

Received 15 July 2022; Revised 20 September 2022; Accepted 16 October 2022

DOI: 10.33119/EEIM.2022.65.5

Riepina, I., Yakusheva, N. (2022). The Development of an Innovation Entrepreneurship Ecosystem in the Era of Industry 4.0. *Education of Economists and Managers*, 65(3), 71–91.

Retrieved from: <https://econjournals.sgh.waw.pl/EEiM/article/view/3051>

The Development of an Innovation Entrepreneurship Ecosystem in the Era of Industry 4.0

INNA RIEPINA

*Department of Business Economics and Entrepreneurship
Kyiv National Economic University named after Vadym Hetman*

NATALIIA YAKUSHEVA

*Department of Business Economics and Entrepreneurship
Kyiv National Economic University named after Vadym Hetman*

Abstract

The development of modern economy based on the use of new technologies, analysis of large databases, development of new management systems using digital technologies is a modern and necessary trend of economic development in the era of Industry 4.0. These processes affect all spheres of both the economy and social life and require thorough research. The economic-static and rating method with its graphic visualisation of the obtained results was chosen as the key method of conducting the research.

As a result of the research, we came to the conclusion that in the course of our activities, each country strives to move forward, following modern development trends, in order

to have a high competitive advantage in the world market. Thanks to information and communication technologies, companies have access to new markets, consumers, online sales and, thus, have a successful business.

Keywords: ecosystem of innovative entrepreneurship, innovative growth, digital technologies, digital resources, industry 4.0 technologies, digital education

JEL Classification: F63, L26, M21, O33, O57, P51

Introduction

The development of the innovation entrepreneurship ecosystem in the era of Industry 4.0 is impossible without modern information technologies. The purpose of the article is to consider modern information technologies of Industry 4.0 and to select the most effective ones for the development of innovative entrepreneurship and the formation of its ecosystem.

The development of the ecosystem of innovative entrepreneurship has been studied by many scientists. It is noted that the innovative ecosystem is a synergy of the state, business, and research environment with the use of organisational, regulatory, educational, methodological, and financial resources and the introduction of a knowledge transfer mechanism for the purpose of transformation into innovative products (Lanovska, 2017). A number of factors influence the formation of an innovative ecosystem, which makes it possible to create a model. The main difference between an innovative ecosystem and other varieties is the presence of an innovative component, innovative culture, electronic environment, and information infrastructure. The heart or core of the functioning of the innovative ecosystem is the presence of an innovative idea, the implementation of which leads to the appearance or improvement of a product or service (Kotko, 2016). The human capital of innovative development is the core of open innovation systems. The main characteristics of open innovation systems are innovative entrepreneurship, innovative networks, innovative cooperation and partnership, innovative clusters and ecosystems (Nosik, 2016). The classic innovation ecosystem is based on five main elements: 1) the academic and engineering community and higher education institutions, which become the main providers of innovative ideas for commercialisation and human resources; 2) venture investors, whose competence includes attracting financial resources to the ecosystem; 3) infrastructure that creates favourable conditions for the existence of innovative companies; 4) stable demand for innovations, which is a guarantee of the normal functioning of the innovation ecosystem as a whole;

5) legislative and legal field, which creates comfortable working conditions not only for the most innovative companies, but also for all participants of the ecosystem (Yaremchuk & Kolomiets, 2016). The modern world is at the stage of the fourth industrial revolution, called 'Industry 4.0'. Given the high, fundamental importance of digital technologies, software, and the complementary work of complex systems, the emergence of platforms to ensure the effective operation of these processes has become inevitable (Dzhafarova & Karpenko, 2021).

The purpose of this article is to study the influence of industry 4.0 on the development of the ecosystem of innovative entrepreneurship.

Research results

The process of penetration of digital technologies, automation, and information technologies at all levels of public life has a great impact on the development of innovative entrepreneurship. The merging of automated production, data exchange and digital technologies into a single self-regulatory system means the least or no human intervention in production processes. Gradual changes cover all areas of activity:

- 1) Changing the functions of the state through the introduction of online services in public administration.
- 2) Changes in society.
- 3) Changes in the functioning of monetary systems.
- 4) There is a digital transformation of activities and the introduction of SMART technologies in production.
- 5) Introduction of the process of robotics in production.
- 6) Application of cloud technologies in all spheres of production and social life.

In today's business environment, entrepreneurs must expand their knowledge and be able to respond quickly to changes in the external environment to have a high competitive advantage in the market. In the era of Industry 4.0, companies are changing production methods, gradually moving away from traditional methods of doing business. The digital transformation of innovative entrepreneurship is aimed at increasing efficiency through better decision-making and risk minimisation. Important modern technologies that an entrepreneur should know today and start in his/her future activities are the following:

- 1) Big Data Analytics. This is a system for collecting and using huge amounts of data, their structuring and analysis. It provides forecasting and modelling based on collected data.
- 2) Additive production (3D printing). A computer programme identifies data about the object and prints it in layers or in the form of precise geometric shapes. The

advantage of 3D printing is the reduction of time, resources, and costs. The entrepreneur who tests the products has an opportunity to print the product and understand whether any changes are needed in the prototype.

