

# **Digitalization of Business Processes of Enterprises of the Ecosystem of Industry 4.0: Virtual-Real Aspect of Economic Growth Reserves**

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*Abstract:* The purpose of the research is to present the features of digitization of business processes in enterprises as a foundation on which the gradual formation of Industry 4.0 and the search for economic growth in new virtual reality, which has every chance to be a decisive step in implementing digital strategy for Ukraine and development of the innovation ecosystem. Key problems that arise during the digitalization of business processes in enterprises are presented, among which are: the historical orientation of production to mass, “running” sizes and large batches; large-scale production load; the complexity of cooperation and logic between production sites. It is determined that high-quality and effective tools of innovation-digital transformation in the conditions of virtual reality should include: a single system of on-line order management for all enterprises (application registration – technical expertise – planning – performance control – shipment); Smart Factory, Predictive Maintenance, IIoT, CRM, SCM. Features of digital transformation in the part of formation of enterprises of the ecosystem of Industry 4.0 are revealed. The capabilities and benefits of using Azure cloud platform in enterprises, which includes more than 200 products and cloud services, are analyzed. Azure is said to support open source technologies, so businesses have the ability to use tools and technologies they prefer and are more useful. After conducting a thorough analysis of the acceleration of deep digitalization of business processes by enterprises, authors proposed to put into practice Aruba solution for tracking contacts in the fight against COVID-19. Aruba technology helps locate, allowing you to implement flexible solutions based on Aruba Partner Ecosystem using a USB interface. It is proposed to use SYNTEGRA – a data integration service that provides interactive analytics and provides data models and dashboards in order to accelerate the modernization of data storage and management, optimize reporting in the company and obtain real-time analytics. The possibilities of using Azure cloud platform during the digitization of business processes of enterprises of the ecosystem of Industry 4.0 in the conditions of virtual reality are determined.

*Key-Words:* digitized business processes, Industry 4.0, ecosystem, virtual reality, digital entrepreneurship, digitalization, reserves of economic growth.

Received: January 15, 2021. Revised: February 24, 2021. Accepted: March 9, 2021.

Published: March 16, 2021.

## 1 Introduction

The structure of Ukrainian economy is raw materials: more than 60% of exports are raw materials, and our GDP is 98% correlated with the raw material price index in the world. No matter how hard we try, when world raw material prices fall, our economy falls. Ukraine is constantly deindustrialized and we are already losing our industry. In addition, today the same system errors are observed in business, which do not allow business to grow economically and technologically and develop innovatively. What exactly are these mistakes? The answer is as follows:

Mistake 1. Financial statements, or rather its absence. According to our statistics, 34% of entrepreneurs do not have financial statements. Entrepreneurs often understand how much money goes into the account, but few keep track of net operating income. In the future, this leads to confusion in financial flows. In pursuit of the goal of large system business, it is necessary to deal with finances and “deeply digitize” them.

Mistake 2. 32% of businesses do not have a development strategy, an idea of the reserves of economic growth. And this is something without which even the “coolest” businesses find it difficult to conquer the market. This will be especially difficult if competitors have a strategy. In particular, in our opinion, it is worth taking into account the fact that you have to work in the same conditions in virtual reality.

Mistake 3. 20% of business owners are not ready for a partnership. According to their mentality, Ukrainians are really individualists, but we need to understand that by attracting strong specialists, we can grow economically twice as fast, digitize business processes, automate them in terms of the formation of Industry 4.0.

Mistake 4. More than 12.5% of entrepreneurs do not understand the market, let alone virtual-real and the peculiarities of its operation. To achieve success, it is necessary to focus on the trends that can be traced in the field in which the company operates, what competitors do and what opportunities there are in foreign markets.

The readiness of Ukrainian enterprises for large-scale application of Industry 4.0 depends on: the degree of involvement in the digitalization of Ukrainian industry and energy of the IT sector and science; creating conditions for the accelerated development of industrial high-tech segments as key to the development of digital economy in terms of virtual reality; support for innovation and export activities of innovators 4.0; creation of “road maps” of digital transformation in priority areas;

accelerating the transition to European standards in the field of 4.0 [3, p. 127].

The search for ways to accelerate digitalization of business processes of enterprises lies in the formation of a new paradigm coordinate system of digital ecosystem of Industry 4.0. However, the problem of transformational digital transformations of business processes of enterprises and their comprehensive impact on the development of Industry 4.0 ecosystem in Ukraine remain insufficiently studied. It is this circumstance that determines the relevance of this publication and determines its scientific and practical significance.

