer, the main task of which will be the management of technology transfer projects.

METHODS. The study used methods of expert evaluation and questionnaire survey of stakeholders using closed and open-ended questions; feedback grids – to diagnose the effectiveness of the created prototype of the Hackathon ecosystem; Pareto diagrams – to analyze the information by determining the total score of the survey results; A / B testing – to choose between the existing version of the site and the created prototype; usability testing – to determine the degree of convenience and intuitive interface prototype.

FINDINGS. The method of creating a hackathon-ecosystem of technology transfer

in higher education institution with elements of design thinking is proposed. The work of new structural unit allows to determine the needs, interest, preferences and priorities of university stakeholders. Such stakeholders are university's employees, business representatives and the state. Tools of design-thought (observation, survey, generation and selection of ideas, prototyping) of stakeholders allow to build an optimal prototype of Hackathon-ecosystem of technology transfer in higher education institution.

CONCLUSION. Determination of compliance of the prototype of Hackathon-ecosystem of technology transfer in higher education institution with the needs of stakeholders allows to get feedback on directions of improvement of innovative work of university in general and new organizational structure, in particular. Questioning of technology transfer stakeholders in Kyiv National University of Technologies and Design allowed to create an optimal user-friendly and intuitive interface of Hackathon ecosystem prototype, corresponding to stakeholder needs.

KEYWORDS: Hackathon ecosystem; technology transfer; institution of higher education.

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
10	2	2

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ВИЗНАЧЕННЯ ВІДПОВІДНОСТІ ПРОТОТИПУ ХАКАТОН-ЕКОСИСТЕМИ ТРАНСФЕРУ ТЕХНОЛОГІЙ У ЗАКЛАДІ ВИЩОЇ ОСВІТИ ПОТРЕБАМ СТЕЙКХОЛДЕРІВ

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ПОСТАНОВКА ПРОБЛЕМИ ТА ЗАВДАННЯ. Розвиток інноваційної екосистеми є одним з основних векторів розвитку української економіки. Одним з основних елементів такої політики виступають заклади вищої освіти. Ефективним переходом до проектного підходу управління трансфером технологій є організаційний підхід. Використання організаційного підходу передбачає створення нової організаційної структури у закладі вищої освіти. Такою структурою може бути створення організаційного підрозділу – Хакатон-екосистеми трансферу технологій, основним завданням якого буде управління проектами трансферу технологій.

МЕТОДИ. У дослідженні були використані методи експертної оцінки та анкетування стейкхолдерів з використанням закритих і відкритих питань; сітки зворотного зв'язку – для діагностики результативності створеного прототипу Хакатон-екосистеми; діаграми Парето – для аналізу інформації шляхом визначення сумарної оцінки результатів анкетування; А / В тестування – для вибору між існуючою версією сайту і створеним прототипом; юзабіліті тестування – для встановлення ступеня зручності і інтуїтивної зрозумілості інтерфейсу прототипу.

РЕЗУЛЬТАТИ. Запропоновано метод створення Хакатон-екосистеми трансфе-

ру технологій у закладі вищої освіти з елементами дизайн-мислення. Робота нового структурного підрозділу дозволяє визначити потреби, зацікавленість, переваги та пріоритети стейкхолдерів університету. Такими стейкхолдерами є співробітники вузу, представники бізнесу, держави. Інструменти дизайн-мислення (спостереження, опитування, генерація і відбір ідей, створення прототипу) стейкхолдерів дозволяє побудувати оптимальний прототип Хакатон-екосистеми трансферу технологій у закладі вищої освіти.

ВИСНОВКИ. Визначення відповідності прототипу Хакатон-екосистеми трансферу технологій у закладі вищої освіти потребам стейкхолдерів дозволяє отримати зворотній зв'язок щодо напрямків вдосконалення інноваційної роботи вузу в цілому і нової організаційної структури, зокрема. Проведене анкетування стейкхолдерів трансферу технологій в Київському національному університеті технологій та дизайну дозволило створити оптимально зручний і інтуїтивно зрозумілий інтерфейс прототипу Хакатон-екосистеми, який відповідає потребам стейкхолдерів.

КЛЮЧОВІ СЛОВА: Хакатон-екосистема; трансфер технологій; заклад вищої освіти.

INTRODUCTION.

Ukraine has a strong scientific potential, every year in higher education institutions (HEIs) innovative technologies, developments are created, technology transfer offices are registered (Andrushkiv et al., 2015). However, most of them remain unrealized in the real sector of the economy (Afanasiev et al., 2013). The modern vector of state policy is aimed at the development of the innovation ecosystem, the main element of which are universities (Sergeeva et al., 2014). The use of the Hackathon Ecosystem of Technology Transfer (HETT) can serve as a prototype for the use of the results of innovation activities in higher education institutions by the needs of stakeholders.

The application of the project approach will make it possible to create effective organizational units on the basis of HEIs – Hackathon-ecosystems of technology transfer, whose main task will be the management of projects and portfolios of technology transfer projects (Kolomiets et al., 2017). The availability of HETT will allow to establish cooperation with business representatives, which, in turn, will increase the level of implementation of scientific and technological developments and attract extrabudgetary funding to the university (Dmitriev, 2017). The creation of such HETT is essentially a project, so there is an objective need to apply project management methodology (Bay et al., 2012). The problem of interaction between HEI, government and business has been the subject of research of many scientists, among which (Bai et al., 2012; Verkhoglyadova, 2004; Grin et al., 2013; Grinkevich, 2017; Grishchenko et al., 2015), some provisions of which were the basis for this study. Some of the mentioned scientists proposed the creation of organizational units – Hackathon ecosystem of technology transfer in HEIs to manage technology transfer processes. However, these studies were conducted without taking into account the project approaches. At the same time, HETT is essentially a mechanism of operational project management, and therefore the application of the project approach in the creation and functioning of HETT is necessary. The issues of creating and organizing such project offices in HEIs have their own peculiarities. Management of projects and project portfolios in HEIs and scientific institutions through the creation of a separate structural unit in HEIs or scientific institution in order to manage innovation activities is the most effective option to solve the problem. However, the issue of creating a new organizational structure for the purpose of managing technology transfer projects and portfolios is still poorly resolved. Therefore, today there is a need to establish ties between representatives of HEI and business, which will increase the level of implementation of the results of scientific and technological research in the real economy and attract extrabudgetary funding to the HEI. The solution to this problem is proposed by creating on the basis of HEI an organizational structure, which will be responsible for managing projects and portfolios of

technology transfer projects – the Hackathon ecosystem of technology transfer. However, for successful creation and further functioning of such organizational structure there is an objective need to apply project approach. The aim of the article is to determine whether the prototype Hackathon-ecosystem of technology transfer in higher education institutions meets the needs of stakeholders. The study is based on the data of Kyiv National University of Technologies and Design (KNUTD) in 2020.

MATERIALS AND METHODS₁₀

Determining whether the prototype Hackathon ecosystem of technology transfer in higher education institutions meets the needs of stakeholders is carried out by processing the responses by expert method using the following eq. (1):

$$\mu C_1 = \frac{\sum A(R_1) \dots A(R_n)}{n}, \quad (1)$$

where $A(R_{1...n})$ – respondents' answers;

$C_1 \dots C_{10}$ – evaluation criteria;

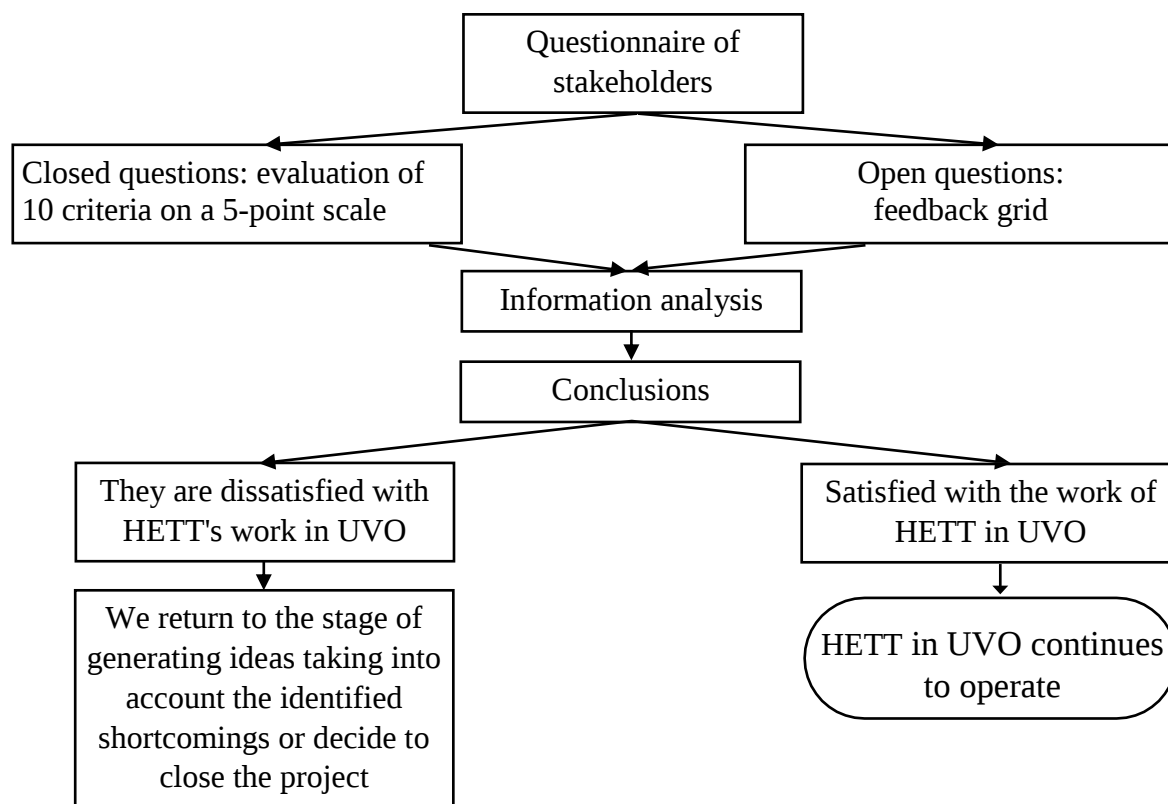
$\mu C_1 \dots C_{10}$ – total numerical evaluation of all respondents.

RESULTS AND DISCUSSION.

The method of determining the compliance of the HETT prototype in the HEI with the needs of the stakeholders will allow to make a decision on the further fate of the new organizational structure – on the beginning of the full functioning of the HETT in the HEI or on the closure of the project. Also, this method will make it possible to determine the directions for improvement of the new organizational structure. However, it should take some time (about 3–12 months) to have an objective opportunity to assess the results of this prototype HETT. The main task is to get feedback on the functioning of HET in the HEI. The method of determining the compliance of the HETT prototype at the HEI with the needs of the stakeholders, presented in Fig. 1, including the questionnaire of the stakeholders using closed questions, the answers to which represent the performance scores on a 5-point scale of 10 criteria, with the total score will assess the level of satisfaction with the HETT work.

In order to determine whether the prototype HETT at KNUTD meets the needs of stakeholders, a questionnaire survey was conducted among respondents who had already participated in surveys at the stage of initializing the project of creating HETT at KNUTD, as well as among other interested parties. The questionnaire was generated with the simultaneous use of closed and open-ended questions. The formulation of closed questions should meet clearly defined criteria for assessing the relevance of the HETT prototype at the HEI to the needs of stakeholders. In order to formulate the closed questions, the criteria

for determining whether the HETT prototype at the HEI meets the needs of stakeholders were established and are shown in Table 1.



Source: proposed by author.

Fig. 1. Approach to determining whether the prototype HETT at the university meets the needs of stakeholders

Table 1
Criteria for determining whether a HETT prototype meets stakeholder needs at the university

Designation of the criterion	The name of the criterion	Description of the criterion
C1	Timeliness	Execution of the project in the established term or with the minimum deviation from the established term
C2	Efficiency	The efficiency of the HETT team; efficiency and efficiency of management decisions; efficiency of technology advancement
C3	Flexibility	Establishing links between different functional units of the UVO for the joint creation of innovative technologies; adjustment to market requirements
C4	Optimality	Creation and maintenance of databases of technologies, developments and OPIV UVO; setting up and maximum simplification of the document management system in UVO regarding technology transfer; creation of the section of the site devoted to UVO technologies for an opportunity of access to the given information of the maximum circle of potential consumers

End Table 1

Designation of the criterion	The name of the criterion	Description of the criterion
C5	Reliability	Providing advice and assistance to technology innovators
C6	Stimulation	Creating a psychological climate in UVO to stimulate innovation; preparation and implementation of an IP Policy, which will determine the distribution of funds received as a result of the transfer of IPR rights or licensing, and will encourage the creation of innovative technologies in the UIA
C7	Economy	Maximum cost reduction: instead of involving third-party specialists (for software development, marketing research, etc.) – the use of own staff and resources
C8	Progressiveness	Participation in national and international projects, continuous development and training
C9	Communication	Establishing relations with representatives of business, the state; setting up communication channels
C10	Effectiveness	Involvement of the Ministry of Education and Science in co-financing the project; attracting additional funding for the purchase of modern equipment for universities; attracting extra-budgetary funding

Source: proposed by author.

The criteria given in the table, taking into account the specific functioning of the HEI and provide an opportunity to carry out an objective assessment of the activities of the new organizational structure. When evaluating the criteria indicated in Table 1, we propose to use a 5-point scale, according to which:

"1" – HETT prototype absolutely does not meet the needs of stakeholders by this criterion;

"2" – the HET prototype does not meet the needs of stakeholders by this criterion;

"3" – the HET prototype meets stakeholder needs in general by this criterion, but it is desirable to improve it;

"4" – the HET prototype meets stakeholder needs by this criterion, but not to the fullest extent;

"5" – the HET prototype fully meets the needs of stakeholders by this criterion.

Thus, on the basis of the criteria defined in Table 1, closed questions are formulated, which the respondent should answer, scoring from 1 to 5 points for each criterion. The total number of points from one respondent can be from 10 (absolute dissatisfaction with HETT at the university) to 50 (full satisfaction).

Taking into account certain criteria for the relevance of the HETT prototype to the needs of stakeholders, as well as the 5-point evaluation scale,

we propose to formulate closed questions with suggested answer options as follows:

Question #1: "Was the HETT project implemented on time?" Answer options: "The project was implemented on time" – 5 points; "The project was implemented with minimal delay" – 4 points; "The project was implemented with a delay" – 3 points; "The project was implemented with a significant delay" – 2 points; "The project was not implemented" – 1 point.

Question #2: "How effective was the work of the HET?" Answer options: "The work of the HETT team was well-coordinated, managerial decisions in matters of technology transfer were prompt and effective, technologies are effectively marketed and there are already successful examples of their implementation" – 5 points; "The work of the HETT team was well-coordinated, managerial decisions in matters of technology transfer were prompt and effective, but technologies have just begun to be marketed" – 4 points; "The work of the HETT team was coordinated, but managerial decisions in matters of technology transfer were not prompt and ineffective" – 1 point.

Question #3: "To what extent has HETT succeeded in setting up links between functional divisions of HEIs to work together to create innovative technologies and adjust the work to market requirements?" Answer options: "Functional divisions of HEIs work together to create innovative technologies taking into account market requirements" – 5 points; "Functional divisions of HEIs begin to work together to create innovative technologies taking into account market requirements" – 4 points; "Functional divisions of HEIs begin to work together to create technologies" – 3 points; "Functional divisions of HEIs have not begun joint work to create innovative technologies taking into account market requirements, but there is an understanding of the need to create innovative technologies" – 4 points.

Question #4: "How convenient is the workflow and data storage of technologies created at the university?" Answer options: "The system of workflow on the created technologies is simplified and clear (there are all necessary forms of documents, schemes of the documents' passing), the work of databases is adjusted, HETT employees assist in filling of all documents and databases if necessary" – 5 points; "The system of workflow is simplified and clear (there are all necessary forms of documents, schemes of the documents' passing), the adjustment of the work of database is in progress, HETT employees assist in the work of the database if necessary".

Question #5: "How do you evaluate the provision of consultations by the employees of KHETT on the issues related to technology transfer? Answer options: "HETT employees provide comprehensive consultations on all issues related to technology transfer at convenient time for HEI employees" – 5 points; "HETT employees provide comprehensive consultations on all issues related to

technology transfer, but only at the time set by such employees" – 4 points; "HETT employees consult on all issues related to technology transfer, but it is very difficult to get to such consultation" – 3 points; "HETT employees consult only on some.

Question #6: "How do you assess the incentives for activities in the field of creating innovative technologies?" Answer options: "Intellectual property policy, clearly defines the distribution of funds, provided distribution encourages innovators to create technologies, the psychological climate also contributes to the creation of innovative technologies" – 5 points; "Intellectual property policy, clearly defines the distribution of funds, provided distribution encourages innovators to create technologies, the psychological climate contributes to the creation of innovative technologies" – 4 points; "Intellectual property policy, clearly defines the distribution of funds, provided distribution encourages innovators to create technologies, the psychological climate also contributes to the creation of innovative technologies" – 4 points.

Question #7: "Was the project implemented within the planned budget?" Answer options: "The project was implemented within the planned budget, thanks to co-financing even managed to save some money" – 5 points; "The project was implemented within the planned budget" – 4 points; "The project was implemented slightly higher than planned budget" – 3 points; "The project was implemented significantly higher than planned budget, but it was possible to implement the project" – 2 points; "The project was implemented significantly higher than planned budget, due to which the project could not be implemented" – 1 point.

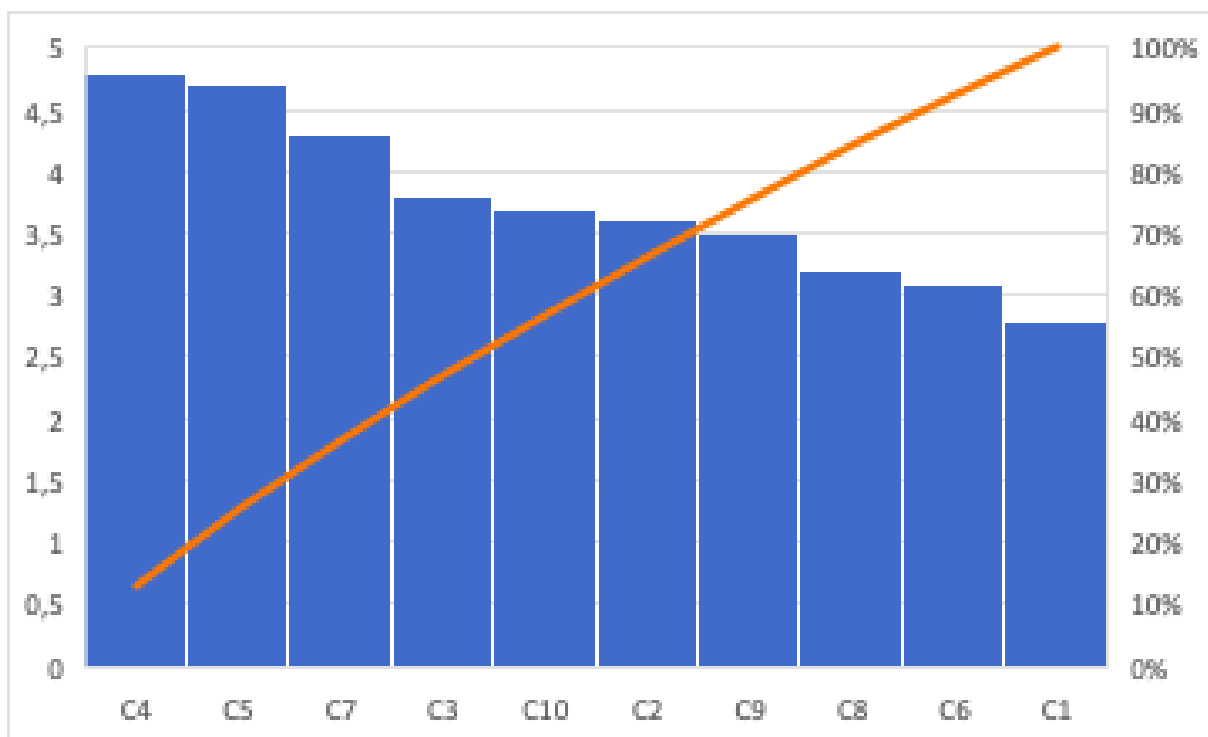
Question #8: "Do representatives of HEIs participate in national and international projects in the field of technology transfer thanks to the work of HETT?" Answer options: "Representatives of HEIs have already actively participated in national and international projects and continue to apply for participation thanks to the information received from the HETT staff" – 5 points; "Representatives of HEIs apply for participation in national and international projects thanks to the information received from HETT staff" – 4 points; "HETT staff distributes information about international or national projects, but HEI representatives perceive this information quite passively" – 3 points; "The staff of the HETT is not involved in national projects" – 2 points.