- 3) Industrial Internet of Things. This is a network of integrated devices (TV sets, video surveillance monitoring systems, and signals that monitor traffic). The technology system uses sensors to identify and transmit data over the Internet. The advantage for companies is that they can use this technology to track excess or insufficient inventory and goods in stock.
- 4) Artificial Intelligence. Brain Industry 4.0. The advantage of using it in business is to improve the quality of the product by constantly collecting data on its performance. This makes it possible to reduce waste and adapt the product to market needs.
- 5) The Digital Twin. Connects the real world with the virtual one. With the help of sensors and other complex components, this technology identifies and analyses the object, models. This technology allows you to understand the effectiveness of the object or situation before its implementation in the real world.
- 6) Cloud computing and cybersecurity. The availability of files anywhere in the world is an advantage for the entrepreneur and his/her business. Cybersecurity is important for business, because the protection of confidential business data, data of consumers it serves is an important condition for a successful business.

Favourable business conditions have a positive impact on the economic development of the country and ratings in the world market. The most attractive countries for doing business can be identified by the ranking of Doing Business, which is conducted by the World Bank. The rating of ease of doing business allows you to see the countries with the most favourable conditions for doing business. The high rating of ease of doing business is due to the fact that the country has the most favourable regulatory conditions for the establishment and operation of the firm. The rating is based on 10 themes, which include several indicators. In determining the rating indicators, the regulations adopted by the countries during a given year are taken into account as well as the conclusions of entrepreneurs on the real effect of legislative changes. With the help of the rating, entrepreneurs can decide on the feasibility of investing in a given country. In particular, the investor decides on the security and feasibility of investing in the country. With the help of the Doing Business rating for 2020, we analyse the countries in which the conditions for doing business are the easiest. The most successful countries in doing business and their ranking on ten indicators are presented in Table 1.

Table 1. Rating of the ease of doing business in the chosen countries in 2020

Country	Rating of ease of doing business	Registration of enterprises	Dealing with construction permits	Getting electricity	Registering property	Getting credit	Protecting minority investors	Paying taxes	Trading across borders	Enforcing contracts	Resolving insolvency
New Zealand	1	1	7	48	2	1	3	9	63	23	36
Singapore	2	4	5	19	21	37	3	7	47	1	27
Hong Kong SAR, China	3	5	1	3	51	37	7	2	29	31	45
Denmark	4	45	4	21	11	48	28	8	1	14	6
Korea, Rep.	5	33	12	2	40	67	25	21	36	2	11
United States	6	55	24	64	39	4	36	25	39	17	2
Georgia	7	2	21	42	5	15	7	14	45	12	64
United Kingdom	8	18	23	8	41	37	7	27	33	34	14
Norway	9	25	22	44	15	94	21	34	22	3	5
Sweden	10	39	31	10	9	80	28	31	18	39	17
Estonia	18	14	19	53	6	48	79	12	17	8	54
Ukraine	64	61	20	128	61	37	45	65	74	63	146

Source: compiled by the authors on the basis of Doing Business 2020.

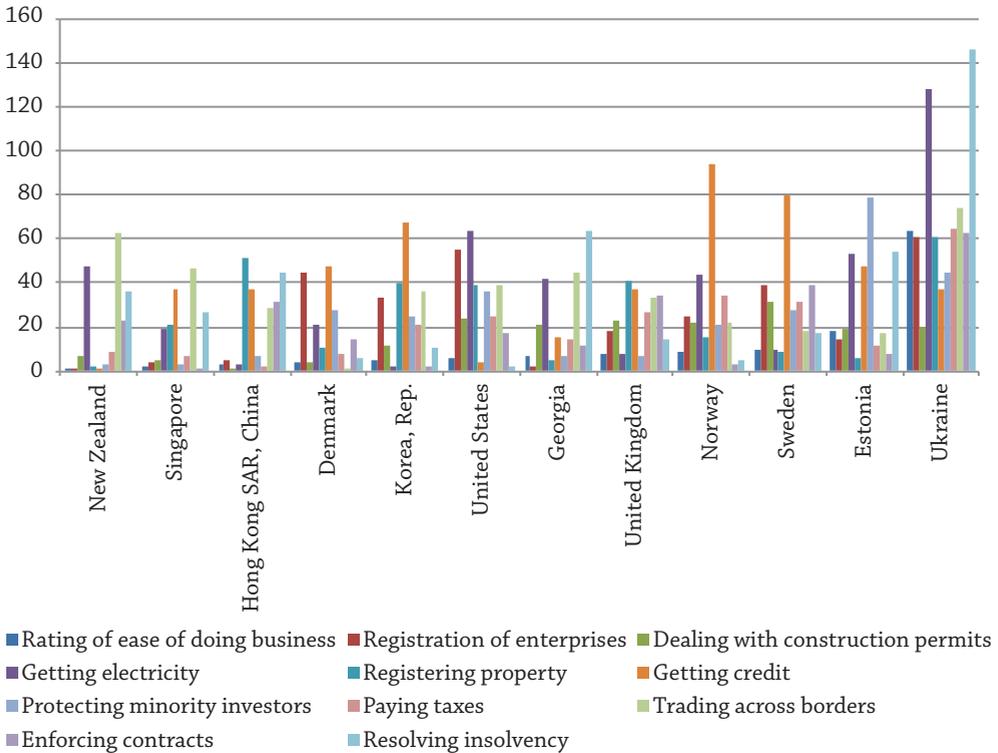
For clarity, research results are represented as Figure 1.