## 2 Problem Formulation

### 2.1 Literature review

The question of the conditions of formation and development of Industry 4.0 is just beginning to attract the attention of foreign and domestic researchers, including Isaacson W. [11], Shantarenkova M. [20]. Based on the analysis of the experience of Industry 4.0 in developed countries, it is proved that Industry 4.0 is one of the highest phases of digitalization, compared to “smart factories”, where such technologies as big data analytics (Big Data), machine learning, m2m-communications, artificial intelligence, a new generation of robots. Due to the gradual decrease in the cost of these technologies, they become available and more used by industry and business, which ultimately affects the content of existing business processes, which also undergoes constant changes in new virtual reality. These results are presented in scientific papers and articles by Azzam M., Sami N., Khalil T. [1], Smit J., Kreutzer S., Moeller C., Carlberg M. [21], Colotla I., Bland D., Knizek C., Spindelndreier D. [4], Tupa J., Simota J., Steine F. [24], Smith J., Kreutzer S. Moeller C., Carlberg M. [22], Trstenjak M., Cosic P. [23], Marcel-Mihai S. [15], Schaeffer E. [19], Heyets V., Voynarenko M., Dzhedzhula V., Yepifanova I. [7; 14; 25-26].

Thus, the protocol of formation of Industry X.0 through the prism of innovation, technology in industry management and business was studied by Azzam M., Sami N., Khalil T., Marcel-Mihai S. and Schaeffer E. Semantic characteristics that determine the formation of smart-industry, smart business, smart services, including modularity, temporal reality, decentralization, interoperability, virtual reality presented in their studies Tupa J., Simota J. and Steine F. Analyzed and comprehensively substantiated methodological approaches to

determining the nature and conditions of formation Industry 4.0 and the discovery of possible ways and tools to accelerate the development of Industry 4.0 was carried out by a group of scientists, including Smit J., Kreutzer S., Moeller C. and Carlberg M.

The works of such foreign researchers as Bao G., Zeng F., Rania E. and Amr E. are devoted to the issues of digital transformation that cause changes in modern development of priority business models and efficiency of staffing of these processes [2; 18].

Among domestic researchers engaged in the disclosure of the content of smart industry in digital economy can be called Vyshnevskiy V.P., Viietska O.V., Garkushenko O.M., Kniyazev S.I., Liakh O.V., Chekin V.D., Cherevatskiy D.Yu. [25]. Scientists Holoborodko O.P., Kraus N.M., Kraus K.M. [6; 12] dealt with the issues of digital transformation of the economy in general, its avant-garde nature of development. The analysis of these recent studies has shown the need for an integrated approach to digitalization of business processes of enterprises of the ecosystem of Industry 4.0 and the search for reserves of economic growth through the modernization of traditional entrepreneurship in accordance with modern challenges as a result of increasing virtual reality.

The originality of this study is that it, unlike existing ones, pursues the goal of identifying forms and methods of influencing digital development of enterprises in virtual reality, deploying the logical-structural scheme of the mechanism for finding reserves of economic growth as a result of digitization of business activities, development of recommendations on main tools of the theory of constraints in decision-making aimed at ensuring inclusive economic development of enterprises of the ecosystem of Industry 4.0 and finding opportunities to implement the strategy of technological breakthrough in digital transformation of business at the micro level.

## 2.2 Purpose of the article

The purpose of the publication is to present features of digitization of business processes of enterprises as a foundation on which the gradual formation of Industry 4.0 and the search for economic growth in new virtual reality, which has every chance to be a decisive step in implementing digital strategy for Ukraine and innovation ecosystem.

## 2.3 Tasks of the article

Among the tasks set in the article are: it is argued to reveal the features of the introduction of innovations in business processes of enterprises on the example of Agrohuh; identify and disclose the content of the

possibilities of using Azure cloud platform during the digitization of business processes of enterprises of the ecosystem of Industry 4.0 in virtual reality; present semantic characteristics of policies to strengthen innovation in the conditions of digital modernization of enterprises and digital transformation, main policy choices for innovation tools in part of formation of enterprises of the ecosystem of Industry 4.0; to reveal the focus of innovation policy in terms of the formation of Industry 4.0, which depends on the stages of development of the country; to reveal the content of opportunities for economic growth for enterprises during the application of SYNTEGRA technologies (data integration service that provides interactive analytics), Aruba; to present the implementation of national standards in terms of their harmonization with European and international standards aimed at accelerating the digitalization of enterprises; specify the features of client applications in terms of their various typical functionality.

## 2.4 Methodology

On the basis of dialectical, system and matrix methods the digitalization of business processes of enterprises of the ecosystem of Industry 4.0 is investigated, which determines a new search for reserves of economic growth and the format of business operation in the conditions of virtual reality. Comparative analysis was used in terms of contact tracking technologies; features of application of client applications; harmonization of implemented national standards aimed at accelerating the digitalization of enterprises with European and international standards.