Question #9: "How tuned are the communication channels between the representatives of HEIs and businesses?" Answer options: "Communication channels, including the Internet, are configured and meet the requirements of the market, namely: the section of the website with a user-friendly interface, dedicated to the technologies of HEI, the active promotion of technology, there is a database of representatives of business, which may be potential consumers of technology, there is communication with them" – 5 points; "The

communication channels, including the Internet, are configured: the section of the website dedicated to the technologies of HEI, only formed a database of representatives of business" – 5 points; "Communication channels are set up, including in the Internet: the section of the website on the technologies of HEI is formed – 2 points; "Communication channels are not configured" – 1 point.

Question #10: "Has extrabudgetary funding been attracted to the university due to the work of the HETT?" Answer options: "Extrabudgetary funding was attracted in a significant amount" – 5 points; "Extrabudgetary funding was attracted not in a significant amount" – 4 points; "Extrabudgetary funding is being attracted" – 3 points; "It is planned to attract extrabudgetary funding" – 2 points; "No plans to attract extrabudgetary funding" – 1 point.

Based on the resulting total scores on equation (1), we propose to build a Pareto diagram, which will determine which of the criteria do not meet, do not quite meet, or do not meet the needs of stakeholders at all. It will allow to define a direction of improvement of HETT work in higher education institution (Fig. 2).



Source: built by the author.

Fig. 2. Pareto diagram for identifying areas of improvement in HETT at the university

Open-ended questions were formulated by supplementing the questionnaire with a feedback grid, shown in Table 2.

Table 2

Feedback grid

What I liked about HETT's work at the university?	What did you dislike about HETT's work at the university?
What questions do you have about the work of HETT?	What are your ideas for improving the work of HETT?

Source: proposed by author.

It is very important that the respondents who provided a low evaluation of HETT activities in the HEI, express their opinions and ideas in the proposed grid. The combination of closed and open questions in the questionnaire process will allow us to make objective conclusions about the need to make changes in the activities of the created HETT. If, as a result of the questionnaire, it is found that the prototype HETT in the university does not meet the needs of stakeholders, it is necessary to return to the stage of generating ideas and, taking into account the information obtained, to select ideas with subsequent iteration. If, as a result of the questionnaire, it is determined that the HETT prototype meets the needs of stakeholders, the HETT will continue to function. However, the ideas identified in the questionnaire to improve its functioning should not be discarded, but can be gradually implemented if appropriate resources are available. To determine the relevance of the prototype section of the site dedicated to technology and development of the HETT, we propose to use A / B testing and usability testing. During A / B testing we propose to show respondents for comparison screenshots of the current version of the HEI section of the site dedicated to technology, development, as well as screenshots of the section of the site that is proposed to be implemented. Based on the respondents' responses, it will be possible to unequivocally determine which version of the site is more acceptable. Usability testing of the prototype section of the site devoted to technologies, developments of the university we propose to conduct by engaging the respondents to search for specific information in this section in order to evaluate how user-friendly and intuitive interface, the possibility of identifying deficiencies with a view to their subsequent elimination. The information obtained as a result of testing on the prototype section of the site will help to decide on the need for its revision or the beginning of full-fledged functioning.

CONCLUSION.

During the observation and survey it was found that there are no modern communication channels between representatives of the University and business, primarily in the Internet. Therefore, during the generation of ideas it was proposed to create an additional product of the project – a section of the website, which will be dedicated to technology, development of the HEI. The method for determining the compliance of the HETT prototype in the HEI with

the needs of the stakeholders was proposed, the main task of which is to get feedback on the functioning of HETT in the HEI. The method includes questioning of stakeholders with the use of closed (evaluation of certain 10 criteria) and open questions (feedback grid), information analysis by determining the total evaluation of each criterion and constructing a Pareto diagram on the basis of obtained data, drawing conclusions, according to which the decision on the further fate of the created prototype is made. Ten criteria for determining the relevance of the HET prototype to the needs of stakeholders, including timeliness, efficiency, flexibility, optimality, reliability, incentives, cost-effectiveness, progressiveness, communicativeness, effectiveness, and a 5-point scale for evaluating these criteria were formulated. On the basis of certain total evaluations of each criterion by constructing a Pareto diagram it was established which areas of HET's work need improvement in the first place. It was proposed to determine the effectiveness of the prototype section of the site devoted to technology, development of HETT by applying the method of A / B testing to choose between the existing version of the site and the created prototype, as well as usability testing method, which will determine how user-friendly and intuitive interface prototype.

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The author is grateful to the heads of higher educational institutions for their assistance in conducting this research

ABBREVIATIONS:

<i>Eq.</i>	Equation
<i>fig.</i>	Figure
<i>HEI</i>	Higher education institution
<i>HETT</i>	Hackathon Ecosystem of Technology Transfer
<i>KNUTD</i>	Kyiv National University of Technologies and Design

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3206.2021.1.7

CONCEPTUAL MODEL OF THE HACKATHON ECOSYSTEM OF TECHNOLOGY TRANSFER IN AN INSTITUTION OF HIGHER EDUCATION

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BACKGROUND AND OBJECTIVES. The strategy of innovation development in Ukraine envisages the creation of innovative ecosystem of higher education institutions. Analysis of the current state of interaction between science, business and the state in Ukraine shows that most of the technologies and developments created as a result of scientific and technical activities of higher education institutions have not yet been implemented in the real economy. Communication interaction between representatives of higher school and enterprises involves the initiation of the innovation ecosystem. Practical implementation of conceptual model of Hackathon-ecosystem of technology transfer in higher education institution will allow to move to a new level of innovative development of higher education institution.

METHODS. The study used: the DFD method for constructing a context diagram and diagram 1 level of functioning of the Hackathon ecosystem of technology transfer in higher education institution; information and technological approaches to the project management of HETT creation in the university to ensure effective management of project data flow; qualitative and operational communication between the project stakeholders.

FINDINGS. The developed conceptual model of Hackathon-ecosystem of technology

transfer in higher education institutions allows to take into account the specifics of functioning of higher education. The proposed block diagram of the initialization project of the creation of the Hackathon-ecosystem of technology transfer consists of 7 stages, which allows to take into account the specifics of the university. The optimal composition of stakeholders of the Hackathon-ecosystem of technology transfer in higher education institutions is defined: initiator, manager, team, customer, curator, owner, competitors, sponsor, authorities, community groups, consumers, organizations, suppliers and contractors.

CONCLUSION. Practical implementation of the developed conceptual model of Hackathon-ecosystem of technology transfer in higher education institutions allows to generate ideas in accordance with market requirements and implement the most effective; to determine the needs and interests in establishing cooperation between representatives of higher education and business; to determine the compliance of the prototypes created with the needs of stakeholders and will provide feedback regarding the functioning of Hackathon-ecosystem of technology transfer.

KEYWORDS: Hackathon ecosystem; technology transfer; institution of higher education.

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
10	3	1

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КОНЦЕПТУАЛЬНА МОДЕЛЬ ХАКАТОН-ЕКОСИСТЕМИ ТРАНСФЕРУ ТЕХНОЛОГІЙ У ЗАКЛАДІ ВИЩОЇ ОСВІТИ

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ПОСТАНОВКА ПРОБЛЕМИ ТА РЕЗУЛЬТАТИ.

ЗАВДАННЯ. Стратегія розвитку інновацій в Україні передбачає створення інноваційної екосистеми вищих навчальних закладів. Аналіз сучасного стану взаємодії науки, бізнесу і держави в Україні свідчить, що більшість технологій і розробок, створених в результаті науково-технічної діяльності закладів вищої освіти, поки ще не впроваджені в реальний сектор економіки. Комунікаційна взаємодія між представниками вищої школи і підприємствами передбачає ініціацію створення інноваційної екосистеми. Практична реалізація концептуальної моделі Хакатон-екосистеми трансферу технологій в установах вищої освіти дозволить перейти на новий рівень інноваційного розвитку закладів вищої освіти.

МЕТОДИ. У дослідженні були використані: метод DFD для побудови контекстної діаграми і діаграми першого рівня функціонування Хакатон-екосистеми трансферу технологій в закладі вищої освіти; інформаційно-технологічні підходи до управління проектом створення Хакатон-екосистеми трансферу технологій в закладі вищої освіти з метою забезпечення ефективного управління потоками даних по проекту; якісної і оперативної комунікації між стейкхолдерами проекту.

Розроблена концептуальна модель Хакатон-екосистеми трансферу технологій в закладах вищої освіти дозволяє враховувати специфіку функціонування вищої школи. Запропонована блок-схема ініціалізації проекту створення Хакатон-екосистеми трансферу технологій складається з семи етапів, що дозволяє врахувати особливості університету. Визначено оптимальний склад стейкхолдерів Хакатон-екосистеми трансферу технологій в закладах вищої освіти: ініціатор, керівник, команда, замовник, куратор, власник, конкуренти, спонсор, органи влади, громадські групи, споживачі, організації, постачальники і підрядники.

ВИСНОВКИ. Практична реалізація розробленої концептуальної моделі Хакатон-екосистеми трансферу технологій в закладах вищої освіти дозволяє генерувати ідеї відповідно до вимог ринку і впроваджувати найбільш затребувані з них; визначити потреби і зацікавленість у налагодженні співпраці між представниками вищої школи і бізнесу; визначати відповідність створених прототипів Хакатон-екосистеми трансферу технологій потребам стейкхолдерів і дозволить отримати зворотній зв'язок щодо функціонування Хакатон-екосистеми.

Ключові слова: Хакатон-екосистема; трансфер технологій; заклад вищої освіти.

INTRODUCTION.

There are many factors that influence the level of social development and acceptance of change, among which culture is essential, the main elements of which are highlighted (Verenych, 2019). Ukrainian culture as a whole does not contribute to socio-economic development. This means that the state should make a lot of effort, orienting its policy to change the perception of society of the specified cultural factors (Afanasiev et al., 2013). Innovative culture as well as civil society in general is only being formed in Ukraine. The analysis showed that the issue of creating a project management system is not reflected in the international standards for project management, as well as not enough researched by domestic and foreign scientists (Sergeeva et al., 2014). The available research of scientists (Kolomiets et al., 2017) on the creation of the Hackathon ecosystem model of technology transfer concern the business sphere and do not take into account the specifics of higher education institutions (Dmitriev, 2017). However, organizational projects of creating a unit in the form of Hackathon ecosystem of technology transfer in the institution of higher education (HETT), have their own specifics (Bay et al., 2012; Verhoglyadova, 2004; Grin et al., 2013; Grinkevich, 2017; Grishchenko et al., 2015). Given the above, the construction of a conceptual model of management of the project of creation of HETT in the university is an important topical task, and given the vector of the state policy is simultaneously a necessity. The purpose of the study is to propose a conceptual model of the Hackathon ecosystem of technology transfer in the institution of higher education. The study was conducted in 2020 on the basis of the Kyiv National University of Technologies and Design (KNUTD).

MATERIALS AND METHODS.

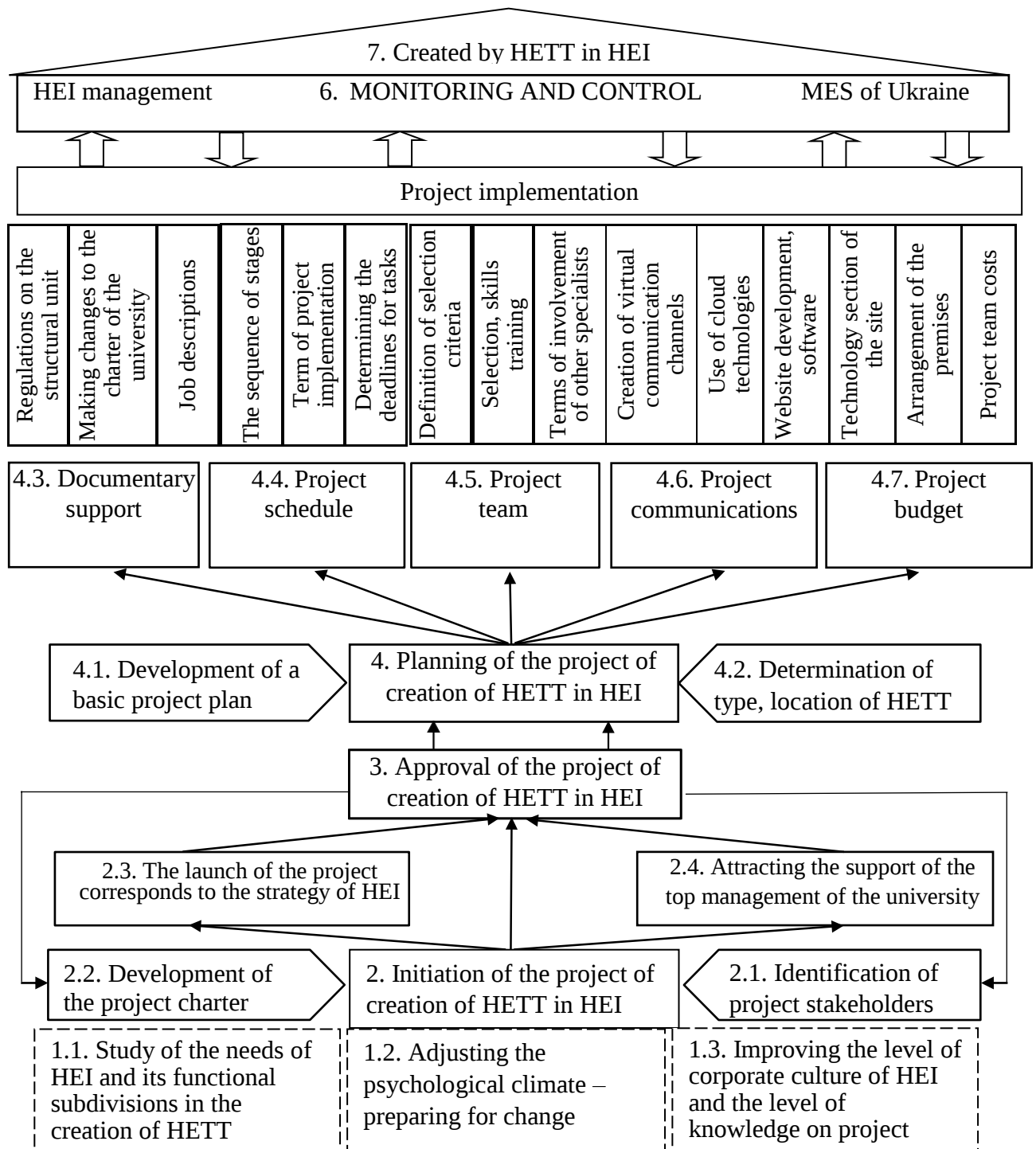
The information model of the project management process of HETT creation in the university was developed in order to ensure effective management of project data flows, quality and timely communication between the project stakeholders. This model includes a context diagram and a Level 1 diagram, which are built on the DFD notation. Within the framework of the proposed model the information flows between the stakeholders in the process of HETT project management in the university in general and at each stage of the management process in particular are defined.

RESULTS AND DISCUSSION.

The conceptual model of the Hackathon ecosystem of technology transfer in an institution of higher education is presented in Fig. 1.

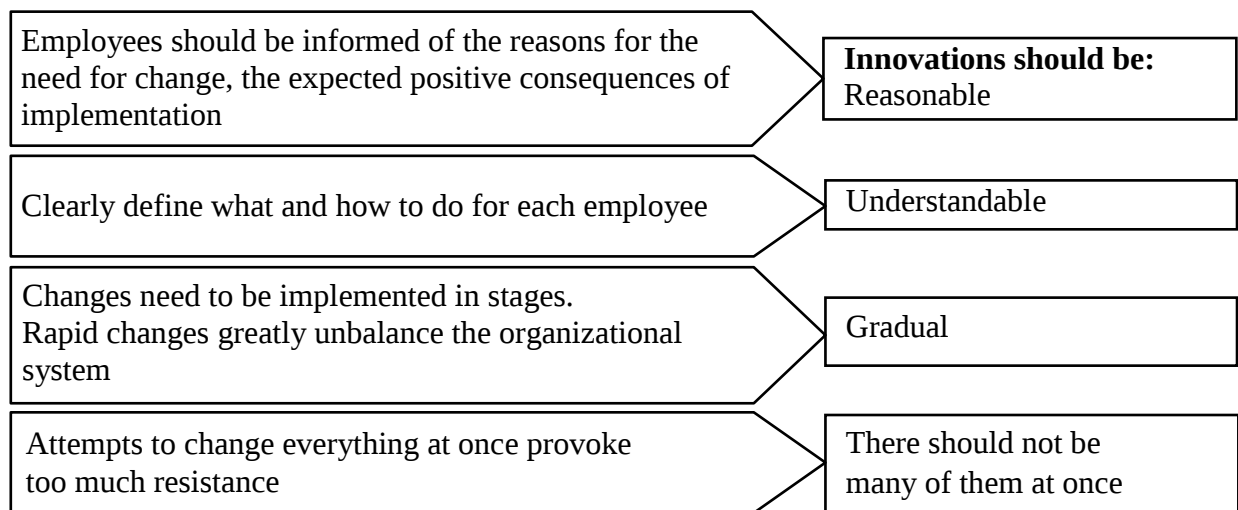
In state-owned institutions (HEIs), the biggest obstacles to development are bureaucracy, risk-aversion and high levels of responsibility, which leads to resistance in implementing change. The following rules or conditions are suggested for the perception of change, which must be met by the initiator –

Fig. 2. The most important is to communicate to employees the specific reasons for the need to implement changes and the expected positive results. For this purpose it is necessary to study beforehand the needs and problems arising in connection with technology transfer in the employees of the university.



Source: built by the author.

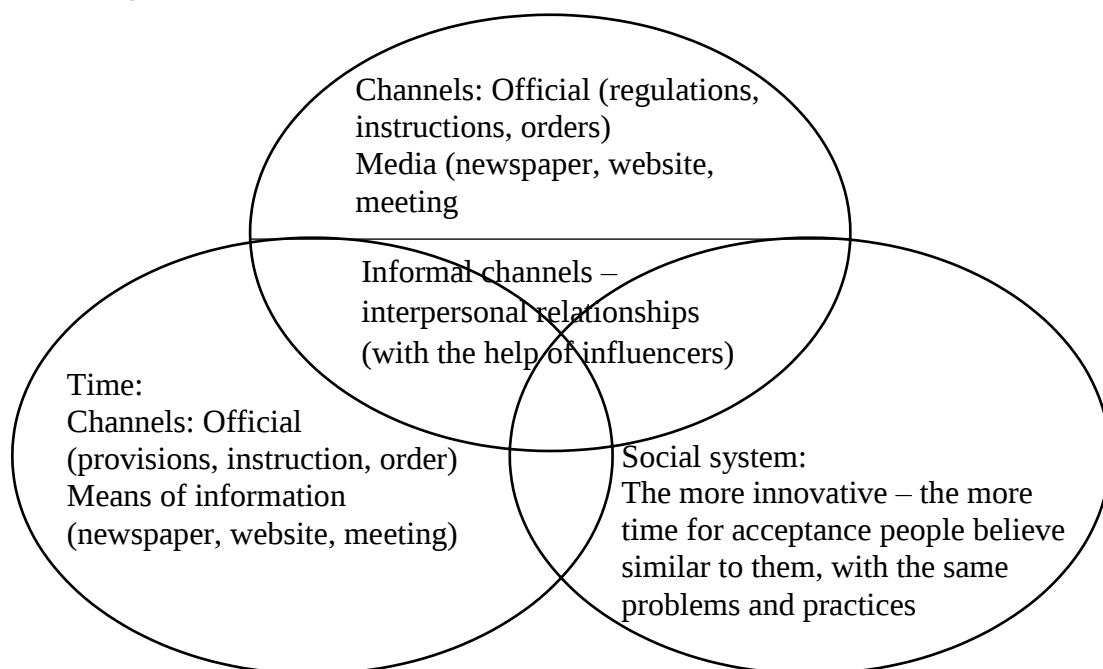
Fig. 1. Conceptual model of project management of HETT creation in HEI



Source: built by the author.

Fig. 2. Rules for implementing innovations

Diffusion of innovation is proposed to be considered through the model of diffusion of innovation proposed by E. Rogers (a process in which innovation is transmitted through certain channels over time among members of the social system) – Fig. 3.



Source: built by the author.

Fig. 3. The main elements that are important in the implementation of innovations

Thus, the most effective channel of introduction of innovation is informal (interpersonal relations) with the help of agents of influence who have already

accepted the innovation and at the same time are similar to other employees, because they face the same problems, work in the same department. Paul Dolan proposed a model of mental space, through the use of factors which provide "nonviolent", but self-motivated change. Managing the mental space of projects and programs is the main use of HETT. The proposed models can be taken into account in the implementation of projects in the university. Some sources suggest determining an organization's level of maturity with respect to project management before implementing HETT. Others define a characterization of competency levels according to the following criteria: subject area, project management area, IT technologies, and tools. The experience of creating a HETT in an institution of higher education is new to our state. The creation of a HETT has not been explored with project management approaches. University technology transfer activities are just beginning in our state. The university's level of competence in HETT creation projects is "embryonic." Therefore, there is a need to increase the level of knowledge on project management, first of all, in the functional managers of the university. The project initiation stage also includes identification of stakeholders and their interests. Project stakeholders, their roles and interests in the creation of HETT in the university are presented in Table 1.