As shown in Figure 1, the most favourable country for starting, registering, and doing business is New Zealand, where it is easy to register a business and get a loan. This has a positive effect on the growth of business activity. New Zealand has a highly developed e-commerce, where online banks are active participants. Most types of business activities do not require permits, and the minimum authorised capital is not enshrined in law. The procedure for registering property and dealing with construction permits is not difficult. The rights of minority investors are protected in this country. The country’s tax policy is favourable for doing business.

If we analyse the business environment in Estonia, we can say that in general the business climate is favourable for doing business. There are no difficulties in registering property and enforcing high-level contracts. In Estonia, it is possible to pay all bills, vote in elections, and register business online. The first and most well-known technology tool is e-governance. E-government is a strategic choice for Estonia. Citizens can receive public services at a time convenient to them, as 99% of them are available online. In Estonia, the Triple Helix model is widely used: when

the state, educational institutions, and business work together to achieve common goals. For example, Tallinn University of Technology (TalTech) is a kind of hub that combines science and business. A Mektory – an incubator at the university – annually develops hundreds of start-ups. For example, the start-up Starship Technologies, which intends to start a logistics revolution in the world, offers smart robots. They do the work of couriers and already today are able to carry small packages. The Real Time Factory concept allows managers to track key performance indicators of the company in real time (Gotsh, 2019). The country is moving forward very quickly thanks to the development of digital technologies, support for start-ups, and the development of innovation.

Figure 1. Rating of the ease of doing business in the chosen countries in 2020 according to Doing Business 2020 by indicators



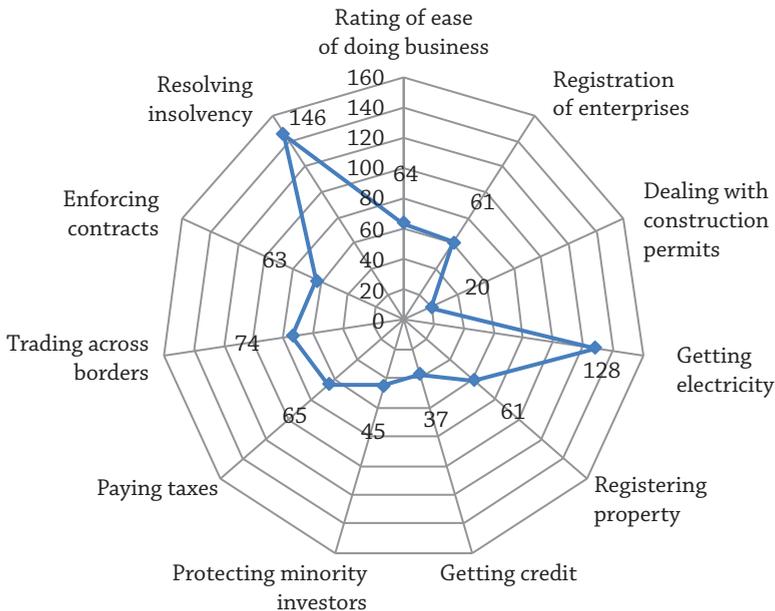
Source: compiled by the authors on the basis of Doing Business 2020.

In the rating Ukraine took the 64th place. According to the World Bank, positive changes affect five of Ukraine’s ten indicators. Our country has simplified the process of dealing with construction permits, namely, eliminated the requirement to hire

an external observer and introduced a system of online notifications. Dealing with construction permits has become less expensive due to a reduction in the share contribution. It also simplified the conditions for getting electricity by optimising the issuance of technical conditions and the introduction of a system of geographic information and increased the reliability of energy supply, introduced a mechanism for compensation for power outages. Ukraine has simplified property registration by increasing the transparency of the land management system. The protection of minority investors has been strengthened through detailed disclosure of company transactions with stakeholders that may be related to majority owners. In the field of international trade, import time has been reduced by simplifying the certification requirements for car parts. In terms of the ‘Getting credit’ indicator, Ukraine has improved access to credit information by creating a state credit register in the National Bank (Doing Business 2020). Continuing previous research on Ukraine’s position in the Doing Business rating (Riepina& Yakusheva, 2019), we want to note that, in general, Ukraine is moving forward through the introduction of changes in public policy and entrepreneurship. From January 1, 2021, there will be a single account for the payment of taxes and fees and a single contribution to the obligatory state social insurance. This helped to optimise the area of taxation.

Ukraine’s rating of 10 indicators in 2020 is shown in Figure 2.