## 3 Problem Solution

### 3.1 Prerequisites for the formation of the ecosystem of Industry 4.0

In today's business environment, on the one hand, companies have identified a list of necessary changes: technological (automation, digitalization, investment incentives and reduction of operating costs) and no less important service (building relationships and communication with customers). On the other hand, the state through regulatory changes creates an environment that would stimulate business to develop and invest.

Industry 4.0 as part of the fourth industrial revolution includes many technologies, main purpose of which is to create a single space for data exchange and virtual visualization of business processes and objects, and also provides for the

creation of robotic systems combined with Internet technologies in the format of “smart” enterprises. Currently, all countries of the world are developing industry taking into account trends of new industrial era – the transition to fully automated digital production, controlled by intelligent ecosystems in real time in constant interaction with the environment, going beyond one enterprise, with the prospect of merging into global industrial network of things and services [3, p. 117].

One or even ten successful examples are not enough to make the ecosystem of Industry 4.0 operational. Country as a whole should be assessed comprehensively and objectively. For example, Finland, which is only five times larger than Lithuania, has 50 times more startups in Silicon Valley. Here is an indicator of success [4, p. 21]. The experience of innovation implementation is presented in Table 1.

Table 1. Features of innovation implementation in Agrohuh

<b>Agrohuh was created for introduction of innovations</b>		
<i>1. Consulting. Innovation Agents – enterprise analysis, identification of needs and innovation priorities, development of startup maps.</i>	<i>2. Scouting and innovation development. Innovative Solutions Database – base of available innovative solutions, ready for application; “Growing” new ideas: MHP Accelerator in conjunction with Radar Tech.</i>	<i>3. Popularization and changing culture. Video course How to Startup together with MHP, trainings “Practical methodology of innovation implementation”.</i>

Source: author’s development

Today, a number of companies that have decided to digitize their activities are called to the results of digital transformation include:

- Execution of orders on time – up to 97%;
- Reduction of downtime;
- Transparent control and accounting of resource movements;
- Reduction of resource reserves by 10%;
- Analysis and elimination of bottlenecks in the operation of equipment;
- Improvement of OEE by 10-15%.

Among the problems that arise during the digitalization of business processes of enterprises indicate: historical orientation of production to mass, “running” sizes and large batches; large-scale production load; the complexity of cooperation and

logic between production sites. Policies to strengthen innovation in the conditions of digital modernization of enterprises are given in Figure 1.

Skilled workforce	Supportive business environment
Strong and efficient system for knowledge creation and diffusion	Policies to encourage firms to engage in innovation and entrepreneurial activities

Fig. 1. Policies to strengthen innovation in terms of digital modernization of enterprises

Source: author’s development

To qualitative and effectively operating tools of innovative-digital transformation in the conditions of virtual reality name:

- A single system of on-line order management for all enterprises: application registration – technical examination – planning – performance control – shipment;

- Smart Factory, Predictive Maintenance, IIoT, CRM, SCM.

For LMICs such as Ukraine:

- Diversifying continuously into higher value-added activities;
- Innovating through the adoption of existing knowledge elsewhere in the world and increasingly through the development of local technological capabilities;
- Regionalization;
- Reforming product, labour and financial markets as well as development schemes;
- Focusing on sectors with export potential.

### 3.2 Analytics in digital transformation of enterprises

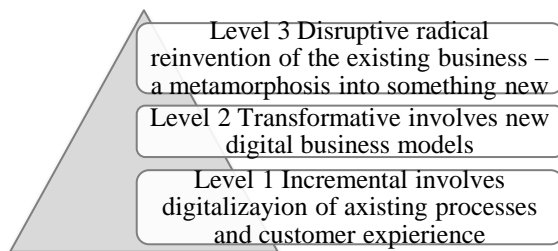
Significant volumes and analytics are used in the framework of digital transformation. Responsibility for its accuracy and clarity always lies with the leader. The ideal picture of data collection and the system of predictive analytics of consumption forecasting is based on the algorithms formed as a result of the analysis of current situation.

The issue of forming the principles of analysis – is a matter of priorities of the company, which are based on the platform of analysis of the situation and the requirements of the regulator. Today, the biggest challenge is to generate this data, create a model for automated retrieval of information about the state of networks, transfer this information to a single database and analysis of the entire array. This could provide information on the most critical ones that need to be replaced.

The problem is that other countries started this path 13-15 years ago, and in Ukraine investment conditions have not even been created for a large-

scale start of such programs, but the country wants to do everything quickly. That is why it is so important to change the investment system and priorities. Levels of digital transformation in part of the formation of enterprises of the ecosystem of Industry 4.0 (Figure 2).

As part of the problem, we consider it appropriate to analyze the opportunities and benefits of using Azure cloud platform in enterprises (Table 2), which includes more than 200 products and cloud services designed to help create new solutions for current and future challenges before the company during digitization of business processes.