Table 1

Stakeholders of the HETT project at the university

№	Stakeholders	Role	Interest
1	Project initiator	The person who initiated the project of creating OTT in ZVO, prepared an application for consideration of the initiative (ZVO employee who professionally carries out scientific, scientific-technical or scientific-pedagogical activity)	High-quality and timely project implementation, gaining experience and skills in the field of project management
2	Project Manager	Employee of the Free Economic Zone, who is responsible for project planning and implementation, risk response (head of the department, professor or associate professor of the department)	High-quality and timely implementation of the project in accordance with the established requirements, gaining experience and skills in the field of project management, receiving material incentives
3	Project team	A group of freelancers who plan and implement a project to create an OTT in freelance according to the instructions of the project manager (freelancers who professionally carry out scientific, scientific-technical or scientific-pedagogical activities)	High-quality and timely implementation of the project in accordance with the established requirements, gaining experience and skills in the field of project management, receiving material incentives

End Table 1

№	Stakeholders	Role	Interest
4	Project curator	Employee of the top management of the Free Economic Zone, who will monitor and control the activities of the team and the project manager (vice-rector)	Qualitative and timely implementation of the project in accordance with the established requirements, raising the rating of free economic zones, attracting extra-budgetary funding and additional funding from the Ministry of Education and Science
5	Customer	Rector of the Free Economic Zone, who finances and monitors the implementation of the project	Qualitative and timely implementation of the project in accordance with the established requirements, raising the rating of free economic zones, attracting extra-budgetary funding and additional funding from the Ministry of Education and Science, achieving the strategic goal of free economic zones
6	Owner	ZVO - has the rights to the result of the project	Achieving the strategic goal of the Free Economic Zone, raising the rating of the Free Economic Zone, attracting extra-budgetary funding and additional funding from the Ministry of Education and Science
7	Investor	The Rector of the Free Economic Zone and the Ministry of Education and Science co-finance the project. It is also possible to involve local governments and business representatives	Qualitative and timely implementation of the project, raising the rating of free economic zones, region, state
8	Competitors of the main project participants	Other free economic zones in which OTTs are created or planned and which are interested in raising the rating of own free economic zones. At the same time, other free economic zones can become partners	Poor and / or untimely project implementation
9	Authorities	MES, Ministry of Economy, local governments, as well as international organizations interested in developing cooperation between science and business	Qualitative and timely implementation of the project, raising the rating of the region, the state, receiving budget revenues, attracting investment to the state

End Table 1

№	Stakeholders	Role	Interest
10	Public groups and organizations, population	Freelance employees	Establishing cooperation with business representatives
11	Suppliers / contractors	Persons who supply computer equipment, furniture for the organization of premises under OTT, as well as provide IT services for the creation of software products for OTT	Qualitative and timely fulfillment of terms of supply / contract agreements
12	Consumers	Freelancers, representatives of business, region, state, community of scientists and inventors, international organizations	Obtaining a quality project product

Initiation of the project of HETT creation in the university also has its own features, because it is usually a state structure, and therefore the coordination and approval of documents is long, involves more steps than in a private company, where speed of decision-making and elimination of bureaucratic procedures are of paramount importance. Initialization of the project will be successful only in case of compliance with the university strategy, MES and in case of support from the university top management. After project approval, the planning stage begins, the basis of which is the development of the basic project plan, definition of the type and place of HETT in the organizational management structure of the university. Also at this stage planning is carried out:

- Documentary support of the project, which includes a set of works on creation of new organizational structure in the university – preparation and approval of the decision of the academic council of the university on creation of HETT, making changes in the charter of the university, preparation and approval of regulations on structural subdivision, job descriptions, approval of staff number, etc.

- Project schedule, according to which the deadline for the project, the deadline for each task of the project, the sequence of their implementation, while planning the schedule is carried out simultaneously with the definition of the project content (goals and objectives).

- Project teams – the criteria for selecting a team, the conditions for involving specialists from other structural units, the functions, powers and responsibilities of each team member are defined. Formation of a highly effective project team, the resulting conceptual model can be adapted to manage the project of HETT creation in the university.

- Communications – determines the most convenient for the project team virtual channel of communication between the available messengers, analyzes the compatibility of cloud storage technology with the necessary HETT software, plans the implementation of cloud storage technology and remote work – a virtual office to be able to work in quarantine, plans to develop a website section for communication with business representatives or other stakeholders. The developed models can be adapted to the implementation of the necessary software for HETT in the university.

- The project budget, which includes the costs associated with the project team (salaries, training costs, training), and unrelated costs for equipping the room for the project team and holding joint meetings with the heads or staff of functional departments of the university, the cost of software and the creation of the site section.

The next stage is the implementation of the project, which should be carried out in accordance with the basic plan of the project. It should also be noted that at any stage of the project to create HETT in the university can be a risk. The monitoring and control phase is carried out by the curator (Vice Rector) and the project customer (Rector), as well as the MES of Ukraine on the results of the project to assess the effectiveness of its implementation. In addition, monitoring and control is carried out by the project manager at each stage. According to the results of monitoring and control an assessment of the effectiveness of the project is given and in fact begins to work again organizational structure in the university – HETT.

CONCLUSION.

It was found that the introduction of the project approach will create an effective innovation infrastructure, the main element of which are HETTs in the university. It was proposed to distinguish projects and portfolios of technology transfer projects, their main differences from other types of projects implemented in the university were determined. The conceptual model for project management of Hackathon-ecosystem of technology transfer in higher education institution which takes into account the specific functioning of the university and includes seven stages, including psychological climate adjustment, initiation, launch, planning, execution, monitoring and control, the completion stage – establishment of HETT in the university was developed. Within the framework of the specified model a flowchart of the initialization of the project of creation of HETT in the university was developed. Also, the stakeholders of the project were identified, indicating the role and interest of each. Organizational model of HETT in universities was developed, which includes a template of DFD project creation HETT in high school, a template of the organizational structure of HETT in high school. The functions of HETT

project team members, the functions of HETT staff and the place of HETT in the organizational structure of the university were defined.

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The author is grateful to the heads of higher educational institutions for their assistance in conducting this research.

ABBREVIATIONS:

<i>fig.</i>	Figure
<i>HEI</i>	Higher education institution
<i>HETT</i>	Hackathon Ecosystem of Technology Transfer
<i>KNUTD</i>	Kyiv National University of Technologies and Design
<i>MES</i>	Ministry of Education and Science in Ukraine

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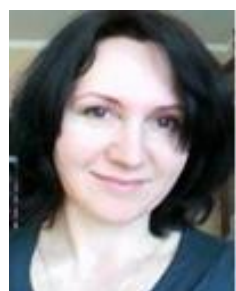
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USING THE HACKATHON ECOSYSTEM AS AN EFFECTIVE TOOL FOR MANAGING THE COMPETITIVENESS OF AN INSTITUTION OF HIGHER EDUCATION

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BACKGROUND AND OBJECTIVES.

Management of competitiveness of higher educational institution as a science is a system of ordered knowledge in the form of concepts, theories, principles, ways and forms of management. We present scientific-methodological bases of competitiveness management in university as a system of ordered knowledge, concepts, theories including basic statements of modern competition theories, self-organization theory, system and integrative approaches of new management paradigms, which universality will contribute to the best interpretation of the process of development of appropriate principles and ways of competitiveness management in higher educational institution. These principles can be implemented with the help of the Hackathon Ecosystem, the main task of which will be to manage the competitiveness of the institution of higher education.

METHODS. In the study to determine the level of competitiveness of the institution of higher education achieved with the help of the Hackathon ecosystem, the integr al indicator of competitiveness of the university as a set of quality potentials of education, competitiveness of educational

services provided, efficiency of marketing activities, efficiency of investment management activities were used.

FINDINGS. Management of university competitiveness as a process is a set of managerial actions, providing the achievement of objectives by transformation of resources at "input" into products at "output". We consider the university competitiveness management as a set of tools and methods for maintaining and increasing competitiveness. The main tool in this case is the quality of educational services. The factors of modern paradigm of university service quality management are revealed and the specific directions of quality assurance of university educational services are offered.

CONCLUSION. The creation of an educational cluster as a group of geographically adjacent interrelated educational institutions of a certain profile (general, primary vocational, secondary vocational and higher vocational education) and related employers headed by branch ministries, state and municipal governments with a coordinating center, will increase the competitiveness of the basic university.

KEYWORDS: inclusive education; higher professional education; people with disabilities.

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10	1	0

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ВИКОРИСТАННЯ ХАКАТОН-ЕКОСИСТЕМИ ЯК ЕФЕКТИВНОГО ІНСТРУМЕНТАРІЮ УПРАВЛІННЯ КОНКУРЕНТОСПРОМОЖ- НІСТЮ ЗАКЛАДУ ВИЩОЇ ОСВІТИ

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ПОСТАНОВКА ПРОБЛЕМИ ТА ЗАВДАННЯ.

Управління конкурентоспроможністю закладу вищої освіти як наука – система упорядкованих знань у вигляді концепцій, теорій, принципів, способів і форм управління. Науково-методологічні основи управління конкурентоспроможністю в закладі вищої освіти представлені у вигляді системи упорядкованих знань, концепцій, теорій, включаючи основні положення сучасних теорій конкуренції, теорії самоорганізації, системного та інтегративного підходів нових парадигм управління, універсальність яких буде сприяти найкращій інтерпретації процесу вироблення відповідних принципів і способів управління конкурентоспроможністю закладів вищої освіти. Ці принципи можуть бути реалізовані за допомогою Хакатон-екосистеми, основним завданням якого буде управління конкурентоспроможністю закладу вищої освіти.

МЕТОДИ. У дослідженні для визначення досягнутого за допомогою Хакатон-екосистеми рівня конкурентоспроможності закладу вищої освіти були використані інтегральний показник конкурентоспроможності закладу вищої освіти як сукупності потенціалів якості освіти, конкурентоспроможності освітніх послуг, ефективності маркетингової діяльності,

ефективності управління інвестиційною діяльністю.

РЕЗУЛЬТАТИ. Управління конкурентоспроможністю закладу вищої освіти як процес – сукупність управлінських дій, що забезпечують досягнення цілей перетворенням ресурсів на «вході» в продукцію на «виході». Управління конкурентоспроможністю закладу вищої освіти розглядається як сукупність інструментів і методів підтримки і зростання конкурентостійкості. Головним інструментом при цьому виступає якість освітніх послуг. Виявлено чинники сучасної парадигми управління якістю послуг вузу і запропоновані конкретні напрями забезпечення якості освітніх послуг закладу вищої освіти.

ВИСНОВКИ. Створення освітнього кластера як групи географічно сусідніх взаємопов'язаних навчальних закладів певного профілю (загальної, початкової професійної, середньої професійної та вищої професійної освіти) та пов'язаних з ними роботодавців на чолі з галузевими міністерствами, органами державного і муніципального управління, що має координуючий центр, підвищить конкурентоспроможність базового закладу вищої освіти.

Ключові слова: Хакатон-екосистема; конкурентоспроможність; установа вищої освіти.

INTRODUCTION.

Changes in the organizational and economic conditions of Ukrainian universities, increasing demands of society for the quality of education, entering the Bologna process and the associated updating of technologies and training standards have largely contributed to the aggravation of competition in the market of educational services (Golovchanskaya, 2011). The competitiveness of vocational education is crucial for the successful development of Ukraine (Gorin, 2014). Introduction of technologies based on high level of intellectual resources and globalization trends become the most important factors determining not only the economy but also the politics of the XXI century (Zharska et al., 2014). In this regard, increasing the level of intellectual potential of citizens becomes a key condition for successful socio-economic development of the country, and two factors become crucial: the transformation of higher education into the most important component of the socio-economic and moral and spiritual basis of social progress (Karpyuk, 2014); wide use of information technology in improving the educational process (Kobzeva, 2021). New needs of social development dictate the most radical revision of the strategy, forms, methods of education, and, consequently, management of higher education in general and universities in particular (Obolenska, 2002). In a concentrated, programmatic form the new tasks are formulated in the "World Declaration on Higher Education for the XXI Century: UNESCO Approaches and Practical Measures", adopted in 1998 in Paris at the World Conference on Higher Education (Dmitrenko, 2012). Domestic higher education institutions, preserving and strengthening the basic values of Ukrainian higher education, training highly qualified personnel, should become available for lifelong learning for citizens who want to acquire new knowledge and competencies, provide students with the optimal range of educational choices, give flexibility to higher education through the use of courses and curricula constantly adapted to the current and future needs of society (Pashchenko, 2018). The management of vocational education needs its further development in connection with the transition to a knowledge economy, where professions with a predominance of intellectual labor account for the main increase in employment. It is necessary to take into account a number of general economic trends and peculiarities of their manifestation in the sphere of educational services: the trend of globalization - integration of national economy into the world economic system; the trend of regionalization due to the effect of factors of economic separatism of individual regions with their significant consolidation; the trend of corporatization, which involves the use of advantages of coordinated management of integrated forms of economic activity. The main directions of integration development are seen on the lines of vertical and horizontal interactions, with the creation of integrated structures of mixed type. Under these conditions the status of higher

education institution should inevitably change, since the university becomes a subject of market relations and acts as a producer of educational services. The new status of higher education institution results in a change in its management methods as a business enterprise with the abandonment of existing models of non-economic behavior in favor of mastering modern management concepts. Prospects and tendencies of development of higher education require development of new, system concept of management of competitiveness of higher education institution in dynamic competitive environment, aimed at ensuring its competitive sustainability (Grishchenko et al., 2015). The statement of the research is based on the fact that the theoretical apparatus formed by now and the available practical experience of work in market conditions do not provide the management of higher education institutions with the necessary scientific and methodological basis. Insufficiently developed theoretical and methodological aspects of higher education institutions' development from the position of increasing their competitiveness bring to the fore the need for scientific-methodological and methodological developments allowing to strengthen the contribution of higher education institutions to socio-economic development of regions and to increase their competitiveness, which determines the relevance of the present study. The aim of the article is to develop theoretical and methodological and conceptual provisions for the formation of competitiveness management system of higher education institution, to develop practical and organizational and economic recommendations for the use of Hackathon ecosystem as an effective tool of competitiveness management of higher education institution. The research was conducted on the basis of Kyiv National University of Technologies and Design (KNUTD) in 2021.

MATERIALS AND METHODS.

Competitiveness of higher educational institution is determined by quality of education, competitiveness of rendered educational services, efficiency of marketing activity, efficiency of management of investment activity and aggregate potential. Therefore, overall efficiency of management of competitiveness of higher educational institution is an integral assessment of efficiency of management of the above-mentioned potentials.

The economic efficiency of competitiveness management of a higher educational institution can be represented by equation (1):

$$E_k = (E_o + E_{mark} + E_{pot} + E_{inv} + E_{kach.obr}) \times 100\%, \quad (1)$$

where E_K is efficiency of management of competitiveness of higher educational institution;

E_o – efficiency of management of competitiveness of educational service;

E_{marck} – efficiency of management of marketing activity of higher educational institution;

E_{pot} – efficiency of management of aggregate potential of higher educational institution;

E_{inv} – efficiency of management of investment activity of higher educational institution;

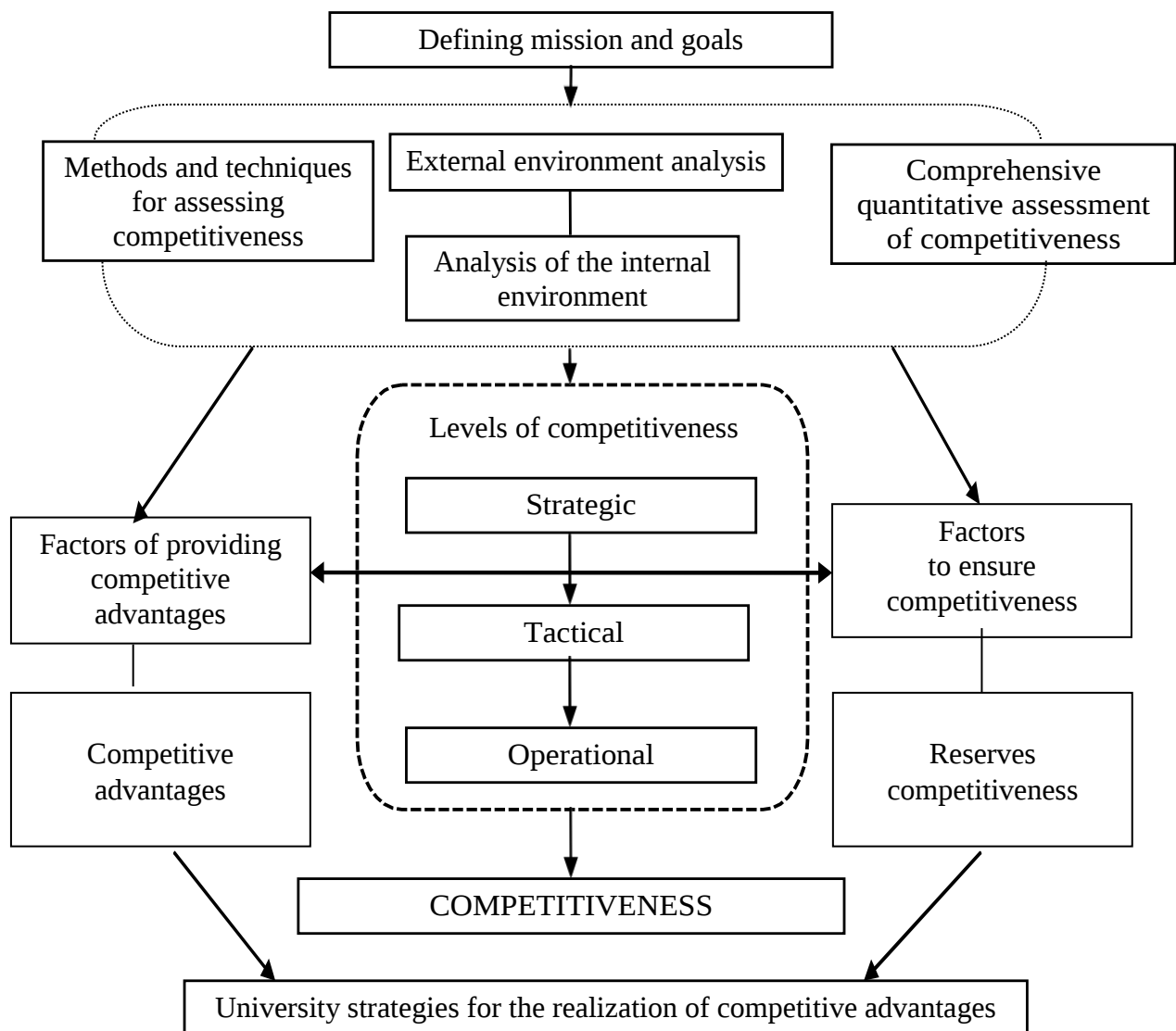
$E_{kach.op}$ – efficiency of management of quality of education in higher educational institution.

RESULTS AND DISCUSSION.

The main form of strategic partnership, which ensures the increase of university competitiveness, is an educational cluster. Educational cluster is a coordinating center of a group of geographically adjacent interconnected educational institutions (general, primary professional, secondary professional and higher professional education) and related employers headed by branch ministries, state and municipal authorities.

The author's concept of university competitiveness management focuses attention on understanding the goal, which should be placed above the space of university activity and interpret it as a supra-objective in this form: always sustainably maintain competitiveness, be competitive, flexibly using the emerging conditions and adapting to them, using competitive advantages. Only such interpretation of the goal – as a supra-objective – will allow to widely cover the unpredictable course of events in the space of university activity and to use unexpected changes of the situation for successful functioning and dynamic development. Thus, if the concept of university competitiveness management is translated into the language of management, the classical strategy emphasizes problem solving, the author's view sees the strategy as the use of opportunities. Management of competitiveness of higher education institution is an integral part of the mechanism of management of economy of higher education institution, which means a set of interconnected elements (links), making a single whole, realizing the process of management of economy of higher professional education institution for achievement of set goals of management. The main elements of university economic management mechanism are goals, management principles, management concepts, mission and philosophy of the institution, regularities and methods of management, personnel, structure and management regulations, management technique and technology, management decision. All these elements in aggregate form the mechanism of management of economy of higher education institution. In building a system of university competitiveness management it is legitimate to use principles of integrative management, the essence of which we define as management of university activities at the market of educational services in a

competitive environment, based on the provisions and principles of modern management and focused on the integration of the university in territorial, industry and interdisciplinary market networks. The key task of university competitiveness management process is justification and realization of effective competitive strategy in the market of educational services, which takes into account own competitive advantages and main participants of competitive struggle, market needs in innovative projects and their realization, interests of university service consumers (population, industrial sphere, state, society). The model of Hackathon ecosystem as an effective tool for competitiveness management of higher education institution was proposed within the framework of the research (Fig. 1).