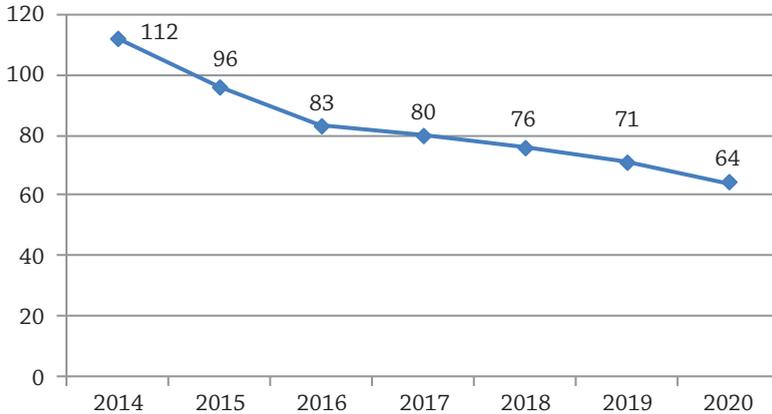
Figure 2. Ukraine’s ranking of the ease of doing business by indicators in 2020



Source: compiled by the authors on the basis of Doing Business 2020.

Carrying out reforms on relevant indicators has helped to improve Ukraine's position on the world stage. To better understand the trend of Ukraine in the overall ranking of Doing Business for 2014–2020, we will show Figure 3.

Figure 3. Ukraine's ranking of the ease of doing business for 2014–2020



Source: compiled by the authors on the basis of Doing Business 2020.

Thus, as the analysis shows, Ukraine is actively moving forward due to the implementation of reforms in public policy. Especially due to the processes of digitalisation in the public sphere and the sphere of entrepreneurship, positive changes have taken place.

In continuation of previous research (Yakusheva, 2018), we would like to note that the active introduction of information and communications technologies for the development of innovative entrepreneurship is important. In particular, according to the Resolution of the Cabinet of Ministers of Ukraine No. 46 of 19.06.2019 *On approval of the Regulations on the integrated electronic identification system* in Ukraine the purpose of the system is to provide electronic identification schemes access to electronic services provided by public authorities, local governments, legal entities and individual entrepreneurs and their services, the functioning of electronic document management, other activities with the use of electronic identification (Kabinet Ministriv Ukraini, 2019). The electronic system allows users to receive electronic services, access to services. The system ensures compliance with the requirements of the legislation on protection of information and personal data, development of the system in the direction of integration into information and telecommunications systems for cross-border electronic identification, integration of information and telecommunications systems of the subjects of interaction into the system. The owner of the system is the state (Kabinet Ministriv Ukraini, 2019). This system

ensures the interaction of public authorities, local governments, their officials; legal entities, and individual entrepreneurs; providers of electronic trust services, and providers of electronic identification services; administrators of intermediate electronic identification nodes (hubs); the technical administrator; the system holder (Kabinet Ministriv Ukraini, 2019). Access to the system is via the official Internet address <https://id.gov.ua>. The task of the system is to create a modern electronic identification infrastructure in Ukraine, create a trust environment in the cyberspace of Ukraine and motivate the subjects of interaction and users of the system to use electronic services (Kabinet Ministriv Ukraini, 2019). Users of the system have an opportunity to obtain information from the Unified State Register of Legal Entities, Individual Entrepreneurs and Public Associations about the head of the legal entity, individual entrepreneur, registration number of the taxpayer's account card and other information (Kabinet Ministriv Ukraini, 2019).

The most popular electronic service for entrepreneurs and individuals is the 'Diya' application, which contains all human documents. Also, the 'Diya' application provides a possibility of opening, making changes, and closing individual businesses; individual entrepreneur registration; notice of the start of construction work on the basis of a construction passport; declaration of readiness of the facility for operation on the basis of a construction passport and other services.

There is *the Electronic office of the State Tax Service for taxpayers*, with the help of which you can submit reports and review preliminary reports, register tax invoices and adjustment calculations, correspond with the tax service.

The Unified State Register of Court Decisions allows you to receive any court decision.

The State Geocadastre allows you to obtain documents from the state land cadastre and technical documentation on the land and monetary valuation, to inform about the ownership rights to a piece of land.

You can use the *Portal of State Registration of Civil Status* to apply quickly for marriage, divorce, or change of your surname.

With the help of the *Citizen's Cabinet* you can access personal information in state registers, property, land, taxes, salaries.

The site of petitions helps to create or support citizens' appeals to the President of Ukraine.

The Electronic Driver's Office provides an opportunity to get information about your cars, get information about fines, and their payment, etc.

The '*Transparent Budget*' information and analytical system (*E-date*) publishes information on the use of public funds.

Search and analytical system 007 contains open data on the use of public funds.

On the '*Prozorro*' public procurement *site* you can register and participate in tenders.

Counterparty Monitoring from Iplex helps to check its counterparties for bankruptcy, reorganisation, change of details, or litigation.

The counterparty verification module provides access to open state registers through the Opendatabot service (Naipopulyarnishi elektronni servisi dlya pidpriemstiv ta fizitshnih osib, 2022).

The Ministry of Digital Transformation of Ukraine has signed a memorandum of cooperation with the K. Fund for participation and development of a national project for business development. The Diya. Business and the School of Small and Medium-sized Business join forces to expand educational opportunities for the business environment. To do this, experts from the School of Small and Medium-sized Business (K. Fund project) will be involved in lectures in offline support centres for entrepreneurs called Diya. Business and in the preparation of publications on the Diya. Business online portal, and in the future will launch joint educational programmes for entrepreneurs (Diya. Biznes i K, 2021).

From the above we can say that the electronic information revolution in the economy has given impetus to reform all areas of activity in Ukraine. This has a positive impact on the ability to create business entities through electronic resources and the development of innovative entrepreneurship in general. The leading factors in the development of innovative entrepreneurship and the formation of its ecosystem are information and digital resources. The introduction of information technology into the socio-political and economic life has formed the digital economy, under the influence of which the sphere of innovative entrepreneurship is successfully developing, where goods presented in the digital form and services are sold through e-commerce.

An important comprehensive indicator that characterises the level of development of information and communication technologies and the network economy of the world is the Networked Readiness Index. This index shows the innovation and technological potential of the world, opportunities for development of the countries in the field of high technology and digital economy. The calculation of this index is carried out by the Portulans Institute together with the World Information Technology and Services Alliance. The level of development of information and communications technologies affects labour productivity, competitiveness, diversification of the economy and contributes to improving the welfare of the population. Countries that are leaders in the development of computer technology occupy a leading position in global competition. Widespread use of information and communications technologies is one of the priority areas of economic development. Therefore, for a better understanding of the level of development of information and communications technologies in the world, we propose considering the data in Table 2.

Table 2. Networked Readiness Index 2020–2021

Країна	NRI rank in 2020	NRI score NRI in 2020	NRI rank in 2021	NRI score NRI in 2021	Trend
Sweden	1	82.75	2	81.57	↓
Denmark	2	82.19	3	81.24	↓
Singapore	3	81.39	7	80.01	↓
Netherlands	4	81.37	1	82.06	↑
Switzerland	5	80.41	6	80.20	↓
Finland	6	80.16	5	80.47	↑
Norway	7	79.39	9	78.49	↓
United States	8	78.91	4	81.09	↑
Germany	9	77.48	8	78.95	↑
United Kingdom	10	76.27	10	76.60	Const.
Estonia	23	70.32	21	71.62	↑
Ukraine	64	49.43	53	55.70	↑

Source: compiled by the authors on the basis NRI (2020).

The above data show the ranking of the most developed countries in the field of information and communication. The United Kingdom has a steady development trend and is among the ten most developed countries in this field. In 2021, Estonia improved its position compared to 2020 and took the 21st place in the ranking. It is a highly developed country in the field of information technology. The Netherlands, Finland, the United States, and Germany have raised their rankings. Sweden, Denmark, Singapore, Switzerland, and Norway are weakening their positions on the world stage. Ukraine rose from the 64th place in 2020 to the 53rd place in 2021, which is a positive trend due to reforms in the country.

The digital economy has significantly increased production efficiency and given a new impetus to the development of innovative entrepreneurship, because even the smallest company can create its own website and sell products around the world without investing huge sums in premises, offices, and other resources needed before. Due to this, companies can significantly expand their markets, growing to become significant market operators. There are Internet companies that specialise in Internet mediation services. The principle of physical competition is replaced by the principle of the ‘virtual’ one. Important tools for the development of the information society that have a significant impact on the development of innovative entrepreneurship are Pay-services, contactless face recognition technologies, cloud technologies and digital footprints, Apple’s Face ID, sharing economy, temporary exchange of

things, blockchain technologies, Big Data, neural network programming, semantic programming, artificial intelligence, voice assistants (Skoryk, 2020).

Digital technologies are an integral part of the successful formation of the ecosystem of innovative entrepreneurship in today’s world. We propose considering the technologies and concepts of Industry 4.0, in the implementation of which innovative entrepreneurship and the formation of its ecosystem at the present stage will reach a high level of development. Summarised data of the analysis are presented in Table 3.

Table 3. Technologies and concepts of Industry 4.0 in the formation of the ecosystem of innovative entrepreneurship

Technology	Components of the technology	Description of the technology
Smart Factory, Smart Manufacturing, Factory of the Future	<ul style="list-style-type: none"> • Virtual and digital enterprises 	Integrated enterprise production systems that are able to respond in real time to changing production conditions, supply chain requirements and meet customer needs. Intensive and comprehensive use of information technology and cyberphysical systems at all stages of production and delivery.
Digital Factory	<ul style="list-style-type: none"> • Automated design systems • CAD/CAM/CAE • PDM product data management system • Applied software for PLM product lifecycle management • CNC machines • 3D printers and other additive technologies 	Development of models produced using digital design and modeling tools. Creating a ‘digital layout’ (Digital Mock-Up, DMU, ‘digital twin’).
Smart Factory	<ul style="list-style-type: none"> • ASUTP – automated process control system • APS (Advanced Planning and Scheduling) – synchronous production planning • MES (Manufacturing Execution System) – production process management system • IIoT (Industrial Internet of Things) • Big Data 	Providing serial production of products. Industrial Internet of Things (IIoT) technologies provide machine-to-machine interoperability. Producing products almost without human intervention. Information is processed by Big Data processing technologies.
Virtual Factory	<ul style="list-style-type: none"> • ERP (Enterprise Resource Planning) • CRM (Customer Relationship Management) • SCM (Supply Chain Management) 	A network of digital and ‘smart’ factories that includes suppliers of materials, components, and services. Creating a virtual model of all organisational processes.