Source: proposed by the author

Fig. 1. Model of competitiveness formation with the help of the Hackathon ecosystem

In this model external factors influence competitiveness of HEI both on "input" and on "output" of the system. At the "input" external factors of competitiveness of HEI are incoming resources for realization of educational services and research work which include qualitative indicators of entrants, presence of cooperative relations with production sphere, worthy working and rest conditions of employees and students, material stimulation of the faculty and conditions of career development. The factors of university competitiveness at the "output" of the system include national and international recognition of the university, receipt of prizes and awards of state and world level, external demand for scientific and educational publications of teachers, availability of orders for patent-license developments, satisfaction of service consumers.

The developed model of competitiveness formation with the help of Hackathon ecosystem of university on the market of educational services allows clearly defining that the basic element of the strategy directed on maintenance of competitiveness of university are competitive advantages of university, and competitiveness is a result of realization of competitive advantages. At the same time competitive advantages and competitiveness, as well as possibility of their formation and realization are exposed to the action of different factors, the degree of influence of which determines the probability of achieving the set goals. In general, the formation of areas of competitiveness is determined by the position of the university at the market of educational services, mission, needs of target markets and capabilities of the university. Components of competitiveness management efficiency of higher educational institution at the moment of analysis are estimated as the ratio of change in the integral index for each particular module of competitiveness (management of competitiveness of educational service, management of marketing activity of higher educational institution, management of total potential of higher educational institution, management of investment activity of higher educational institution, management of quality of education in higher educational institution) in each subsequent period compared with the previous one to the value of the integral index in the pre.

CONCLUSION.

Management of university competitiveness as a function is a purposeful information impact on people and economic objects in order to direct their actions and obtain the desired results. The sphere of higher professional education is characterized by constant interaction and mutual influence of producers and consumers of services. The formation of complex loyalty in the sphere of higher professional education allows increasing competitiveness of an institution of higher education. Management of university competitiveness as an apparatus is a set of structures and people, providing use and coordination of all resources of social systems for achievement of their goals. Strategic partnership

of basic state higher education institutions of industrialized region with other higher education institutions, academic science, industry, business and power structures positively influences the state of labor market and socio-economic development of the region. The creation of an educational cluster as a group of geographically adjacent interrelated educational institutions of a certain profile (general, primary vocational, secondary vocational and higher vocational education) and related employers headed by branch ministries, state and municipal authorities with a coordinating center will increase the competitiveness of the basic university. In the conditions of higher education market development, competitiveness as a target-oriented parameter of higher education institution functioning is replaced by competitiveness. Competitiveness of HEI is the ability of HEI to form and use in the long-term perspective the cumulative potential, providing HEI stable market position, realization of its priority goals, partner cooperation and economic advantages in comparison with other HEIs at its chosen market.

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The author is grateful to the heads of higher educational institutions for their assistance in conducting this research.

ABBREVIATIONS:

<i>Eq.</i>	Equation
<i>fig.</i>	Figure
<i>HEI</i>	Higher education institution
<i>HETT</i>	Hackathon Ecosystem of Technology Transfer
<i>KNUTD</i>	Kyiv National University of Technologies and Design

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ORGANIZATION OF THE ENERGY MANAGEMENT SYSTEM ON THE BASIS OF THE UNIVERSITY KNOWLEDGE HUB

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BACKGROUND AND OBJECTIVES.

Energy efficiency and energy saving are the priority direction of science, technology and engineering development in Ukraine. The policy of energy saving, carried out all over the world, is directed to all branches and scientific researches in all spheres. The big consumer of energy resources is the higher school. Updating of normative-legal and technical base aimed at design and operation of buildings with low energy consumption and high energy efficiency class shows the necessity of short-term solution of the problem. At the same time, there is a lack of a systemic view of energy efficiency, which does not allow evaluating the level of energy costs throughout the life cycle of higher education institutions, which shows the need to find effective solutions to the problem.

METHODS. Multiple regression equation was used to assess the influence of factors on electricity consumption and energy efficiency of Kyiv National University of Technologies and Design, statistical analysis of the obtained data was performed.

FINDINGS. As a result it was found out that the data of electricity consumption do not obey the law of normal distribution, so it is difficult to build an accurate prediction

of electricity consumption. The use of HAB knowledge on energy efficiency allowed a more qualitative analysis and highlighted the main factors affecting electricity consumption. The university has unregulated central heating, individual air conditioning systems, and central and individual lighting. In this regard, we selected the following main factors: average outdoor air temperature, average duration of daylight hours, heating period, average number of people working per day, during the month to conduct energy monitoring and energy audit of university buildings.

CONCLUSION. Implementation of suggested scheme of structural organization of typical system of automatic accounting of university energy consumption on the basis of university HUB of energy efficiency knowledge: server, allowing to collect, store and process data; routers by means of various wire and wireless communication technologies; hubs, installed on the objects of energy consumption; workstations, which are personal computers with installed software of used HUB will allow to optimize energy consumption.

KEYWORDS: HAB of knowledge on energy efficiency; university; energy consumption; energy audit.

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**ОРГАНІЗАЦІЯ СИСТЕМИ
ЕНЕРГОМЕНЕДЖМЕНТУ НА БАЗІ
УНІВЕРСИТЕТСЬКОГО ХАБ ЗНАНЬ**

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**ПОСТАНОВКА ПРОБЛЕМИ ТА
ЗАВДАННЯ.**

Енергоефективність та енергозбереження є пріоритетним напрямком розвитку науки, технологій і техніки в Україні. Проведена в усьому світі політика енергозбереження спрямована на всі галузі і наукові дослідження в усіх сферах. Значним споживачем енергоресурсів є заклади вищої освіти. Актуалізація нормативно-правової та технічної бази, спрямованих на проектування і експлуатацію будівель з низьким рівнем енергоспоживання і високим класом енергоефективності свідчить про необхідність короткострокового вирішення проблеми. При цьому має місце відсутність системного погляду на енергоефективність, що не дозволяє оцінити рівень витрат енергоресурсів на всьому протязі життєвого циклу закладів вищої освіти, що показує необхідність пошуку ефективних шляхів вирішення проблеми.

МЕТОДИ. Для оцінки впливу факторів на електроспоживання та енергоефективності Київського національного університету технологій та дизайну було використано метод множинної регресії, проведений статистичний аналіз отриманих даних.

РЕЗУЛЬТАТИ. В результаті вдалося з'ясувати, що дані електроспоживання не підкоряються закону нормального розподілу, тому побудувати точний прогноз електроспоживання важко. Використання ХАБ знань з енергоефек-

тивності дозволило провести більш якісний аналіз і виділити основні фактори, що впливають на електроспоживання. Університет має нерегульоване центральне опалення, системи індивідуального кондиціонування, а також центрального та індивідуального освітлення. У зв'язку з цим для проведення енергетичного моніторингу і енергоаудиту будівель університету було обрано такі основні фактори: середня температура повітря на вулиці, середня тривалість світлового дня, опалювальний період, середня кількість осіб, які працюють в день, протягом місяця.

ВИСНОВКИ. Впровадження запропонованої схеми структурної організації типової системи автоматичного обліку енергоспоживання університету на базі університетського ХАБ знань з енергоефективності: серверу, що дозволяє збирати, зберігати і обробляти дані; маршрутизатори за допомогою різних провідних і бездротових технологій зв'язку; концентратори, встановлені на об'єктах енергоспоживання; робочі станції, які являють собою персональні комп'ютери з встановленим програмним забезпеченням використовуюваного ХАБ дозволить оптимізувати енергоспоживання і підвищити енергоефективність університету.

КЛЮЧОВІ СЛОВА: ХАБ знань з енергоефективності; університет; енергоспоживання; енергоаудит.

INTRODUCTION.

One of the priority directions of development of Kyiv National University of Technologies and Design (KNUTD) is to reduce energy intensity and optimize the use of energy resources. Therefore, the issue of improving energy efficiency and energy conservation of the university is quite relevant at the moment, and energy management is the financial tool that will allow the university to save money through a competent policy of energy resources use ((Shaposhnikova et al., 2016; Vieira et al., 2020).

Achieving real improvements in energy efficiency must be based not only on technical solutions, but first and foremost on perfect management (García et al., 2020; Nayak et al., 2021). The process of creating an energy management system in Ukrainian universities, despite its relevance has not been properly developed (Werth et al., 2021; Di Stefano, 2000; Xing et al., 2019). The unified technical policy on all issues of operation, maintenance and repair of power equipment of the university is carried out by the department of the chief power engineer (Abu-Rayash et al., 2020; Wang et al., 2021). This department ensures and is responsible for the uninterrupted and reliable energy supply to all university departments (Liu et al., 2019).

Energy management functions related to the optimization of equipment operation modes in order to improve energy efficiency and minimize energy costs are generally not properly performed in practice (Zhong et al., 2020; Shcherbak et al., 2019; Shcherbak et al., 2021). Creation and implementation of decent energy management service within the university will certainly give additional impetus to the process of energy efficiency improvement within Kyiv National University of Technologies and Design (Gryshchenko et al., 2017).

The Energy Management Service should be a permanent university body for effective management of energy use and control over the implementation of energy-saving projects and programs. Its creation will allow to concentrate in one place all managerial functions directed on energy saving and increase of energy efficiency. In the structure of the university, this service should report to the top management – the Representative of the Management for Energy Management (Hanushchak-Yefimenko et al., 2018). This would give it the status of a cross-functional, rather than a highly specialized unit with horizontal and vertical links with other units. One of the options for creating such a unit is to organize the energy management system on the basis of the university Knowledge Hub.

The purpose of this article is to substantiate the necessity and expediency of the organization of energy management system on the basis of university hub of knowledge. The research was conducted on the basis of Kyiv National University of Technologies and Design in 2020.

MATERIALS AND METHODS.

To assess the impact of each factor on electricity consumption and energy efficiency it is necessary to use a multiple regression equation. The linear equation of multiple regression has the following form (1):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_m X_m + \varepsilon, \quad (1)$$

where β_0 – free term;

β_n – values of coefficients of influence of each specific factor on the final result;

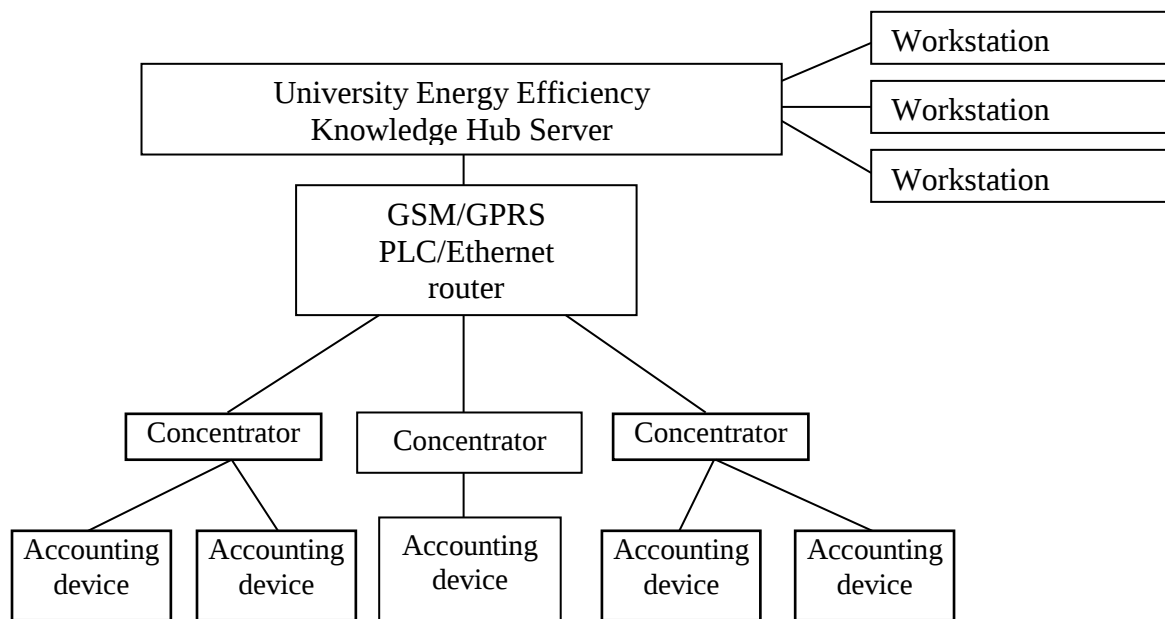
X_n – quantitative value of the factor.

RESULTS AND DISCUSSION

The main functions of the energy management service of the university on the basis of the university Knowledge Hub:

- providing extended and continuous control over energy consumption and efficiency of fuel and energy resources use;
- formation of technical, economic and personnel policy of rational energy consumption;
- developing annual plans to implement the energy saving program;
- organization of targeted energy monitoring and assessment of the actual economic effect from implementing energy-saving projects and measures;
- coordination of activities to develop and implement energy-saving measures;
- forming proposals to the university's investment program;
- organization of information exchange, training and cooperation in the field of efficient energy use;
- analysis and coordination of the university energy technological services in terms of reducing irrational energy consumption;
- development of terms of reference for pre-project work on energy saving projects;
- development of technical specifications for investment projects on modernization or design of new energy saving equipment and technologies, organization of work on holding tenders by potential contractors;
- technical support of the energy saving projects being implemented;
- preparation and approval within the university of the technical part of agreements and contracts for the purchase of energy saving technologies, equipment and materials;
- collection, analysis and systematization of information about new energy saving technologies and equipment used in related organizations;
- organization of work to increase the level of information support of the university's energy consumption.

Let's consider a simplified scheme of structural organization of a typical system of automatic energy consumption accounting. The basis of system is the server, allowing to collect, store and process the data. To this server hubs are connected through routers by means of different wired and wireless communication technologies, installed at objects and uniting data collectors into groups. Also connected to the server are workstations, which are personal computers with installed software from the university's Energy Efficiency Knowledge Hub. In universities that use only one workstation, the same station can be the server (Figure 1).



Source: Kaplun et al., 2016.

Fig. 1. Simplified diagram of the structural organization of the university Knowledge Hub

Most of the existing automatic energy accounting systems are organized according to the given structure (Zhong et al., 2020). The main tasks of the university energy management service on the basis of the university Knowledge Hub should include:

- Assessment of the results of departments and divisions on rational energy consumption and energy conservation based on the analysis of the actual consumption of fuel and energy resources.
- Development, expertise, timing of implementation and control of energy saving projects aimed at solving current and strategic tasks of energy saving.
- Develop methods to assess the actual efficiency of the implemented energy saving measures.
- Develop, coordinate and implement mechanisms to stimulate efficiency of fuel and energy resources use.

- To control the implementation of the program of rational energy consumption and energy saving.

- Implementation of targeted energy monitoring.

The number of staff in the university's energy efficiency hub will depend on the volume of energy costs, the number and characteristics of university facilities, and their current level of energy efficiency. In any case, the specialists of these units should not combine the functions of energy managers with other job responsibilities. We suggest including several energy managers and energy auditors in this service.

Energy manager – a specialist whose activity is aimed at ensuring the implementation of the energy policy of the university. Organization of activities aimed at the continuity of energy management, ensuring communication functions between all objects of energy management, planning and control of activities aimed at the maximum efficiency of energy management (Kaplun et al., 2016).

Energy auditor – a specialist in conducting energy audits of consumers of fuel and energy resources in order to establish indicators of efficiency of fuel and energy resources use and to develop economically sound measures to reduce the consumption of fuel and energy resources (Kaplun et al., 2016).

Within the university Energy Efficiency Hub of Knowledge, the main requirements for an energy manager should be:

- the presence of higher professional education;
- knowledge of the methodology of energy management evaluation and training of employees in this area;
- knowledge of the methodology for rewarding university employees who save energy;
- ability to analyze energy flows in detail;
- ability to communicate with the administration and all staff;
- ability to conduct economic analysis of energy saving measures;
- the ability to develop energy-saving measures;
- know the basic technologies of the given organization;
- the ability to work with new information technologies.

The functions of the university energy manager will include:

- organizing the work of the energy management service;
- supervise the energy audit;
- conducting an analysis of energy consumption, taking into account the evaluation of energy saving measures;
- preparation of proposals for the improvement of the production process, equipment, maintenance and operation of the equipment;
- determination of energy consumers' efficiency;
- control over investments in energy saving measures.

Requirements to the energy auditor of the university:

- availability of higher profile education;
- basic knowledge of energy management;
- knowledge of standards for conducting audits;
- knowledge of safety requirements when carrying out energy audits;
- have the ability to analyze data on energy consumption;
- ability to analyze energy flows in detail;
- have practical auditing skills;
- be able to develop energy-saving measures;
- have an idea of the main technologies of the organization;
- be able to work with new information technologies.

Functions of the energy auditor of the university:

- conducting an energy survey of the university;
- to audit the energy management system;
- preparation of university energy passport;
- analysis of carrying out corrective and preventive actions;
- instrumental inspection of energy supply systems;
- calculation of standard indicators of consumption of each type of fuel and energy resources;
- development of effective measures to implement the identified energy saving potential;
- development of proposals for the organization of energy management system at the university.

In addition, all those university employees who will be involved in the organization of energy consumption and related to the operation of energy facilities must be aware in advance:

- of the need to comply with the energy policies, procedures, and requirements of the energy management system;
- of their roles, responsibilities, and authority to facilitate compliance with the requirements of the energy management system, and the benefits of energy efficiency improvements;
- any significant energy consumption arising in the performance of work, and any consequences of the actions performed.

One of the main moments of energy management system organization in Kyiv National University of Technologies and Design is the formation of energy policy. Energy policy is an official written declaration of interest in rational spending and saving of fuel and energy resources, environmental protection accompanied by a list of stated goals, action plan for their achievement, provision with necessary resources and clear distribution of delegated rights, duties and responsibilities. The mandatory existence of an energy policy in the university is not always realized by the top management and its staff. There is

usually shared responsibility and accountability for the expenditure of fuel and energy resources and energy supplies. Until responsibility and interest are formalized at the formal level, there is a danger of ignoring energy policy, shifting priorities with a loss of ongoing control over energy use and rationalization.

The university energy policy should:

- define the main objectives in the field of energy use and available at the boundary of the application of energy management system;
- include requirements for energy efficiency and energy saving;
- include obligations for legal and informational support for effective energy use;
- provide an opportunity to make adjustments and revise tasks.

The primary role in the implementation of effective energy management in the university should be given to the management. Its task is to formulate and adopt energy policy of Kyiv National University of Technologies and Design and maintain energy management system in working and self-improving state.

Thus, the direct responsibilities of the University management in ensuring the operability of the University Energy Efficiency Knowledge Hub can include:

- the activities of developing and implementing energy management system documents;
- enforcement of university standards and regulations that are part of the energy management system;
- appointment of a responsible and authorized management representative in the energy management system. Periodic reporting by this person on the effectiveness of energy management and energy efficiency in the university;
- planning of measures and operational management of the energy management system;
- allocation of responsibilities and delegation of management authority.

Equation of four-factor regression was obtained: based on eq. (1)

$$Y = -1341024,8002 + 110,5904X_1 + 3538,9134X_2 - 2518,0955X_3 - 8304,8214X_4.$$

To assess the quality of the resulting equation, we make calculations for each month of energy consumption KNUTD, calculate the standard deviation. The calculation results are presented in Table 1.

Table 1

Results of calculations of the energy efficiency of KNUTD

Month	Electricity consumption, kWh	Estimated electricity consumption, kWh	Deviation, kWh	Rejection, %
January	186808	189483,69	2829,69	1,46
February	160339	168838,34	8499,24	4,68
March	141634	138348,22	4286,88	3,02

End Table 1

Month	Electricity consumption, kWh	Estimated electricity consumption, kWh	Deviation, kWh	Rejection, %
April	98240	98200,84	49,14	0,04
May	46984	49948,94	2983,94	4,21
June	34941	33419,82	2421,18	6,83
July	22192	22482,19	390,19	1,86
August	43904	39211,83	4682,16	8,89
September	48684	61424,31	2840,31	4,84
October	122034	123444,43	1419,44	1,24
November	183193	168984,64	4218,34	3,01
December	211063	201866,60	9296,39	4,40

The calculations confirm the feasibility of organizing the university's Energy Efficiency Knowledge Hub.

CONCLUSION.

Timely provision and organization of high-quality energy management system of the university on the basis of the Energy Efficiency Hub will allow Kyiv National University of Technologies and Design to: reduce costs, eliminate unproductive costs, improve financial performance and gain a reputation as an organization successful in improving its energy efficiency.

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ABBREVIATIONS

%	Percentage
Eq.	Formula of calculation
Fig.	Figures
HEI	Higher education institution
Hub	Common connection point
KNUTD	Kyiv National University of Technologies and Design

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METHODOLOGY AND TECHNOLOGY OF HACKATHON ECOSYSTEM TO ENGAGE UNIVERSITY FACULTY AND STUDENTS IN INNOVATION AND ENTREPRENEURSHIP IN THE CONTEXT OF REDUCING THE IMPACT OF THE COVID-19 PANDEMIC

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BACKGROUND AND OBJECTIVES.

Currently, the functioning of public universities in Ukraine is provided at the expense of funds from entrepreneurial activities at the level of 40%. This activity in a market economy is a source of financial resources that allow universities to adequately carry out their educational and scientific mission in society, to expand and strengthen the material and technical base, to retain human resources. An analysis of funding trends for universities in the context of the COVID-19 pandemic has shown a steady decline in the share of funds allocated to universities from the budget in the total volume of resources received. This fact actualizes the study of the problems of entrepreneurial management of public universities aimed at ensuring economic security and academic freedom, which can be implemented with the help of the Hackathon ecosystem.

METHODS. The solution of the problems set in the work was carried out using a systematic approach based on the Hackathon ecosystem, methods of scientific abstraction, modeling, analysis, synthesis, expert evaluations, comparative and other general scientific methods. Reliability of scientific provisions, conclusions and practical recommendations are based on theoretical and methodological provisions formulated in the studies of domestic and foreign economists, on the analysis of statistical and factual information. Development of the newest approach in the care of critically ill coronavirus

patients (functional adaptive clothing of new design and with new properties) was carried out by rebranding tools based on benchmarking to determine the possibility of developing additional segments of consumption.

FINDINGS. The project of rebranding adaptive clothing made of flexible morphological structure for bed-ridden critically ill patients with acute respiratory distress syndrome COVID-19 and nonintubated patients receiving acid therapy or non-invasive lung ventilation is proposed, creating exclusive competence in two areas of application: Providing technical-medical assistance in COVID-19 patient care using world-leading expertise (international benchmarking) in creating and providing textile fabrics with special antibacterial properties.

CONCLUSION. The project of involvement of innovation-entrepreneurial activity of university teachers and students under conditions of COVID-19 pandemic decrease in the form of assets of individual human potential (patents, copyright certificates, know-how) and branded intangible assets (trademarks, trade secrets) is offered. Its implementation will allow to use the organizational possibilities of rebranding in the dissemination of research results to additional segments of consumption and expand the totality of intangible and virtual assets in the form of «goodwill».

KEYWORDS: Hackathon ecosystem; goodwill; COVID-19; rebranding; university.

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МЕТОДОЛОГІЯ ТА ТЕХНОЛОГІЯ ХАКАТОН-ЕКОСИСТЕМИ ЗАЛУЧЕННЯ В ІННОВАЦІЙНО-ПІДПРИЄМНИЦЬКУ ДІЯЛЬНІСТЬ ВИКЛАДАЧІВ ТА СТУДЕНТІВ УНІВЕРСИТЕТУ В УМОВАХ ЗМЕНШЕННЯ ВПЛИВУ ПАНДЕМІЇ COVID-19

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ПОСТАНОВКА ПРОБЛЕМИ ТА ЗАВДАННЯ. В даний час функціонування державних університетів України забезпечується за рахунок коштів від підприємницької діяльності на рівні 40%. Дана діяльність в умовах ринкової економіки є джерелом фінансових ресурсів, що дозволяє університетам адекватно виконувати свою освітню і наукову місію в суспільстві, розширювати і зміцнювати матеріально-технічну базу, зберігати кадровий потенціал. Аналіз тенденцій фінансування університетів в умовах пандемії COVID-19 показав стійке зниження частки коштів, що виділяються університетам з бюджету, в загальному обсязі отриманих ресурсів. Цей факт актуалізує дослідження проблем управління підприємницькою діяльністю державних університетів, спрямованої на забезпечення економічної безпеки та академічної свободи, що може бути реалізовано за допомогою Хакатон-екосистеми.

МЕТОДИ. Рішення задач, поставлених в роботі, здійснювалося з використанням системного підходу на базі Хакатон-екосистеми, методів наукової абстракції, моделювання, аналізу, синтезу, експертних оцінок, порівняльного та інших загальнонаукових методів. Достовірність наукових положень, висновків і практичних рекомендацій ґрунтується на теоретичних і методологічних положеннях, сформульованих в дослідженнях вітчизняних і зарубіжних економістів, на аналізі статистичної та фактичної інформації. Розробка нового підходу в догляді за важкохворими на коронавірус

пацієнтами (функціонального адаптивного одягу нової конструкції і з новими властивостями) проводилася інструментарієм ребрендингу на основі бенчмаркінгу для визначення можливості освоєння додаткових сегментів споживання.

РЕЗУЛЬТАТИ. Запропоновано проект ребрендингу адаптивного одягу з гнучкою морфологічною структурою для лежачих тяжкохворих з гострим респіраторним дистрес-синдромом COVID-19 і неінтубованих пацієнтів, які отримують кісневотерапію або неінвазивну вентиляцію легенів, що створює ексклюзивну компетентність у наданні техніко-медичної допомоги в догляді за хворими COVID-19 з використанням провідного світового досвіду (міжнародний бенчмаркінг) по створенню і використанню текстильних полотен з спеціальними антибактеріальними властивостями.

ВИСНОВКИ. Запропонований проект залучення в інноваційно-підприємницьку діяльність викладачів і студентів університету в умовах зниження впливу пандемії COVID-19 у вигляді створення і реалізації активів індивідуального людського потенціалу (патентів, авторських свідоцтв, ноу-хау) і фірмових нематеріальних активів (торгових марок, комерційних секретів) дозволяє використовувати організаційні можливості ребрендингу в поширенні результатів дослідження на додаткові сегменти споживання і розширити сукупності нематеріальних і віртуальних активів у вигляді «гудвілу».

Ключові слова: Хакатон-екосистема; гудвіл; COVID-19; ребрендинг; університет.

INTRODUCTION.

The consequences of the COVID-19 pandemic in Ukraine have fundamentally changed the economic conditions of public universities. These conditions are characterized by increased instability and uncertainty in the external environment, increased competition in the market of educational services, and a significant reduction in the budget financing of higher education (Bansal et al., 2020; Bendau et al., 2020). In this context, universities are faced with the problems of ensuring viability, maintaining financial health at a sufficient level, and finding sources of sustainable development (Barbosa et al., 2020). The natural solution to the accumulated problems was the development of entrepreneurial activities of universities.

The newest outbreak of coronavirus is a global problem, posing a serious risk to the entire world population (Buckee et al., 2020). Due to the unusual rate of spread of the disease, the World Health Organization (WHO) declared COVID-19 pandemic on 11.03.2020. The occurrence of coronavirus disease in Ukraine was recorded on 3.03.2020, when the first case was confirmed in Chernivtsi region. Reviewing the literature on the COVID-19 outbreak, one can notice that a great number of scientific articles have been published recently on how to adopt preventive and control measures to minimize the spread of the disease, how to mitigate the risks of infection and transmission, how to ensure proper behavior with medical waste generated by treating patients with coronavirus (Byambasuren et al., 2020). The challenge of developing morphologically flexible garments for the critically ill as well as textile support products in the face of a new COVID-19 pandemic outbreak and its rebranding by benchmarking methods for new consumption segments is very urgent and needs to be addressed immediately. Humanity's past experience gives reason to expect that the innovative data obtained in the fight against coronavirus will help save lives, prevent disease contamination and generally make people more active and productive. As the world's leading scientists point out, it is possible that the search for means to combat coronavirus will produce new knowledge that can be applied to pandemics, epidemics and diseases on new and innovative principles. Another challenge of today's society is not only to realize the global complexity of the situation, but also to find out the current and future risks, the need for increased safety requirements. The aim of the article is to substantiate the technology of Hackathon-ecosystem to engage in innovative and entrepreneurial activities of university teachers and students in reducing the impact of the COVID-19 pandemic. The study was conducted at the Kyiv National University of Technologies and Design (KNUTD) in 2020.

MATERIALS AND METHODS.

The solution of the problems set in the work was carried out using a systematic approach, methods of scientific abstraction, modeling, analysis,

synthesis, expert evaluations, comparative and other general scientific methods. The reliability of scientific provisions, conclusions and practical recommendations is based on theoretical and methodological provisions formulated in the studies of domestic and foreign economists, on the analysis of statistical and factual information.

The basis of research methodology lies in the application of bipolar approach, where introversion as a technical and technological component is reflected in the possibility of using the latest approach in caring for seriously ill coronavirus patients (functional adaptive clothing of new design and with new properties) to remove them from the crisis state; extraversion as an economic component represents the effectiveness of rebranding based on the rebranding of clothing with flexible morphological structure in accordance with possible. The methods of expert questioning, multifactor analysis and results processing will identify the most influential factors on the performance properties of articles made of flexible morphological structure, which will allow adapting these methods to the needs of this study. This will make it possible to develop appropriate product designs and determine the most significant material property requirements. In accordance with the tasks set, there will be theoretical developments and practical measures to provide textiles with various types of necessary properties – bactericidal, sorption, shock absorbing, etc. This can be solved by varying the physical and mechanical properties in a wide range and layering them into packages. Innovative textile materials and special product designs will make it easier to care for critically ill patients. The project will develop a series of new garments in the category "outfit and means of rehabilitation designed to care for critically ill patients for coronavirus and to facilitate the movement of patients with impaired mobility. The use of the method of cluster analysis will make it possible to tare the offered assortment of articles with a flexible morphological structure for different consumption segments. The possibility of practical use of the authors' know-how is confirmed by the qualitative characteristics of the experimental samples, technical, economic and consumer characteristics of the developed medical textile and clothing made of it, which corresponds to the level of properties of the leading world manufacturers, the possibility of using the benchmarking tools for rebranding the obtained results.

RESULTS AND DISCUSSION.

The main and specific types of entrepreneurial activities of the university, in addition to renting space in the university, printing activities and other typical types in the university are:

- realization of paid educational services in accordance with the approved state standards;
- realization of the results of scientific and methodological activity;

- comprehensive scientific and educational services to the client with the provision of additional services necessary for education with a break from work or permanent place of residence;

- implementation of intermediary services in the field of education.

The structure of the university business processes is shown in Table 1.

Table 1

List of university business processes

<u>Basic:</u> The educational process (subprocesses: basic education, additional education, preparatory courses)	<u>Auxiliary:</u> The process of methodological support activities; The process of logistical support; The process of capital construction and repair.
<u>Management:</u> Planning of activities; Organization of the educational process; Motivation, training and growth of employees	<u>Development:</u> Creation of a branch network; Expanding the spectrum of services; Improving the quality of services.

Source: Gorin, 2014; Zharska et al., 2014; Kobzeva, 2015.

To improve the efficiency of a higher education institution's entrepreneurial activity, its managers must manage service delivery according to several criteria. In our opinion, the most important criteria to be managed are: customer satisfaction; staff development; research and invention; management; marketing; brand; leadership. The main elements of entrepreneurial activity of the university are presented in Table 2.

Table 2

Correlation of university activities and basic adjustment criteria

Criteria	Types of university activities
1. Customer satisfaction	The educational process; The process of methodological support of activity; The process of logistical support
2. Professional development	Research process Motivation, training and growth of employees
3. research and inventions	The research process
4. Management	Research process Motivation, training and growth of employees
5. Marketing	Educational process; Creation of a branch network; Expanding the range of services
6. Brand	Educational process; Creation of a branch network; Expanding the range of services
7. Leadership	Improving the quality of services

Source: Obolenska, 2002; Dmitrenko, 2012; Grishchenko et al., 2015.

Based on the table above, it is reasonable to use the method of management based on management by deviations with the use of adjustments. Management by deviations is management, when the managing person, the management body fixes deviations from the pre-planned plan, program and takes measures to eliminate the deviations. This approach makes it possible to make efforts exactly in those areas of activity where there are the most significant deficiencies and not to disperse one's energy on less significant problems. Based on such a control system, managers should:

- identify which of the units need to improve performance and reflect this quantitatively by comparison with available standards;
- ensure that the managers of each unit receive performance information;
- respond immediately to high achievements by rewarding the heads of these units;
- provide assistance to those units that are lagging behind;
- to make this procedure systematic;
- to introduce a system of comparisons over a longer period of time in case of repeated high performance of the same units;
- introduce a report on all areas of activity, so that they are not neglected;
- ensure operational management of priorities, so that there are no neglected areas of activity.

One of such projects of entrepreneurial activity of Kyiv National University of Technologies and Design is a project of creation of adaptive and rehabilitative clothes with expanded range of requirements, which include indicators of comfort and multifunctionality depending on the purpose of clothes, including protective properties: protection from hypothermia and hyperthermia and bacterial contamination and so on. Rebranding of the assortment of innovative textile materials with antimicrobial and therapeutic properties with justification of their choice in packages based on benchmarking of the best world achievements, can be used not only in products for seriously ill people, but also for low-mobile population, elderly people, people with disabilities. This approach allows not only to reduce social tension in the society, but also to expand their opportunities and improve their quality of life.

The further use of the results of the project in public practice can include:

- creation of a new range of items of equipment and means of rehabilitation, designed to facilitate movement, dressing and undressing and rapture items, and many other varieties of rehabilitation and preventive items;
- confection of textile materials into garments for people with disabilities of various categories, the seriously ill and other people with limited mobility;
- developing basic designs and improving the technology of production and providing the necessary properties of products for these categories of consumers, taking into account the peculiarities of their use;

- obtaining baseline data to address the issues of mass production of an innovative product.

The presence of a large number of people with disabilities necessitates the production of specially adapted clothing and care items made of textiles, which will help to solve some of the household problems, self-care, as well as involvement in a full-fledged life in society.

The rebranding of adaptive clothing made of flexible morphological structure for bedridden critically ill patients with acute respiratory distress syndrome COVID-19 and non-intubated patients receiving oxygen therapy or non-invasive ventilation creates exclusive competence in two areas of application: Providing techno-medical care in COVID-19 patient care using benchmarking to create and provide textile fabrics with special antibacterial properties, recognized individual human assets, and branded intangibles. The methodology of the applied research stage includes both theoretical substantiation of the regularities of developing designs and selecting materials for garments and other adaptation-prophylactic items and the practical component of the research – making experimental samples of such items. In the course of the experimental part of the project, in order to provide the given therapeutic and prophylactic properties, the methods of providing antimicrobial properties to textile materials by eco-safe technologies will be used. Carrying out physiological and hygienic researches will allow to approach reasonably to manufacturing of samples of rehabilitation and adaptation garments for their subsequent transfer to experimental operation.

CONCLUSION.

The most significant expected results and scientific novelty: development of new design and technology of garments with flexible morphological structure and auxiliary textile products for COVID-19 patients; development of technological regulations "Technology of clothing and other rehabilitation and adaptive garments for lying patients on artificial ventilation (ventilator) and mobile patients receiving noninvasive therapy" and technical and operational conditions of its implementation; mechanism of rebranding

Scientific and practical value of the results: substantiation of conceptual approaches, models and mechanisms of rebranding of the system to prevent new outbreak of pandemic COVID-19 according to the new standards of quality of life and health of mankind. On the basis of scientific recommendations and practice-oriented results of the research, the project can be successfully implemented by creation and development of effectively functioning system of rebranding of products from flexible morphological structure for COVID-19 patients. Use of such new innovative mechanism will allow to solve a number of applied problems: to support medical institutions in conditions of new outbreak of pandemic COVID-19 in the form of timely provision of adaptive, comfortable

and ergonomic clothes for lying patients; on the basis of rebranding and marketing analysis to study additional segments of consumption taking into account new standards of quality of life and health of mankind.

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CONFLICT OF INTEREST.

V. Shcherbak, substantiated the research methodology, validation, conceptualization and control. S. Arabuli collected and analyzed data, processed and provided the results.

ABBREVIATIONS

COVID-19	Corona Virus Disease 2019, corona virus infection 2019-nCoV
Eq.	Equation
fig.	Figure
HEI	Higher education institution
HE	Hackathon Ecosystem
KNUTD	Kyiv National University of Technologies and Design

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CONCEPTUAL PRINCIPLES OF HOTEL AND RESTAURANT BUSINESS DEVELOPMENT

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BACKGROUND AND OBJECTIVES. In Ukraine, not all issues relating to modern theoretical, methodological and applied foundations of enhancing the development of hotel and restaurant business are covered. There is a need for in-depth scientific research of theoretical aspects of the formation of methods of organizational and financial resource provision of tourism development at the national and regional levels, the definition of priorities and determination of ways to improve the efficiency of management of the complex use of the rich recreational and tourist potential of Ukraine.

METHODS. Methodology of scientific research are general scientific and special research methods: dialectical method of research of processes and phenomena in their interrelation and development, system-structural analysis (when studying the conceptual foundations and systematization of methodical approaches to management of development of hotel-restaurant business); methods of group analysis and statistical approaches, economic-statistical

methods, comparison (when analyzing social and economic preconditions, opportunities and motives of development of hotel-restaurant business), methods of analysis of the economic and social situation (when analyzing social and economic preconditions, opportunities and motives of development of hotel-restaurant business).

FINDINGS. The elements of functional support for the development of domestic hotel and restaurant business are substantiated

CONCLUSION. The study of domestic hotel and restaurant business, in particular the regional market of tourist services, is based on the assessment of the environment of market activity. It involves the use of a comprehensive approach to the application of theoretical and applied foundations of sectoral and territorial analysis and aims to form the leading levers of development of hotel and restaurant business

KEYWORDS: tourism potential; tourist services market principles of tourism and hospitality industry development management; hotel and restaurant business.

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КОНЦЕПЦІЙНІ ПРИНЦИПИ РОЗВИТКУ ГОТЕЛЬНО-РЕСТОРАННОГО БІЗНЕСУ

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Вступ. В Україні висвітлені далеко не всі питання стосовно сучасних теоретико-методологічних та прикладних засад активізації розвитку готельно-ресторанного бізнесу. Існує потреба у поглибленому науковому дослідженні теоретичних аспектів формування методики організаційного та фінансово-ресурсного забезпечення розвитку туризму на загальнодержавному та регіональному рівнях, визначенні пріоритетів та окресленні шляхів підвищення ефективності управління комплексним використанням багатого рекреаційно-туристичного потенціалу України.

Гіпотеза наукового дослідження полягає у поглибленні теоретичних засад формування політики розвитку готельно-ресторанного бізнесу та обґрунтуванні методичних положень щодо напрямів її реалізації у контексті стимулювання організаційного та фінансово-ресурсного забезпечення галузі в регіонах України.

Метою дослідження є обґрунтування на теоретичному рівні елементів функціонального забезпечення розвитку вітчизняного готельно-ресторанного бізнесу.

Методологією наукового дослідження є загальнонаукові та спеціальні методи дослідження:

діалектичний метод дослідження процесів і явищ у їхньому взаємозв'язку й розвитку, системно-структурний аналіз (при дослідженні концептуальних засад та при систематизації методичних підходів щодо управління розвитком готельно-ресторанного бізнесу); методи груповального аналізу і статистично-прогнозних підходів, економіко-статистичні методи, порівняння (при аналізі соціально-економічних передумов, можливостей і мотивів розвитку готельно-ресторанного бізнесу та визначенні пріоритетних напрямків рекреаційно-туристичної діяльності).

Висновки. Дослідження вітчизняного готельно-ресторанного бізнесу, зокрема регіонального ринку туристичних послуг, ґрунтується на оцінці середовища ринкової діяльності. Вона передбачає використання комплексного підходу щодо застосування теоретико-прикладних засад галузевого та територіального аналізу і переслідує мету формування провідних важелів розвитку готельно-ресторанного бізнесу.

Ключові слова: туристичний потенціал; ринок туристичних послуг; принципи управління розвитком туристично готельної індустрії; готельно ресторанний бізнес.

Statement of the problem. A characteristic feature of the transformation processes taking place in the economy of Ukraine is the intensification of the development of the hotel and restaurant business. The scientifically substantiated formation of a favorable financial, economic, legal and information environment in order to stimulate the development of the hotel and tourism industry in the regions of Ukraine is becoming increasingly important.

Analysis of recent research. Recreational science has been developing most intensively in Ukraine since the 1960s. Today such scientists as O.I. Shabliy, N.Yu. Nedashkivska, M.I. Dolishniy, M.S. Nudelman, S.V. Trokhimchuk, G.S. Bachynsky, V. Kravtsiv are especially actively engaged in the development of the tourist and hotel industry. In the future, tourism and the hotel industry, as relatively new objects of interdisciplinary research, are constantly in the spotlight of economics. A large array of economic literature highlights the features and prospects of tourism and the hotel industry.

The purpose of the study is the formation of conceptual foundations for the development of hotel and restaurant business in the state.