Technology	Components of the technology	Description of the technology
Digital Twin	<ul style="list-style-type: none"> • Virtual digital dual sensors and real device sensors • Industrial Internet of Things (IIoT) technologies. • Geometric and structural model of the object • Set of estimated data details in general • Mathematical models • Information about technological processes • Product life cycle management system 	Software analogue of a physical device that simulates the internal processes, technical characteristics, and behaviour of a real object in environmental conditions.
Machine Learning, ML	<ul style="list-style-type: none"> • Inductive learning • Deductive learning • Controlled learning • Uncontrolled learning • Neural networks and deep learning • Machine learning for business 	A large unit of artificial intelligence that studies methods of building algorithms capable of learning.
Industrial Internet of Things, IoT	<ul style="list-style-type: none"> • Advanced analytical tools • Artificial Intelligence • Machine learning • Adjusted and virtual reality technologies • MQTT (Message Queue Telemetry Transport) – a simplified data exchange protocol suitable for use in controllers and sensors 	A system of integrated computer networks and connected industrial facilities with built-in sensors and software for data collection and exchange, with the possibility of remote control and management in an automated mode, without human intervention.
Manufacturing Resource Planning, MRP II	<ul style="list-style-type: none"> • MRS system (material requirements planning) 	Methodology of detailed planning of production resources.
Advanced Planning and Scheduling, APS	<ul style="list-style-type: none"> • Synchronous planning • Dispatching of production • Optimisation planning • Quick response to changes in the production environment • Distributed planning • Ability to use web-based technologies • Effective visualisation tools and report generator 	Production planning, the main feature of which is the ability to build a schedule of equipment throughout the enterprise.

cont. Table 3

Technology	Components of the technology	Description of the technology
Manufacturing Execution System, MES	<ul style="list-style-type: none"> • RAS (resource allocation and status) – status control and resource allocation • ODS (operations / detail scheduling) • DPU (dispatching production units) • DOC (document control) – document management • DCA (data collection / acquisition) – data collection and storage • LM (labour management) – personnel management • QM (quality management) • PM (process management) – management of production processes • MM (maintenance management) – management of maintenance and repair • PTG (product tracking and genealogy) – product tracking • PA (performance analysis) 	A specialised system designed to solve problems of synchronisation, coordination, analysis and optimisation of production.
Enterprise Resource Planning, ERP	The software package includes: <ul style="list-style-type: none"> • Finance and accounting • HR • storage • Selling • Customer Relationship Management (CRM) • Purchases • Supply Chain Management (SCM) • Production 	Strategy of integration of production and operations, human resources management, financial management and asset management with the help of a specialised integrated application software package.
Master Data Management, MDM	<ul style="list-style-type: none"> • System of integration and synchronisation of all basic data of various information systems 	Processes and tools for continuous management of enterprise data.
Product Data Management, PDM	<ul style="list-style-type: none"> • EDM (Engineering Data Management) • PIM (Product Information Management) • TDM (Technical Data Management) • TIM (Technical Information Management) 	Product data management system – design data, technological routes, results of technical tests.
Customer Relationship Management, CRM	<ul style="list-style-type: none"> • CSS (Customer service & support) – automation of customer support and service • SFA (Sales force automation) – automation of sales activities • MA (Marketing automation) 	Application software designed to automate customer interaction.

Technology	Components of the technology	Description of the technology
Blockchain	<ul style="list-style-type: none"> • Blockchain-as-a-Service (BaaS) • Blockchain Foundry – a service for prototyping and industrial production • Bigchain DB – scalable blockchain services • Chain – blockchain for financial resources • ADEPT – blockchain for the formation of the Internet of Things • EU Blockchain Observatory 	A continuous sequential chain of blocks containing information built according to certain rules. The technology is used everywhere – from finance to production.

Source: compiled by the authors on the basis Technologii i kontseptsii Industry 4.0(2022).

Table 3 describes the most important, in our opinion, Industry 4.0 technologies. Their application in innovative entrepreneurship and in the formation of its ecosystem will lead to the improvement and increase of technical and technological level of innovative enterprises, infrastructure to support innovative entrepreneurship, which, in turn, will lead to a high level of innovation in general.