Presentation of the main material. In support of these facts in the modern world prevails the economic concept of world tourism, which is manifested in the fact that the economic aspect of hotel and restaurant business prevails over others, encouraging the development of production, services, rational use and reproduction of tourist resources.

However, these characteristics of the hotel and restaurant business in the world will look incomplete and one-sided. A more detailed analysis of it, along with impressive quantitative indicators, reveals other aspects of this industry. Thus, in the absence of proper planning and management, the development of the hotel and restaurant business can lead to such socio-economic problems as:

- excessive use of natural ecosystems (forests, mountains, lakes);
- destruction of natural systems for tourism facilities;
- harmful emissions of vehicles;
- generation of garbage and other household waste;
- negative impact on the culture and customs of the local population;
- destruction of historical and architectural heritage;
- increasing population density in tourist centers.

Since the preserved natural environment and socio-cultural sphere are the most necessary conditions for full recreation, their observance becomes an important economic factor in the development of the hotel and restaurant business and for those who determine policy in this area. Therefore, with a seemingly unshakable economic concept from the beginning of the twentieth century. In the field of tourism regulation, the concept of sustainable development is becoming increasingly important, which requires taking into

account the long-term interests and consequences of the industry, limiting the scale of tourism so that the host territory saves its resources for future generations. Using the principles of the Concept of Sustainable Development, the hotel and restaurant industry can not only overcome the so-called "side effects", but also act as a driver that will lead other industries on the path of sustainable development. Priority efforts to implement the principles of sustainable development should minimize the negative environmental consequences of tourism. This task becomes especially relevant, given the rapid development of the industry, which is expected in the coming years, and, accordingly, the growth of its burden on the environment. After all, in the end, the industry will be able to develop only with the rational use of natural recreational resources. Therefore, in the future, transport and hotel services, catering, waste disposal, etc. must be organized with much greater diligence and environmental friendliness than today. However, successes in the fields of environmental protection and socio-cultural environments, care for them depend primarily on the initiative of the state and local administrations, public and private organizations that coordinate the development of tourism. The role of the state is especially important because it develops the necessary strategic basis for planning the tourism industry: ensures the development of valuable recreational areas and tourist centers, conducts basic research and monitoring, and assesses infrastructure needs and their consequences. The development and practical implementation of the concept of sustainable development for recreation and hotel and restaurant business should be carried out in cooperation with all stakeholders, especially the private sector and local people, taken into account in the development of practice-oriented state and regional programs for recreation and tourism. In order to ensure a sustainable structure of consumption and production within the tourism sector of the economy, it is necessary to support the national capacity to develop and implement policies in areas such as planning in kind, conducting economic activities and assessing their consequences, regulation in information exchange, education and marketing. Sustainable development of tourism can ultimately lead to sustainable development of the entire territory, while carrying out nature protection, cultural protection, social and economic development. An example of the expediency and prospects of such an approach in ensuring the transition of the regions of Ukraine to the principles of sustainable development can be the western region. Given that the priorities for this region, along with other industries, are tourism, recreation and health resort, the issue of scientifically sound approach to managing their development today is of particular importance. Due to radical changes in the socio-economic life of the state and new socio-political guidelines, the role of further research into the development of the hotel and restaurant business is growing.

Existing methods of research of domestic development of hotel and restaurant business, in particular the national market of tourist services, are based on an estimation of the environment of market activity, definition of factors of effective work of subjects of tourism and size of their influence on final economic results. They provide for the use of an integrated approach to the application of theoretical and applied principles of sectoral and territorial analysis and pursue the goal of forming the leading levers of national tourism policy.

According to the results of research, it is advisable to identify the following principles of development of hotel and restaurant business in the country:

1) assessment of factors of external and internal environment of functioning of development of hotel and restaurant business on the basis of the system approach;

2) a comprehensive analysis of the level of development of the hotel and restaurant business;

3) forecasting the directions of development of hotel and restaurant business and stimulating their activity. It will be useful to consider in more detail the above conceptual principles:

1. Assessment of external and internal factors of the functioning of the hotel and restaurant business on the basis of a systematic approach. The mechanism of analysis involves the division of all factors of influence into two groups: external and internal environment, and the principle of systematization allows a comprehensive assessment of their effect. The factors of the internal environment include those that have a direct impact on the functioning of the domestic market of tourist services. In particular, it is the state (through legislative activity), related to the tourist and hotel sphere of activity, consumers of the tourist and recreational product, investors, ecological, natural factors, etc.

The external environment provides an indirect impact on the state of the national market of tourist services and includes: political, psychological factors, socio-cultural environment, the state of the economy and STP, geographical location, international events and more. The algorithm for estimating the magnitude of the impact of these factors of the internal and external environment on the functioning of the domestic market of tourist services involves the use of economic and mathematical methods of analysis.

2. Comprehensive analysis of the level of development of the hotel and restaurant business involves the study of market conditions, assessment of the structure and level of consumption of tourist services, structural and territorial analysis of the market of tourist services and the state of the tourist industry. The analysis of the state of recreation and tourism should be carried out, taking into account the assessment of available logistical, financial, labor, natural recreational and tourist resources in kind, value and quality, in absolute, relative

or average values. The application of the method of integrated assessments to determine the level of development of recreation and tourism contributes to the complexity and integrity of the approach. The analysis of the dynamics of the leading components of the tourist process should be carried out according to the system of economic and statistical indicators, which should include the definition of average growth rates, variation scale, coefficient of variation. Territorial-dynamic analysis is designed to establish the structural and spatial dependences of the functioning of the market of tourist and recreational services and to prepare input data for forecasting its development and optimization of the territorial organization. In general, the purpose of a comprehensive analysis of the level of development of the hotel and restaurant business is:

- study of the state, structure, typology and territorial differentiation of the supply of tourist and recreational services and demand for them;
- establishing the level of development of recreation and tourism and the level of meeting the needs for tourist and recreational services;
- assessment of the market situation of tourist and recreational services and identification of existing disparities.

3. Forecasting the development of hotel and restaurant business can be considered the final or final stage of the analysis of the level of development of national and regional markets for tourism services and used as information support for the formation of tourism and recreation policy.

Forecasting should be performed using economic and mathematical methods (including factor modeling), programming methods to identify the effectiveness of recreation and tourism, depending on the impact of changes in internal and external factors. Particular attention in forecasting and planning recreational and tourist activities should be paid to the study of demand, supply of tourist product and optimization of their ratio in the market of tourist services.

Conclusions and prospects for development. The main task of modern management systems should be to ensure optimal conditions for the development of hotel and restaurant business. This includes the implementation of information, regulatory and legislative support, development of forecasts of tourist needs, coordination of tourist activities. The main areas of regulation include recreational nature management; staffing of tourist establishments with qualified workers; ensuring the work of institutions that provide special and household services to travelers; compliance with the requirements of living in recreational areas. The results of the analysis of the market of tourist services should be the basis of concepts and programs for the development of recreational and tourist sphere, which would solve the problems of the industry in the general context of socio-economic development and contain priority goals, main directions of their implementation, optimal location recreational facilities, activities to provide opportunities to meet the effective demand of the

population for spa, tourist and recreational services, taking into account environmental, socio-economic, resource constraints; as well as miscalculations of alternative directions of tourism and recreation development, socio-economic efficiency of their implementation. Socio-economic efficiency of the hotel and restaurant business development policy should be determined by implementing a system of multipliers that will help assess both direct and indirect effects of tourism development due to the projected change in tourist flows:

- income multiplier – reflects the dynamics of income of tourism and recreational entities;
- demand multiplier – reflects the dynamics of the real volume of effective demand for recreational services;
- supply multiplier – reflects the change in the real volume of competitive tourist and recreational services in the regional market of recreational product;
- multiplier of economic activity – allows to estimate the dynamics of employment in the tourism sector and related economic sectors;
- investment multiplier – reflects the dynamics of investment support in the tourism industry.

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FORMATION OF AN INFORMATION TECHNOLOGY PLATFORM TO SUPPORT AND DEVELOP THE HOTEL BUSINESS

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BACKGROUND AND OBJECTIVES.

The issue of providing the sphere of hotel business with information resources and improving the information support system is relevant, requires new solutions to increase the competitiveness of hotels and similar accommodation facilities at the national and international level.

METHODS. Methods of scientific research are general scientific and special methods of the research: abstract-logical method – for substantiation and specification of basic positions of information support of hotel business development; at the analysis of social phenomena and specification of economic essence of categorical row, dialectical-logical – for determination of presence of synergy effect from forms of network organization of information-technological platform by adding various subjects to development of hotel business.

FINDINGS. The hypothesis of the scientific research is to model the conceptual foundations for creating an information technology platform that aims to add to the development of the hotel business of different subjects. The aim of the research is to substantiate theoretically the elements of formation of the information-technology platform for support and development of the hotel business.

CONCLUSION. It has been substantiated that as a result of using the platform, consumers will be able to access the necessary range of information about the hotel business. The proposed platform should include an element of an alternative booking system, where the consumer has the ability to independently select the necessary hotel or similar accommodation fixture, get reservation services, specify the type of room, date, book accommodation online and receive confirmation. In addition, guests (customers) will be able to communicate and exchange information, including everything that relates to specific requirements and personal needs. Hotels will be able to collect data and various information about their clients and to analyze their wishes, which will allow personalizing the services for each individual client. This can be the basis for the formation of a loyalty program for hotels and similar accommodation facilities, providing customers with an incentive to become a repeat customer and consumer of the hotel visited.

KEYWORDS: hotel and restaurant business; communication; information support; loyalty program; network organization.

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
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ФОРМУВАННЯ ПЛАТФОРМИ ІНФОРМАЦІЙНИХ ТЕХНОЛОГІЙ ДЛЯ ПІДТРИМКИ ТА РОЗВИТКУ ГОТЕЛЬНОГО БІЗНЕСУ

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Вступ. Питання забезпечення сфери готельного бізнесу інформаційними ресурсами та вдосконалення системи інформаційного забезпечення є актуальним, потребує нових рішень для підвищення конкурентоспроможності готелів та аналогічних засобів розміщення на національному та міжнародному рівні.

Гіпотеза наукового дослідження полягає у моделюванні концептуальних засад створення інформаційно-технологічної платформи, яка націлена на можливість долучення до розвитку готельного бізнесу різних суб'єктів.

Метою дослідження є обґрунтування на теоретичному рівні елементів формування інформаційно-технологічної платформи підтримки та розвитку готельного бізнесу.

Методологією наукового дослідження є загальнонаукові та спеціальні методи дослідження: абстрактно-логічний метод – для обґрунтування і конкретизації основних положень інформаційного забезпечення розвитку готельного бізнесу; при аналізі суспільних явищ та уточненні економічної сутності категоріального ряду, діалектико-логічний – для визначення наявності синергетичного ефекту від форм мережевої організації інформаційно-технологічної платформи шляхом долучення до розвитку готельного бізнесу різних суб'єктів.

Висновки Обґрунтовано, що внаслідок використання платформи, споживачам буде надано можливість доступу до необхідного спектру інформації щодо діяльності готелю. Запропонована платформа повинна включати елемент альтернативної системи бронювання, де споживач має можливість самостійно підібрати необхідний готель чи інший аналогічний засіб розміщення, отримати послуги резервування, вказати тип номеру, дату, забронювати розміщення в он-лайн режимі та одержати підтвердження. Крім того гості (клієнти) матимуть спроможність проводити комунікацію й обмін інформацією, зокрема все, що стосується специфічних вимог і особистих потреб. Готелі ж отримують можливість збору даних, різного роду інформації про клієнтів, провести аналіз їхніх побажань, що дасть можливість персоналізувати послуги під кожного окремого клієнта. Це може стати основою для формування програми лояльності для готелів та аналогічних засобів розміщення, надання клієнтам стимулу, щоб повторно стати клієнтом і споживачем відвідуваного готелю.

Ключові слова: готельно ресторанний бізнес; комунікація; інформаційне забезпечення; програма лояльності; мережева організація.

Statement of the problem. The issue of providing the hotel business with information resources and improving the information support system is relevant, it needs new solutions to increase the competitiveness of hotels and similar accommodation facilities at the national and international levels.

Analysis of recent research. World and domestic experience has accumulated a considerable amount of knowledge on modeling and forecasting of economic processes in the hotel and restaurant industry. However, the search for, development and improvement of methods that would allow to analyze and forecast all economic processes in accordance with market conditions of development and transformational transformations continues in Ukraine. Studying the processes in modern society to improve the system of information support, it is necessary to gather the necessary information about the factors and resources that affect the development of the hotel and restaurant industry in Ukraine.

The purpose of the study there is a substantiation on a theoretical level of elements of formation of an information-technological platform of support and development of hotel business.

Presentation of the main material. In the conditions of formation of world hotel economy large-scale and full-fledged application of the Internet for promotion of hotel products and services on the market, effective introduction of modern information technologies in activity of hotels and similar means of accommodation becomes important. The rapid development of services and tourism in the last decade has contributed to the formation of various methods of promoting hotels. After all, in market conditions, hotel businesses must qualitatively meet the needs of the population and at the same time make a profit. Therefore, the modern system of marketing measures to promote hotel services should include the use of the latest information technologies, which are the key to "survival" in fierce competition and at the same time the competitive advantage of both the individual hotel business and the tourism industry as a whole (Zavidna, 2017).

The Internet includes huge information resources, databases for all segments of the tourism industry, as well as information systems and technologies that open access to information and allow you to process its huge volumes. To date, there are thousands of tourist sites, portals and search engines, regularly ranked websites. Today, the Internet is an important element of e-commerce as a tool to promote hotels. It may include parts such as PR; internet integration; online sales; information management; customer service, etc. Specialized search engines for tourism have also been created. One of the first was the Booking.com hotel booking system Booking.com, founded in Amsterdam in 1996, focused on the European market (Voronkova, 2018).

The system of information, software for automation of hotel business activity promotes expansion of possibilities of management:

- thanks to automation, managers get a reliable, clear picture of hotel activities;

- allows to reduce the role of the human factor and the level of its influence in the management system;

- the undoubted advantage of automation is manifested in the exclusion of rather laborious and complex accounting operations, as well as in the provision of flexible management of the policy of discounts and bonuses (Tikhanychev, 2018);

- creation of opportunities for regular monitoring of the activities of all functional structures of the hotel, analysis and assessment of the consequences of the activities of accommodation establishments;

- the possibility of combining the structural and functional units of the hotel into a single network to simplify management through remote information retrieval. Today, within the framework of the open innovation paradigm, the terms of all stages of the innovation process are shortened, including the duration of the cycle of innovation implementation in the field of service provision. Under such conditions, the most successful are those businesses that have not created a breakthrough innovation, and those that provide the shortest time to implement innovation in optimal business processes. As a result, the dominant modern process of implementation of innovative ideas are mechanisms that ensure the successful implementation of the latest developments in the economic system. A significant role in this belongs to IT products aimed at adjusting and optimizing both internal and external business processes. The most important among them are technologies of automation of relations with clients and adjustment of activity of sphere of rendering of hotel services in all its displays directly. And in order for the hotel business to develop successfully, they need to use the most modern automation tools and software (Fedulova, Kucher, 2015).

Information technologies used in the hotel business are divided into the following types: increasing the opportunities to influence the external environment of hotel enterprises and improving internal business processes.

The first group includes:

- 1) introduction of multimedia technologies, in particular directories, booklets, catalogs;

- 2) the use of electronic or Internet distribution as a tool for managing and optimizing hotel bookings and revenues received through online channels, which include the website of the hotel (hotel company), online agencies and automated booking systems;

3) definition of three ways of access of the hotel enterprise to the international reservation systems:

- connection to the hotel chain;
- entry into the marketing chain;
- work through the provider;

4) selection of three main models of hotel work with online intermediaries: Merchant, Opaque, Retail.

To establish internal business processes carry out:

- introduction of a database of hotel guests based on CRM-systems;
- use of a digital telephone exchange in the work of the hotel enterprise, which provides multi-channel access and the ability to make calls at any time of the day;

- introduction of a remote monitoring system for all public areas of the hotel and digital video surveillance systems;

- use of wireless communication system;
- use of multiservice data transmission network;
- creation of software and hardware systems that solve the problems of the hotel business, ie hotel management automation systems, namely ERP systems.

The sharing economy is best represented in the activities of the electronic giant Airbnb, thanks to which private owners rent real estate for a relatively short period of time in exchange for a fee. Hotels in major European cities are facing more competition due to the expansion of Airbnb locations. Hotels are responding to this by lowering the price. In addition to reduced prices, consumers benefit from an increase in the number of services offered by peer-to-peer platforms. Airbnb offers the opportunity to travel at low prices, even booking at the last minute, as well as provides personalized services and many other benefits such as discounts, gift cards, etc. (Basiuk, Voshchana, 2020).

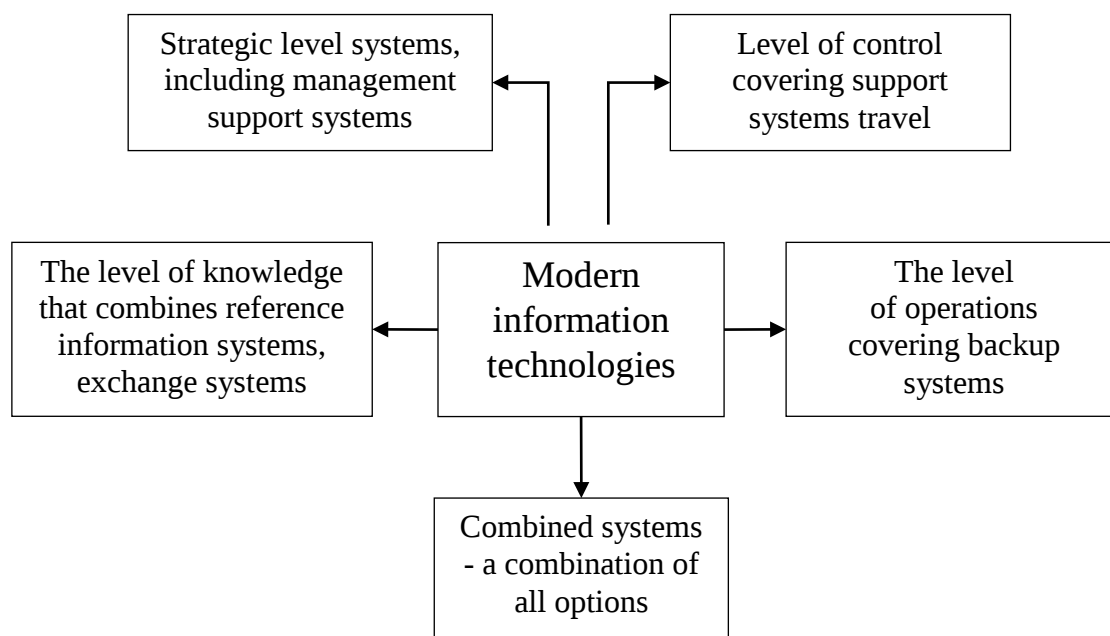
On the territory of Ukraine, this platform has practically not become widespread, it is quite unusual and new for Ukrainian consumers.

In European practice, information technology is used to ensure the booking process, the phone book of hotel rooms. But this requires the hotel management to solve the following organizational tasks (digitalsignage.net.ua, 2014):

- collection and adequate use of consumer information;
- features of communication with customers will be different, even due to the fact that they live in different countries and on different continents, but technological solutions should remove barriers to communication without creating additional problems for hotel staff;
- taking into account the personal needs of the client, in particular a flexible approach to check-in and check-out time depending on the schedule of his trip;
- a more serious approach to the social communication network, which allows you to expand the customer base and additional information about the

customer. Information support and technologies are designed to solve certain problems in the management of the hotel business: the combination of marketing sources in a holistic information environment; business development; increasing competitiveness and brand promotion; attracting new customers; optimization of institutions; cost savings; reduction of human resources; minimum time to create a platform; easy to manage; possibility of expansion of functions (property of multifunctionality). In recent decades, we can trace the rapid growth of innovations in information technology and information support for the development of the hotel business, tourism segment. This leads to increased competition in this area, the search for new improved solutions for communication, cooperation of market participants in hotel and tourism services, the optimal use of resources. According to the analysis of modern information technologies, we can identify the main directions of popular developments and research on information technology to improve the level and quality of services in the hotel business in the tourism sector (Fig. 1).

A special place among information technologies is occupied by information technology platforms, which are versatile, combining in their environment the specific sectoral interests of different parties with generalizing rules and procedures that accompany the life cycle of a product or service from idea to implementation (Balanchuk, Ivanova, Mykhalchenkova, Kukharets, 2014).



Source: compiled on the basis of (Sushchenko, Kravchenko, 2018, Hliebova, 2012, Liubitseva, 2018).

Figure 1. The main directions of development and research on information technology to improve the level and quality of hotel business services in the tourism sector

Given the conditions in which the hotel business operates, for the successful conduct of financial and economic activities, it is important to invest in new information technologies and tools for information support of the hotel business.