Innovative entrepreneurship is developing rapidly, so there is a need for constant updating and improvement of its components. Thanks to the introduction of modern technologies in Industry 4.0, positive changes will take place in the activities of innovative enterprises, which will contribute to the effective formation of the ecosystem of innovative entrepreneurship. In particular:

- the introduction of global industrial networks in the field of innovation, the use of 3D printers, the existence of ‘smart factories’ will lead to the effective introduction and entry into the market of new types of innovative products;
- the use of the Internet of Things platform will help to achieve savings in the supply chain;
- the combination of Big Data and the Industrial Internet of Things will ensure the uninterrupted operation of equipment for a long time and the planning of maintenance work long before the failure;
- cloud computing technology will help to manage effectively the flow of large amounts of data;
- the system of additive production or 3D printing will provide data collection from the cloud storage of 3D models and create models on the best equipment that has been analysed and found;
- augmented reality will allow you to overlay virtual images on a physical object. With the help of augmented reality glasses, mechanics can contact experts in real time for emergency care. During the pilot project, employee productivity increased by 11% (Sabitov, 2020);

- digital cloning will allow manufacturers to conduct virtual tests of the object and improve the characteristics before its manufacture;
- machine learning technology using neural networks will provide an opportunity to improve control algorithms for systems, machines, and equipment. This will help to achieve the highest accuracy in production and management.

The synthesis of all the existing technologies will create a new, human-independent infrastructure. Human participation will be minimal and will consist in the management of these systems.

Entities of innovative entrepreneurship in the implementation of Industry 4.0 technologies in their activities will benefit from a number of advantages, namely:

- application of an individual approach in accordance with the characteristics of the client's preferences;
- reduction of production costs;
- unique production of a product at a low cost;
- increasing the speed of production of a new product due to the introduction of the robotics process;
- its time control over the manufacture and release of a new product in the market;
- forecasting possible failures and their timely detection.

Thus, it should be noted that in the era of Industry 4.0 the development of innovative entrepreneurship and the successful formation of its ecosystem is greatly influenced by digital technologies. Today, Ukraine is on the path of digital restructuring of society and business. The digital transformation will have a positive impact on the development of innovative entrepreneurship, the formation of its ecosystem, the development of the economy, business, society, and the state as a whole. A necessary condition for the digital innovative development of our country is the development of digital education and mastery of digital competencies by citizens of Ukraine at a high level. In particular, digital education should include the acquisition and development of competencies such as viewing, retrieving, and filtering data, information and digital content; data, information and digital content management; pursuing own inquiries and needs by means of digital technologies; self-actualization and personal development in the digital society; primary programming skills; understanding how copyright and licenses apply to data; creative use of digital technologies, interaction and cooperation with the help of digital technologies; use of e-services; network etiquette; Internet security and personal data protection; protection of health and well-being; environmental protection; lifelong learning and professional development in the digital environment.

Conclusion

Based on the purpose of the article, we can say that the introduction of modern technologies in business processes involves not only the installation of modern equipment or software, but also fundamental changes in approaches to management, corporate culture, external communications. Businesses that implement digital transformation strategies work with the best companies and operate at their level of development. Acceleration of the digitalisation process in all spheres of public life and digital transformation of production processes will create opportunities for the development of new sectors of the economy, faster creation of innovative resources, and development of innovative entrepreneurship, transformation of life into a new, more efficient, and modern one.

References

- Diya. Biznes i K. (2021). Fund obyednuut` zusillya dlya pidtrimki pidpriemtsiv. Ministerstvo ta Komitet tsifrovoi transformatsii Ukraini. Retrieved from: <https://thedigital.gov.ua>
- Doing Business (2020a). *Ukraine in the ranking*. Retrieved from: <https://uk.m.wikipedia.org/wiki/>
- Doing Business 2020 (2020b). *World Bank Group*. Retrieved from: <https://russian.doingbusiness.org/ru/rankings>
- Doing Business 2020 (2020c). *Zavdyaki tshomu Ukraina pidnyalasya v reytingu na 64 shodinku. Ekonomitshna pravda. Spilka ukrains`kih pidpriemtsiv*. Retrieved from: <https://www.epravda.com.ua>
- Dzhafarova, E., Karpenko, M. (2021). Osoblivosti ta problemi vprovadzshennya industrii 4.0 v Ukraini. *Ekonomika ta suspilstvo*, 32. Retrieved from: <https://file:///C:/Users/user/Downloads/764-%D0%A2%D0%B5%D0%BA%D1%81%D1%82%20%D1%81%D1%82%D0%B0%D1%82%D1%82%D1%96-733-1-10-20211127-1.pdf>
- Gotsh, A. (2019). Estoniya: pidpriemnit'skiy landshaft. *Intelekt-proekt Kievo-Mogilyans`koi biznes-shkoli*. 2019. Retrieved from: <https://open.kmbis.ua/estonia/>
- Index gotovnosti mereshi 2021 (2021). Retrieved from: <https://networkreadinessindex.org>
- Kabinet Ministriv Ukraini (2019). *Postanova Kabinetu Ministriv Ukraini No. 546 19.06.2019, Pro zatverdzhennya Polozhennya pro integrovaniu sistemu elektronnoi identifikatsii*. Retrieved from: <https://zakon.rada.gov.ua>
- Kotko, O.K. (2016). *Innovatsiina ekosistema yak nova paradigma innovatsiyogo rozvitku ekonomiki*. Universitet mitnoi spravi ta finansiv. *Visnik ONU imeni I.I. Mechnikova*, T. 21. Vip. 7–1(49), 52–56.