Conclusions and prospects for development. We consider it necessary to propose a concept of improving the use of information technology, which is a generalized system approach to building an information technology platform to support and develop the hotel business, including elements of strategic management, innovative information technology and management decision support, room reservation system in hotels, information reference systems, communication business environment. The task of information technology platforms is to organize effective interaction of all stakeholders, to create cooperation. Information technology platforms perform the functions of the basis, provide processes of introduction, processing, storage, distribution, exchange of information on hotel services and products, serve as a communication tool aimed at intensifying opportunities in the supply of hotel services and products, attracting additional financial resources for hotel development business. The information technology platform includes: information databases; interface of authorized access to data via the Internet; wide (free) access interfaces – sites of international and regional segments; regulations and procedures for participants to work with the information system, software and methodological software. The platform has a modular structure that allows you to develop and combine its components based on the practical needs of its members

The components of the proposed information technology platform for the support and development of the hotel business should be considered in the context of two large-scale sectors.

The concept of the information technology platform provides for the possibility of involving various entities in the development of the hotel business. These can be persons who act as guests, business entities of the hotel industry, persons (both legal and natural) who invest in the development of hotel enterprises, government institutions of various levels of government to cooperate and support investment projects. To organize this interaction, it is advisable to use virtual space and automation of information processes. Hotels and similar accommodation facilities will be able to connect to a virtual information technology platform to ensure the development and competitiveness of their own activities, the application of Internet marketing principles: creating an image of the organization, sales and promotion of hotel services, products and brand; order formation, sale of services; control, analysis, organization and planning of economic activity of hotels; automation of managerial tasks. They have the opportunity to perform a number of functions, including the

distribution of negotiations, information support, promotion of hotel services, sales and payment, and to abandon the expensive services of intermediary companies. This method will provide direct access to the end user of their hotel services, provide them with detailed information on available services without significant financial costs, reduce the multilevel system of distribution of advertising resources and promotion of services, organize cooperation with customers in the context of direct marketing.

The information technology platform for the support and development of the hotel business is a comprehensive solution for hotels with different classifications and similar accommodation. Thanks to the implementation of the platform, the quality of management and administration, the degree of control and regulation of activities, as well as allows management to make more rational and balanced management decisions. The information technology platform aims to disseminate the best innovative business ideas, exchange contacts and information between investors and entrepreneurs seeking to develop the hotel business, enter the business circle of both novice startups and experienced businessmen, establishing relationships with hotel management, etc.

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MATHEMATICAL MODEL OF THE MANAGEMENT OF DEVELOPMENT OF INTEGRATED BUSINESS STRUCTURES

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BACKGROUND AND OBJECTIVES.

In modern economic conditions the formation of financial and economic factors to enhance the development of integrated business structures cannot take place without the active use of mathematical modeling methods. One of the main directions of improving the financial and economic mechanism is the use of these methods as an effective modern tool for strategic management of the development of integrated business structures.

METHODS. The methodology of scientific research are general scientific and special research methods: All scientific research carried out within the framework of established integrated business structures, use general scientific methods, such as the method of scientific abstraction, the method of analysis and synthesis, the method of unity of historical and logical, positive and normative methods, as well as specific research methods. To the specific methods of research can be attributed modeling, which is presented in the study

as the basis for effective management of the development of integrated business structures.

FINDINGS. The hypothesis of the scientific study is to model the process of development of integrated business structures as a given condition for managing the available combined potential. The aim of the study is to substantiate theoretically the use of mathematical modeling in the management of the development of integrated business structures.

CONCLUSION. It was determined that in modern conditions, under the specifics of the formation and development of integrated management structures, which includes many structural units, to improve the management mechanism can be achieved by using as an effective tool of computer technology, allowing a flexible and responsive to changing economic conditions.

KEYWORDS: integration potential; mathematical modeling; integrated business structures; integrative-innovative development; business entities; factors of external and internal environment.

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МАТЕМАТИЧНА МОДЕЛЬ УПРАВЛІННЯ РОЗВИТКОМ ІНТЕГРОВАНИХ БІЗНЕС СТРУКТУР

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Вступ. У сучасних умовах господарювання формування фінансово-економічних чинників для активізації розвитку інтегрованих структур бізнесу не може відбуватися без активного використання математичних методів моделювання. Одним з основних напрямів вдосконалення фінансово-економічного механізму є застосування цих методів як ефективного сучасного інструменту стратегічного управління розвитком інтегрованих структур бізнесу.

Гіпотеза наукового дослідження полягає у моделюванні процесу розвитку інтегрованих структур бізнесу, як заданої умови управління наявним об'єднаним потенціалом.

Метою дослідження є обґрунтування на теоретичному рівні використання математичного моделювання в управлінні розвитком інтегрованих структур бізнесу.

Методологією наукового дослідження є загальнонаукові та спеціальні методи дослідження: Усі наукові дослідження, що проводяться в межах сформованих інтегрованих структур бізнесу, використовують загальнонаукові

методи, такі як метод наукової абстракції, метод аналізу і синтезу, метод єдності історичної і логічної, позитивний і нормативний методи, а так само специфічні методи дослідження. До специфічних методів дослідження можна віднести моделювання, який представлено в дослідженні як основу для ефективного управління розвитком інтегрованих структур бізнесу.

Висновки. Визначено, що в сучасних умовах, згідно із специфікою формування та розвитку інтегрованих структур управління, до складу якого входить багато структурних підрозділів, удосконалювати механізм управління можна з використанням як ефективного інструменту комп'ютерні технології, що дозволяють гнучко і оперативно реагувати на зміни економічних умов.

Ключові слова: інтеграційний потенціал; математичне моделювання; інтегровані структури бізнесу; інтегративно-інноваційний розвиток; суб'єкти бізнесу; чинники зовнішнього і внутрішнього середовища.

Statement of the problem. The task of mathematical modeling of economic systems is the use of mathematical methods for the most effective solution of problems arising in the development of integrated business structures.

Analysis of recent research. The implementation of building models in practice is very diverse. A large number of scientists are interested in this problem in the context of the study of economic systems. The analysis of literature sources showed that there is no universal tool for modeling financial and economic indicators of integrated business structures, everyone chooses his own way to solve the problem.

The experience of creating some has shown that each of the models well describes the economic system for this particular situation and has no universality. For example, multifactor models of economic growth developed by P. Douglas, R. Solow, J. Tinbergen and J. Mead, interpreting development as a derivative of economic growth, reveal the dependence of the dynamics of national production on labor costs, capital and time, from the level of technology and the integrated coefficient of proportionality. According to these models, the way to solve the problem of achieving sustainable development is to overcome obstacles to the growth of gross domestic product by eliminating the negative effects of declines in production and related unemployment, inflation and rising social tensions (Ansoff, 2004; Burgelman and Maidigue, 2004; Yermoshenko and Hanushchak-Iefimenko, 2010; Hanushchak-Iefimenko, 2013, 2014; Hurzhii, Karakai, Petrenko et al., 2006).

The purpose of the study substantiation at the theoretical level of the use of mathematical modeling in the management of the development of integrated business structures.

Presentation of the main material. For the development of integrated business structures it is advisable to solve economic problems in several stages:

Stage of meaningful task statement. It includes qualitative and quantitative analysis of objects and situations. Thus difficult objects are broken into parts, communications of these elements, their properties, quantitative and qualitative values of properties, quantitative and logical relations between them which are expressed in the form of equations, inequalities and so forth are defined. That is, the object is represented as a system. The next stage is the mathematical formulation of the problem, in the process of which the construction of a mathematical model of the object and the definition of methods for solving the problem. This stage can be defined as a stage of systematic synthesis of tasks in the field of development of integrated business structures. If the conducted system analysis has led to such a set of elements, properties and relations for which there is no acceptable method of solving the problem, it is necessary to return to the stage of system analysis (Burgelman and Maidigue, 2004).

However, to solve economic problems, system analysis must take into account a lot of features, so it is difficult to rely on a known mathematical model and algorithm for its solution.

This is followed by the stage of developing a program for solving the problem. For complex objects, consisting of a large number of elements with a large number of properties, you need to compile a database and tools for working with it, methods of data retrieval required for calculations. For integrated business structures, the use of standard software packages and database management systems, in our opinion, is unacceptable because of the limited choice of methods, and there is no choice of the best option from the alternative. At the final stage, the model is operated and the results are obtained.

Consistent use of methods of research of operations and their realization allows to overcome subjectivism, to exclude the volitional decisions based not on the strict and exact account of objective circumstances, and on casual emotions and personal interest of heads.

System analysis allows you to take into account and use in the management of all available information about the managed object, to coordinate the decisions made in terms of objective rather than subjective criteria of efficiency. The use of computer technology allows the manager to receive only the necessary information, by processing huge amounts of data. And the use of a systematic approach in the formation of management decisions shows how to effectively apply previously open economic laws (Yermoshenko and Hanushchak-Iefimenko, 2010).

In their activities they use various models as a simplified reflection of an economic phenomenon or object or a simplified description of reality. The model can be described in the form of equations, diagrams, graphs, diagrams. In economic analysis, the assumption of the variability of one parameter with the invariability of all others is usually used.

To model the economic processes of development of integrated business structures use aggregate quantities, ie a set of specific economic units as a whole. For the purpose of the qualitative and more effective economic analysis, it is expedient to define, with what type of model it is necessary to carry out researches, namely:

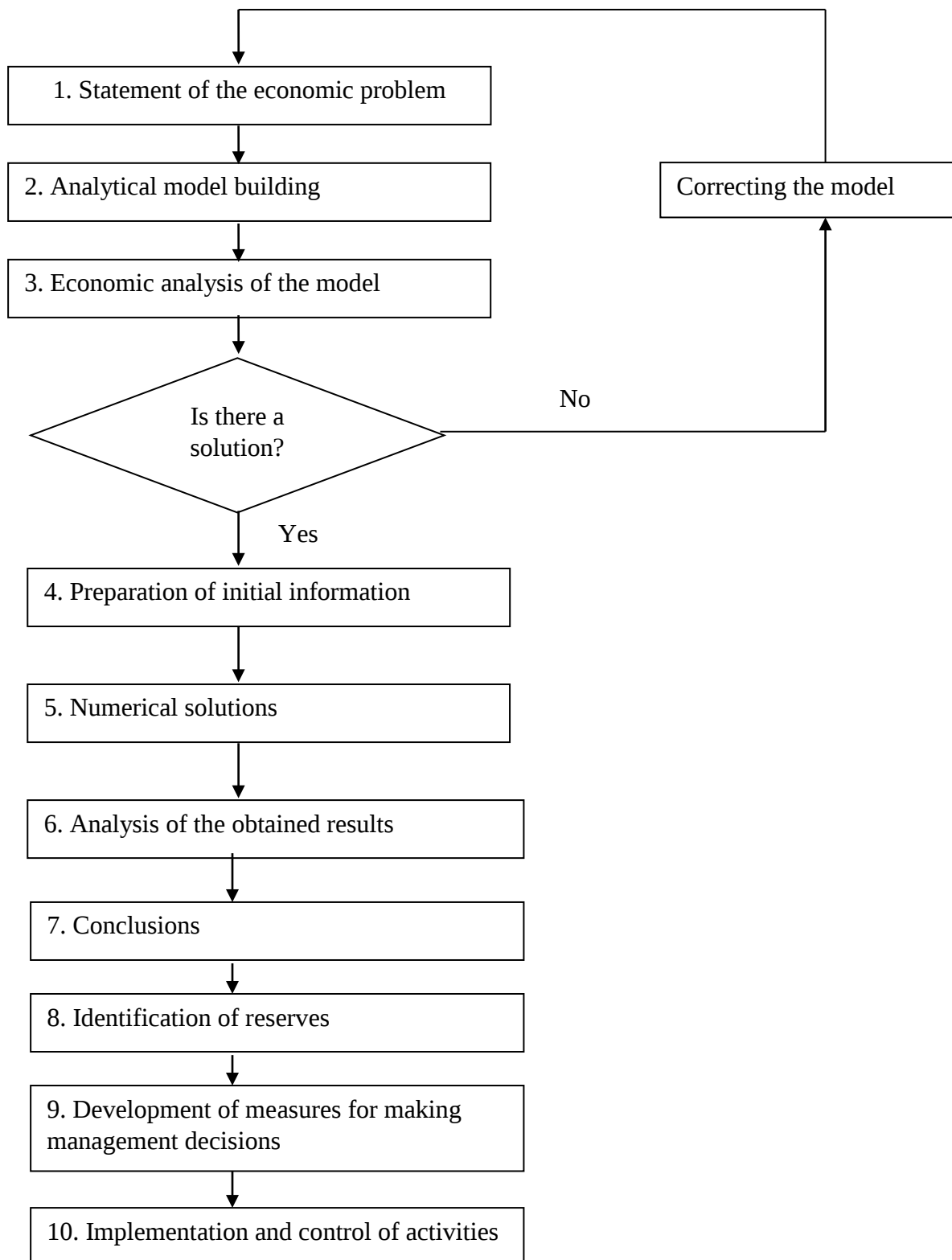
- theoretical models explore the general properties of economics, using deductive methods and formal assumptions;
- applied models analyze the functioning of a particular economic object and use the results of research in practice. Applied ones include econometric and economic-mathematical models;
- macroeconomic models describe the economy as a whole, using aggregate quantities;

- microeconomic models are the main components of economic and mathematical modeling;
- in trend models, the development of the economic modeled system is reflected by the trend of its main indicators;
- optimization models are designed to choose the best option from a certain number;
- simulation models are intended for use in the process of machine simulation of the studied processes;
- static models reflect the economic process at the beginning and end of a certain period and do not consider the transition process itself;
- dynamic models depict economic processes taking into account the time factor;
- in deterministic models use rigid functional connections between variables;
- in stochastic models there is a factor of randomness. In the study of these models using probability theory and mathematical statistics (Hanushchak-Iefimenko, 2014).

For integrated business structures, only complex models are used, for example, micro- or macroeconomic dynamic models, which, in our opinion, most adequately describe this economic system.

The modeling process is cyclical, and in each cycle there are several stages. To conduct qualitative research, it is necessary to follow this sequence of economic and mathematical modeling (Fig. 1).

According to the proposed block diagram, the economic task is formulated step by step, preconditions and assumptions are accepted, the properties of the modeled object, its structure are distinguished, hypotheses explaining the behavior and development of the object are formulated. At the stage of building a mathematical model is the expression of the studied problem in the form of specific mathematical dependencies. The construction of models is divided, in turn, into several stages. First, the type of economic-mathematical model is determined, the possibilities of its application in this task are studied, a specific list of variables, parameters and forms of relations is specified. For some complex objects, it is advisable to build several multifaceted models, with each model highlighting only some properties of the object, and other properties are taken into account approximately. The desire to build a model that belongs to a well-studied class of mathematical problems is justified, which may require some simplification of the initial assumptions of the model, which does not distort the main features of the modeled object. However, it is possible that the formalization of the problem leads to a previously unknown mathematical structure.



Source: (Yermoshenko and Hanushchak-Iefimenko, 2010).

Fig. 1. Block diagram of the modeling process for the development of integrated business structures

At the stage of mathematical analysis of the model, the general properties of the model and its solution are revealed by mathematical methods of research. An important point is the proof of the existence of a solution to the formulated problem. Analytical research finds out whether the only solution is which variables can be included in the solution, to what extent they change, what are the trends of their change and so on. However, models of complex economic objects are difficult to analyze, in such cases, move to numerical research methods. In economic problems, the process of preparing initial information is the most time-consuming stage of modeling, because it is not reduced to passive data collection.

Mathematical modeling has strict requirements for the information system, it is necessary to take into account not only the fundamental possibility of preparing information of the required quality, but also the cost of preparing information arrays. In the process of preparing information, methods of probability theory, theoretical and mathematical statistics are used to organize sample surveys, assess the reliability of data and so on. In systematic economic and mathematical modeling, the results of the operation of some models serve as initial information for others. At the stage of execution of numerical solutions of the problem, algorithms are developed, programs are prepared and calculations are performed directly, and significant difficulties arise due to the large dimensionality of economic data. Usually calculations based on the economic-mathematical model are multivariate. Numerous model experiments, the study of model behavior under different conditions are carried out due to the high speed of modern computer technology (Hanushchak-Iefimenko, 2013). The numerical solution significantly complements the results of the analytical study, and for many models it is the only possible one. At the final stage there is an analysis of numerical results and their application. The question of correctness and calculation of modeling results and their applicability both in practical activity and for the purpose of model improvement is solved. Therefore, first of all, the adequacy of the model is checked for those properties that are selected as essential.

Conclusions and prospects for development. For integrated business structures from the analysis of the obtained results it is possible to draw conclusions and identify reserves, then develop measures for management decisions and complete this flowchart of implementation and control of measures.

These stages of economic and mathematical modeling are closely interrelated, in particular, there may be reversals of stages. Thus, at the stage of building a model it may become clear that the statement of the problem is either contradictory or leads to too complex a mathematical model; in this case, the initial statement of the task must be adjusted. Most often, the need to return to

the previous stages of modeling arises at the stage of preparation of initial information.

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MATHEMATICAL MODELING OF THE DEVELOPMENT OF THE POTENTIAL OF INTEGRATED BUSINESS STRUCTURES

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The article presents the results of research in the field of modeling the development of the potential of integrated integrated business structures. It is substantiated that in the conditions of transformation of the economic system of Ukraine, economic systems, being by their nature complex, dynamic and probabilistic, are characterized by uncertainty of structure, condition and development. Market transformations of the economy of Ukraine, which are characterized by changes in property relations, the creation of capital of business structures, generate an increase in the probability of merging business entities to form integrated business structures. All this raises new priorities for finding new management methods and principles, modeling to develop the potential of integrated integrated business structures.

The hypothesis of the scientific research is to study the mathematical modeling of the process of developing the potential of joint business entities for the formation of integrated business structures in the transformation of the economic system of Ukraine.

The aim of the research is to substantiate at the theoretical level the use of mathematical modeling for the formation of integrated business structures and their combined potentials.

The methodology of scientific research is the following used research methods: within the existing integrated business structures, general scientific methods, such as the method of scientific abstraction, method of analysis and synthesis, the method of unity of historical and logical, positive and normative methods, as well as specific research methods mathematical modeling, which served as the basis for the study.

Conclusions. The process of potential development of integrated business structures is substantiated and mathematically modeled. It is determined that both in the world economy as a whole and in the economies of the leading countries of the world the main role is played not by individual business entities but by integrated integrated business structures. Currently, the so-called "era of integrated business structures" prevails, which combines the potential of different forms, and due to their integrative combination, a competitive economic system is formed.

Keywords: integrated business structures; integration potential; mathematical modeling; economic systems; transformational changes; management methods.

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МАТЕМАТИЧНЕ МОДЕЛЮВАННЯ РОЗВИТКУ ПОТЕНЦІАЛУ ІНТЕГРОВАНИХ БІЗНЕС- СТРУКТУР

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У статті викладено результати досліджень у сфері моделювання розвитком потенціалу об'єднаних інтегрованих структур бізнесу. Обґрунтовано, що в умовах трансформації економічної системи України, економічні системи, будучи за своєю природою складними, динамічними і імовірнісними, характеризуються невизначеністю структури, стану і розвитку. Ринкові трансформації економіки України, які характеризуються змінами у відносинах власності, створенням капіталу підприємницьких структур, генерують зростання імовірності об'єднання суб'єктів господарювання для утворення інтегрованих структур бізнесу. Все це ставить нові пріоритетні завдання відносно пошуку нових методів і принципів управління, моделювання для розвитку потенціалу об'єднаних інтегрованих структур бізнесу.

Гіпотеза наукового дослідження полягає у дослідженні математичного моделювання процесу розвитку потенціалу об'єднаних суб'єктів господарювання для формування інтегрованих структур бізнесу в умовах трансформації економічної системи України.

Метою дослідження є обґрунтування на теоретичному рівні використання математичного моделювання для

формування інтегрованих структур бізнесу і їх об'єднаних потенціалів.

Методологією наукового дослідження є наступні використані методи дослідження: в межах сформованих інтегрованих структур бізнесу, загальнонаукові методи, такі як метод наукової абстракції, метод аналізу і синтезу, метод єдності історичної і логічної, позитивний і нормативний методи, а так само специфічні методи дослідження, зокрема метод математичного моделювання, який слугував базою для проведеного дослідження.

Висновки. Обґрунтовано та математично змодельовано процес розвитку потенціалів інтегрованих структур бізнесу. Визначено, що як у світовій економіці у цілому, так і економіках провідних країн світу головну роль грають не окремі суб'єкти господарювання а об'єднанні інтегровані структури бізнесу. Наразі панує так звана «ера інтегрованих структур бізнесу», яка поєднує потенціали різних форм, і за рахунок інтегративного їх поєднання, формується конкурентна економічна система.

Ключові слова: інтегровані структури бізнесу; інтеграційний потенціал; математичне моделювання; економічні системи; трансформаційні зміни; методи управління.

Statement of the problem. A large number of studies are devoted to the qualitative assessment of the performance of economic systems of varying complexity. The authors use different approaches that allow both a narrow assessment – on the basis of productivity (Kosachev, 2004), and generalized – on the basis of identifying the competitive status of the manufacturer (Yermoshenko and Hanushchak-Iefimenko, 2010). The object of study is the economic relations of relatively simple components of a single economic system. The main prerequisite for building regression models is the absence of structural changes in the modeled system. It is obvious that to build forecasts of the dynamics of the potential of integrated integrated business structures in the transformation processes in the economy of Ukraine should use models that take into account the possibility of changing both the parameters of the economic system over time and its structure (Yermoshenko and Hanushchak-Iefimenko, 2010).

Analysis of recent publications on the problem For this type of research, it seems possible to use different numbers of indicators. Therefore, in scientific sources (Yermoshenko and Hanushchak-Iefimenko, 2010; Tsyhylyk et al., 2004; Kosachev, 2004; Kofman, 1982) there are recommendations regarding the number of indicators in each group of a balanced scorecard (Kofman, 1982).

The purpose of the study is study of the process of modeling the development of the potential of integrated integrated business structures in the conditions of transformation processes in the economy of Ukraine.

The main results and their justification. After analyzing different models (Kosachev, 2004) for universality, taking into account the economic situation in the country to develop the potential of integrated integrated business structures in our opinion, the most justified use of multifactor linear models, as the simplest in calculations and at the same time the most adaptive, describing economic situation.

Therefore, the author proposes the use of the following method of building an economic-mathematical model and forecasting financial and economic indicators of the development of the potential of integrated integrated business structures, which is as follows:

1. For samples find the sample means, sample variances and sample standard deviations, where y is the studied indicator, and x_1 and x_2 – the factors affect it.

2. Find the sample correlation coefficients r_{y1} , r_{y2} , r_{12} .

Given that r , write the correlation matrix:

$$R = \begin{pmatrix} 1 & r_{y1} & r_{y2} \\ r_{1y} & 1 & r_{12} \\ r_{2y} & r_{21} & 1 \end{pmatrix}. \quad (1)$$

3. Using the Student's t test, check the significance of the coefficients t , comparing the observed value with the critical $t_{кр}$.

4. To determine the closeness of the connection r and one of the parameters y and x excluding the influence of the other find the coefficients of the private correlation. The significance of the coefficients is checked according to the Student's criterion. Draw conclusions about the significance of the coefficients.

5. Using the found correlation coefficients, we obtain the linear regression. The required equations have the form:

$$y = b_{01} + b_{11}x_1, \quad y = b_{02} + b_{12}x_2. \quad (2)$$

As a measure of how well the model (regression equation) describes this system of observations, find the coefficients of determination, check their significance.

6. Find the multiple regression equations. To do this, first compile and solve a system of equations:

$$\begin{cases} \beta_1 + r_{12}\beta_2 = r_{1y} \\ r_{12}\beta_1 + \beta_2 = r_{2y} \end{cases} \quad (3)$$

Then find the coefficients b by the formulas:

$$b_1 = \beta_1 \frac{\sigma_y}{\sigma_1}, \quad b_2 = \beta_2 \frac{\sigma_y}{\sigma_2}, \quad b_0 = \bar{y} - b_1\bar{x}_1 - b_2\bar{x}_2. \quad (4)$$

and write the regression equation

$$y = b_0 + b_1x_1 + b_2x_2. \quad (5)$$

7. For each find the theoretical values.

Determine the coefficient of multiple determination. Using Fisher's test, the observed value of F is calculated and compared with the critical value. If the hypothesis of simultaneous equality of zero coefficients should be ignored. This means that at least one of the coefficients is significantly different from zero. In other words, the regression equation is significant and can be used for analysis in this economic system (Kosachev, 2004).

The value of using this technique as a tool for developing the potential of integrated business structures is the analysis of any economic indicator with different factors, taking into account the influence of factors on each other, in a randomly selected period of time. Therefore, it is not necessary to rely only on the financial statements associated with a particular frequency, and use to consider the impact of production factors on economic or financial.

But such an analysis of economic systems of the relationship of financial and economic factors with production activities involves the following

forecasting as an effective tool for strategic management, as well as making informed current decisions.

Examining the literature on the use of forecasting methods (Yermoshenko and Hanushchak-Iefimenko, 2010; Tsyhylyk et al., 2004; Kosachev, 2004; Kofman, 1982), it was found that the most accurate forecast was obtained using Box-Jenkins models. For example, Kendell (Kofman, 1982) provides a comparative table for predicting time series using different models. In most cases, the predictions obtained using the Box-Jenkins models, ie the predictions made using one of the autoregressive models, which integrated the moving average, turned out better.

In practice, models with a finite number of non-zero coefficients are usually used, ie different variants of the ARKS model (p, q). This is due to the following reasons:

- the desire to build the simplest possible model;
- finite number of observations.

The development of the scientific apparatus of forecasting provides increasingly stringent requirements for the peculiarities of the use of a particular mathematical apparatus. However, the importance of accounting for expert assessments is a very important component that determines the description of the problem using a systematic approach, accounting for qualitative characteristics, the use of forecasts and their practical significance. According to modern methodology, the following methods of economic forecasting are considered and widely used: naive model, naive model taking into account the trend, naive model of the rate of change of the time series, naive model taking into account the seasonal component, simple averages, moving averages, double moving averages, exponential (Holt's method), exponential smoothing taking into account trend and seasonal variations (Winters' method), simple regression (linear, inverse, indicative, static), multidimensional regression analysis, Boxer-Jenkins autoregressive models (Kosachev, 2004; Kofman, 1982).

The Box-Jenkins model has a general appearance:

$$y_t = \varphi_0 + \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \dots + \varphi_p Y_{t-p} + \varepsilon_t - \omega_1 \varepsilon_{t-1} - \omega_2 \varepsilon_{t-2} - \dots - \omega_q \varepsilon_{t-q}, \quad (6)$$

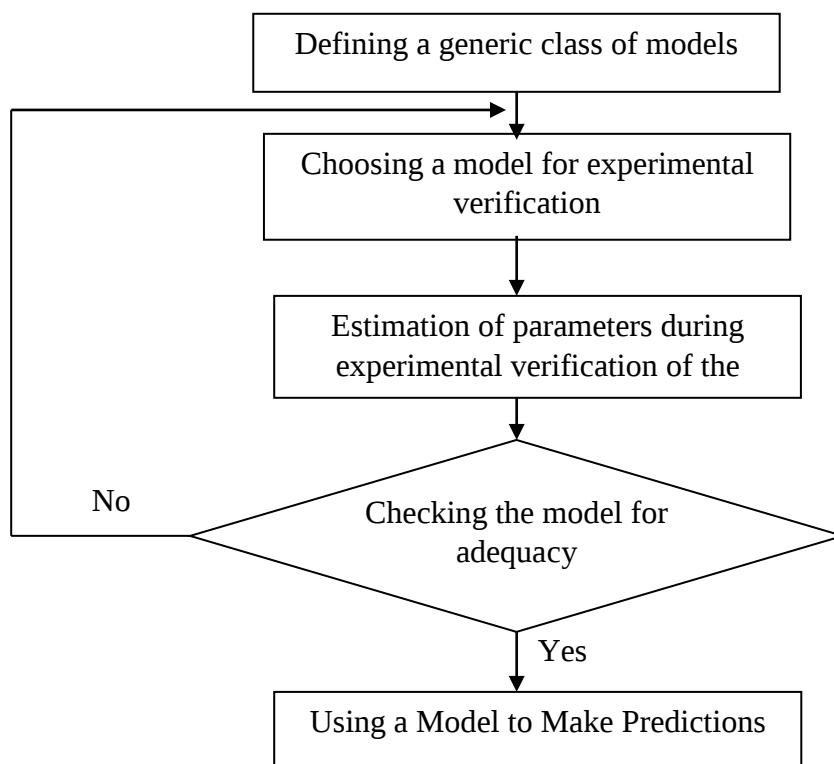
where Y_t – dependent variable at a time t ;

$Y_{t-1}, Y_{t-2}, \dots, Y_{t-p}$ – dependent variable at values of time intervals $t-1, t-2, \dots, t-p$ in accordance;

$\varphi_0, \varphi_1, \varphi_2, \dots, \varphi_p$ i $\varepsilon_t, \varepsilon_{t-1}, \varepsilon_{t-2}, \dots, \varepsilon_{t-q}$ – estimated coefficients.

The effectiveness of different forecasting methods depends on the remoteness of the forecast in time and type (annual, quarterly, monthly) of the analyzed data. Some methods provide greater accuracy for a short period of time, while others are more suitable for long-term predictions. Some methods

work well with annual data, while others are more effective for quarterly and monthly data. For further selection of the best technique, it is advisable to conduct a comparative analysis. For these techniques, special attention was paid to errors, which is an integral part of forecasting. In (Kosachev, 2004) such a comparative analysis was performed and found that the most adequate is the autoregressive method of Box-Jenkins, in which the errors of the method for the study period are up to 10%, which is several times less than when using other methods. Thus, the method makes it possible to predict financial and economic factors in the future. The Box-Jenkins prediction methodology differs from most methods in that it does not provide for any special structure in the data of the time series for which the prediction is made. It uses an interactive approach to determining a valid model among a general class of models (Kosachev, 2004; Kofman, 1982). The selected model is then compared with historical data to verify that it accurately describes the series. The model is considered acceptable if the residues are mostly small, distributed randomly and in general, do not contain useful information. If the given model is not satisfactory, the process is repeated, but with the use of a new, improved model. This integrated procedure is repeated until a satisfactory model is found. From this point on, the model can be used for forecasting purposes (Figure 1).



Source: (Kosachev, 2004; Kofman, 1982).

**Fig. 1. Block diagram of the model selection strategy
by method Box-Jenkins**

The Box-Jenkins methodology is a very powerful tool for accurate short-term forecasting. It should be borne in mind that the creation of a satisfactory model according to the method of Box-Jenkins requires a fairly large amount of historical data and significant time spent by the analyst. This methodology is based on a number of procedures for identifying, adjusting and verifying models to analyze these time series. The forecast follows directly from the selected model. The principle of economy states that if there is a choice, a simple model is always more acceptable than a more complex one. The Box-Jenkins approach to time series analysis is a very powerful tool for constructing accurate, short-range predictions. The models are quite flexible and can describe a wide range of characteristics of time series that occur in practice. The formal procedure for checking the model for adequacy is simple and accessible. In addition, predictions and intervals of prophecy follow directly from the selected model (Kosachev, 2004; Kofman, 1982).

Conclusions. Modern requirements for speed, reliability, accuracy of management of financial and economic systems and information load on the analyst are so high that the set of tasks can be solved optimally only by automating management processes. Therefore, it is important to create such a software product that ensures compliance with all the above requirements with the possibility of in-depth mathematical analysis and as a consequence of an accurate economic forecast to enhance the development of the potential of integrated business structures.

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Загальні відомості щодо подання рукопису статей в журнал:
«Менеджмент» Київського національного університету технологій та дизайну
“Management” of Kyiv National University of Technologies and Design

Редакційна колегія журналу «Менеджмент» приймає до розгляду наукові статті авторів за матеріалами досліджень і науково-технічних розробок. Представлені статті розглядаються редакційною колегією журналу «Менеджмент», проходять подвійне сліпе рецензування, після отримання позитивної рецензії приймаються до публікації.

ЗАГАЛЬНІ ВИМОГИ ДО ПОДАННЯ РУКОПISУ СТАТЕЙ
в журнал «МЕНЕДЖМЕНТ»

Для публікації автори подають до редакції журналу: рукопис статті з анотаціями українською та англійською (польською) мовами. Основний текст статті виконується англійською (польською) мовою.

Структура статті: Назва; Анотація; Ключові слова; Вступ; Матеріали та методи; Результати та обговорення; Висновки; Подяки та посилання.

Титульна сторінка

Титульний лист повинен включати:

- Ім'я (імена) автора (ів)
- Коротку і інформативну назву
- Місце роботи (а) і адреса (а) автора (ів)
- Адреса електронної пошти, телефон та ORCID кожного автора

Назва статті

Назва довжиною до 17 слів не повинна містити назви населених пунктів, країн або міст дослідження, а також скорочень. Уникайте складних і технічних виразів і не використовуйте розпливчасті вирази. Подається англійською (польською) та українською мовами.

Анотація

Резюме від 200 до 300 слів, має структуру: постановка проблеми, мета дослідження, основна гіпотеза, використані методи, результати, висновки. Анотація не повинна містити скорочень або посилань. Подається англійською (польською) та українською мовами.

Ключові слова: Вкажіть від 5 до 7 ключових слів, які можна використовувати для індексування. Ключові слова не повинні повторювати слова з назви статті або містити скорочення і повинні бути написані в алфавітному порядку через крапку з комою. Аббревіатуру слід визначати при першій згадці і послідовно використовувати в подальшому в тексті. Подається англійською (польською) та українською мовами.

Вступ

У вступі повинна бути вказана мета дослідження і чітко позначений пробіл у знаннях, який буде заповнений при дослідженні огляду літератури. Дата і місце проведення дослідження, що проводилося протягом усього дослідження, повинні бути вказані в кінці цього розділу.

Матеріали та методи

Розділ «Матеріали і методи» повинен містити достатньо інформації, щоб можна було повторити експериментальну роботу. Він повинен включати чіткі описи і пояснення процедур вибірки, дизайну експерименту, основних характеристик вибірки і описової статистики, перевірених гіпотез, точних посилань на літературу, використані методи, кількість даних, які використовуються в статистичних тестах.

Результати та обговорення

Розділ «Результати» повинен описувати результат дослідження. Дані повинні бути представлені якомога лаконічніше – при необхідності в формі таблиць або рисунків,

слід уникати дуже великих таблиць. Обговорення повинно бути інтерпретацією результатів і їх значення з посиланням на роботи інших авторів.

Текст

Інтервал – 1,15; шрифт – 12 пт. Поля – по 2 см з кожного боку. Тільки Microsoft Word, doc, docx. Шрифт – Times New Roman. Всі нетекстові об'єкти повинні бути побудовані із застосуванням засобів Microsoft Word (Microsoft Excel Chart, Microsoft Equation і т.д.)

Таблиці

Не оформляйте таблиці і графіки у вигляді фотографій. Таблиці повинні бути розміщені всередині тексту. Таблиці повинні бути розміщені в тексті, повинні мати чітку і раціональну структуру з послідовним порядком номерів. Всі таблиці повинні бути пронумеровані (1, 2, 3 і т. д.). Для кожної таблиці необхідно надати заголовок (підзаголовок) таблиці, яка пояснювала б компоненти таблиці. Вкажіть будь-які раніше опубліковані матеріали, вказавши першоджерело у вигляді посилання в кінці заголовка таблиці. Виноски до таблиць повинні бути позначені верхнім індексом малими літерами (або зірочками для значень значущості та інших статистичних даних) і поміщені під основною частиною таблиці.

Цифри

Рисунки / ілюстрації повинні бути виконані в художньому оформленні високої якості, в межах 200–300 dpi і надані окремо в форматі Excel. Переконайтеся, що цифри чіткі і мають розмір, що дозволяє розбірливо відтворити їх в журналі. Рисунки слід розміщувати всередині тексту. До рисунків слід зробити наступні примітки:

- Кожен рисунок повинен мати короткий підпис, точно описує, що зображено на рисунку. Включайте підпис в текстовий файл статті, а не в файл рисунка.
- Підписи до рисунків починаються з терміну Fig. Рисунки повинні бути з підписами нижче в обмеженій кількості.
- В кінці підпису знаки не ставляться.
- Внизу рисунку необхідно зробити посилання на раніше опубліковані матеріали, вказавши першоджерело у вигляді посилання в кінці підпису до рисунку.

Висновки

У цьому розділі слід виділити основні важливі відкриття і вказати, в чому полягає додана вартість основного відкриття, без посилань на літературу.

Внесок авторів

Вкажіть внесок кожного учасника виконання статті. Напишіть ініціали та прізвище авторів, а також їх роль в написанні статті.

Подяки

Подяки людей, гранти, фонди і т. д. повинні бути поміщені в окремий розділ перед списком літератури. У цьому розділі необхідно вказати фінансову підтримку дослідження, якщо така існує. При цьому повинен бути включений номер гранту фінансової підтримки.

Конфлікт інтересів

Заява про конфлікт інтересів виглядає наступним чином: «Автори заявляють про відсутність конфлікту інтересів щодо публікації цієї статті».

Скорочення

Список всіх скорочень, які використовуються в тексті статті. Вони повинні бути визначені в тексті при першому використанні (уникайте додавання скорочень в анотацію статті). Список скорочень повинен бути наданий в алфавітному порядку. Якщо стаття не містить скорочень, необхідно сказати в цьому розділі «Не застосовується».

Посилання

Всі номери зі списку літератури повинні бути процитовані по всьому тексту статті, а також в розділі «Посилання», оформленому відповідно до стилю посилань журналу Менеджмент. Посилання слід перераховувати спочатку в алфавітному порядку, а потім в хронологічному порядку. Кількість посилань з одного журналу не повинно перевищувати 3–5 цитувань, що є середнім допустимою кількістю. Рекомендується, щоб кількість посилань переважно було не менше 25–30. Авторам також настійно рекомендується посилатися на публікації не раніш, чим за останні 10 років. Обсяг, номер і сторінки всіх посилань повинні бути вказані в форматі журналу Менеджмент.

Цитування та перерахування веб-посилань

Як мінімум, повинен бути зазначений повний URL. Також повинна бути надана будь-яка додаткова інформація, якщо вона відома (імена авторів, дати, посилання на вихідну публікацію і т. д.). Переконайтеся, що всі посилання, цитовані в тексті, також присутні в списку літератури.

Всі цитати в тексті повинні бути представлені в наступному вигляді:

1. Один автор: ім'я автора (без ініціалів, якщо немає двозначності) і рік публікації;
 2. Два автора: імена обох авторів і рік публікації;
 3. Три або більше авторів: ім'я першого автора, за яким слід «і ін.» і рік публікації.
- Посилання можуть бути зроблені прямо (або в дужках). Групи посилань слід перераховувати спочатку в алфавітному порядку, а потім в хронологічному порядку. Приклади: «як показано (Jones, 2015). (Kramer *et al.*, 2000) недавно показали ... »

Список літератури

Список літератури слід спочатку розташувати в алфавітному порядку, а потім при необхідності впорядкувати в хронологічному порядку. Кілька посилань від одного і того ж автора (ів) в один і той же рік повинні позначатися буквами «а», «б», «с» і т. д., розміщеними після року публікації.

Джерел повинно бути не менше 20–25 позицій, мовами оригіналу, оформляється згідно з ДСТУ 8302:2015 та ДСТУ 3017: 2015.

Окремо подається **References** списку літератури оформленого за вимогами:

транслітерація с укр – <http://www.slovnnyk.ua/services/translit.php>

транслітерація с рус – <http://www.fotosav.ru/services/transliteration.aspx>

Приклади оформлення списку References:

Журнальна стаття

Nouri, J., Lorestani, B., Seif, F. (2011). Phytoremediation potential of native plants grown in the vicinity of Ahangaran lead-zinc mine. *Environmental Earth Sciences*, 62 (3): 639–644. DOI: 10.1007/s12665-010-0553-z. URL: <https://link.springer.com/article/10.1007/s12665-010-0553-z>.

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Davis, M. (2005). *Introduction to Environmental Engineering*. 3rd. ed. McGraw Hill Inc.

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Дисертація

Trent, J.W. (2015). *Experimental acute renal failure*. Candidate of Sciences. Dissertation, University of California. University of California, USA.

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Cartwright, J. (2007). Big stars also have the weather. IOP Publishing Physics Web. Retrieved from: <http://physicsworld.com/cws/article/news/2007/jun/26/big-stars-have-weather-too>.

Зверніть увагу, що посилання на електронні сайти повинні використовуватися тільки в тому випадку, якщо є очікування, що сайт буде підтримуватися.

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Всі статті, що знаходяться на розгляді або опубліковані в журналі Менеджмент, підлягають перевірці з використанням програмного забезпечення для запобігання плагіату. Плагіат – серйозне порушення публікаційної етики. Інші порушення включають дублюючу публікацію, фабрикацію і фальсифікацію даних, а також неправомірне визначення вкладу учасника. Таким чином, плагіат, шахрайські або свідомо неточні твердження є неетичною поведінкою, неприпустимі, а відправка одній і тій же рукописи в більш ніж один журнал одночасно є неетичною поведінкою при публікації і неприпустимо. Стаття буде перевірена на предмет виявлення плагіату. Загальна схожість (індекс подібності) не повинна перевищувати граничне значення 10%. В іншому випадку стаття буде відхилена редакцією.

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