- Lanovska, G.I. (2017). *Innovatsiina ekosistema: sutnist ta printsipi*. Ekonomika i suspilstvo. Ekonomika ta upravlinna pidpriemstvami. Mukatshivskiy derzhshavniy universitet. Vip. 11/2017, 257–262.
- Naipopulyarnishi elektronni servisi dlya pidpriemstv ta fizitshnih osib. (2022). Retrieved from <https://portfel.ua/elektronni-servisi/>
- Nosik, O.M. (2016). *Vidkriti innovatsiyni sistemi: golovni harakteristiki i napryami internatsionalizatsii*. Visnik Dnipropetrovskogo universitetu. Seriya: Menedzshment innovatsiy. Vip. 6, 103–113.
- NRI (2020). *The network readiness index 2020*. Retrieved from: <https://NRI-2020-Final-Report-Oktober2020.pdf>
- Riepina, I., Yakusheva, N. (2019). *Comparative analysis of business conditions in eu countries by doing business rating. Strategies for Entrepreneurship for Sustainable Development of Small and Medium-Sized Innovative Entrepreneurship*, 48–52. International Conference. Riga: Baltic International Academy. Retrieved from: https://ndipzir.org.ua/wp-content/uploads/2019/Ryha_09.10.19/Ryha_09.10.19_10.pdf
- Sabitov, O. (2020). *7 kl`utchovuch technology Industrii 4.0: vid maschunnogo navtshchannya do 3D-druku*. Retrieved from: <https://www.hightech.fm>industry-4-0>
- Skoryk, O.O. (2020). Osoblyvosti innovatsiynogo pidpnyemnutstva u tsufrovoy ekonomitsi. *Efektivna ekonomika*, 7. Retrieved from: <https://www.economy.nayka.com.ua/57.pdf>
- Technologii i kontseptsii Industry 4.0 (2022). *IT-Enterprise*. Retrieved from: <https://www.it.ua/knowledge-base/technology-innovation/industry-4>
- Yakusheva, N.V. (2018). *Informatsiyni tehnologii pidtrimki monitoringu rozvitku innovatsiynogo pidpnyemnutstva v Ukraini*. Stanovlennya mehanizmu publitshnogo upravlinnya rozvitkom sil`s`kih teritoriy yak prioritet derzhshavnoi politiki detsentralizatsii: zb. materialiv Mizshnar. nauk.-prakt. konf. Zshitomir, 554–556. Retrieved from: http://znau.edu.ua/images/images-news/2019/01/zbirnik04122018_%D1%82%D0%B0%D0%BD%D0%BE%D0%B2%D0%BB_%D0%BC%D0%B5%D1%85.pdf
- Yaremchuk, R.E., & Kolomiets, O.G. (2016). Formuvannya institutsiynogo seredovischa rozvitku innovatsiynoi ekosistemi Ukraini. *Institutsiyni problemi ekonomiki. Sotsialno – ekonomichni problemi suchasnogo periodu Ukraini*, 3(119). 9–14.

Inna Riepina

Doctor of Economic Sciences (2014), PhD in Economics (1998). Currently, she holds the position of the Head of the Department of Business Economics and Entrepreneurship, Kyiv National Economic University named after Vadym Hetman, Kyiv, Ukraine. The main directions of her scientific research are formation, evaluation, and management of entrepreneurial potential; asset and value management of the enterprise; innovation, intellectual property, and competitiveness. During her professional activity she took an active part in many international pro-

jects associated with the Karl Duisberg Society (InWEntgGmbH: 2002), CEUME (2004), worked as a local trainer under the TACIS MTP4 programme (2006–2007). Her internships involved the ones in France (ESIDEC: 2004), Germany (InWEnt: 2005), Austria (UNIDO: 2009, 2016), Poland (Universities of Warsaw and Jagiellonian University: 2017–2018), Erasmus+, Staff Mobility for Training Programme (University of Foggia, Italy: 2019). She took part in the international scientific and practical conferences in Cracow, Poland (2018), Riga, Latvia (2019).

e-mail: rephousenew@gmail.com

ORCID: 0000-0001-9141-0117

Nataliia Yakusheva

PhD student at Kyiv National Economic University named after Vadym Hetman, Department of Business Economics and Entrepreneurship, Kyiv, Ukraine. Her scientific interests involve the problems of development of innovative entrepreneurship and forming of its ecosystem. She has practical experience in the field of business economics; she worked at the specialist position in the SHEU company. She took part in the international scientific and practical conferences in Cracow, Poland (2018), Riga, Latvia (2019).

e-mail: nata-sheu@ukr.net

ORCID: 0000-0001-9511-2723