**Fig. 2.** Digital transformation in terms of the formation of enterprises of the ecosystems of Industry 4.0

Source: compiled by authors based on sources 8; 9; 12; 14

This platform allows you to create and run applications and manage them in multiple clouds, locally and on the periphery, using convenient tools and platforms in virtual reality.

Table 2. Possibilities of using Azure cloud platform during digitization of business processes of enterprises of the ecosystem of Industry 4.0 in the conditions of virtual reality

Problems	Difference between environment; Dev dependencies; Lack of tools on your platform; Predictable environment; Speed of development.
History of containers	1979 – chroot in Unix v7; 2000 – Free BSD Jails; 2003 – Borg (predecessor of Kubernetes); 2006 – Process Containers; 2013 – Docker; 2014 – Kubernetes; 2015 – Windows Containers.
Containers in Azure App Services	Both Windows and Linux; Deploy from any registries; Use deployment slots and slot swaps Auto-scale; App Service Log Streaming; Connect directly into your containers.
Container Instances	Starts in seconds; Billed by seconds (CPU/Memory); Good for data processing jobs; Work with Logic Apps; Virtual Kubelets for AKS.
Docker Orchestrators	Docker Swarm, DC/OS, Kubernetes.

Kubernetes	Open-source system for automating deployment, scaling, and management, of containerized applications; Easy command line interface; Declarative configuration via YAML/JSON files.
K8s Aspects	Cluster, Nodes, Pods, ReplicaSets, Deployments, Services, StatefulSets, Volumes, Jobs/Cron, DaemonSets, Namespaces.
Serverless Apps on Top of K8s	Kubelets, Fission, Apache OpenWhisk, Funktion (deprecated).
Azure Kubernetes Service (AKS)	100 % Kubernetes; Easy deployment & management; Scale with confidence (Azure Traffic Manager, Virtual Kubelets); Secure with Azure AD; Accelerate development with connected environments (Azure Dev Spaces).
Container Use Cases	“Lift and shift”; Refactor existing applications for containers; Develop new container-native applications; Microservices architecture; Continuous integration and deployment; Repetitive jobs and tasks.
Why to use in Clouds?	Cost effective; Smoother development experience; Many IT specialists available; More tools at our disposal; Runs anywhere.

Source: compiled by authors based on source 24

Azure supports open source technologies, so companies have the opportunity to use tools and technologies they prefer and they are useful. This allows enterprise to run virtually any application that uses its data source with the existing operating system on the device. When using Azure, the company always has a choice.

### 3.3 Digitalization of business processes

Digitalization of business processes of enterprises has certain threats, one of the main – cybersecurity. The more open the exchange of information and communication channels, the greater risks.

#### 3.3.1 Hybrid cloud Azure

The comprehensive protection services provided by Azure team of experts include precautionary measures, which are trusted by businesses, government organizations and startups. Security and privacy are important to Azure. Microsoft adheres to the highest levels of trust, transparency, compliance with standards and regulatory requirements with the most complete set of proposals for compliance among cloud service providers.

Azure provides solutions for all industries through proven combinations of cloud products and services. Businesses are able to solve their industry

business challenges instantly and are always ready for the challenges of the future, implementing innovations through Azure solutions.

Today, Azure is perhaps only hybrid cloud that is so well-coordinated that provides unsurpassed performance for developers, provides comprehensive multi-level security tools, including maximum coverage of compliance requirements among all cloud service providers. In addition, Azure is not as expensive as AWS when used with Windows Server and SQL Server workloads [28].

### 3.3.2 Laboratory Information Management System

Laboratory Information Management System (LIMS) is a specific application that provides a simple extension of the system from a single computer to many service systems with a large number of enterprise customers. Types of client applications with different functionality are presented in Table 3. Microsoft SQL Server is used to store regulatory information and metadata. The results of laboratory tests are also stored in Microsoft SQL Server, but can be stored in parallel on the real-time data server of the corporate MES.

Table 3. Client applications in terms of their various typical functionality

Types of client applications of different functionality			
Full-featured APM engineer for administration, configuration and system configuration	Laboratory assistant APM for data entry and settlement	APM view to get results as screens and reports	APM web browsing

Source: author's development

Requests from customers are processed in Digital Lab by a server data processing module (licensed by the number of simultaneous connections), which can be supplied with extensions to implement tasks of laboratory business process automation and for integration with MES, top-level ERP systems.

The convergence of Web 3.0 technologies and service architectures will introduce new business models, information exchange and social networks based on the Internet of Services (IoS). In the future, network architectures will promote full integration of the Internet of People, the Internet of Things and the Internet of Services.

Ability to integrate Grid and Cloud computing into NGN; introduction of adaptive technologies for the creation of information systems. The concept of a smart enterprise involves virtual integration of structures and processes with adaptive information links and a common set of standards that are produced as a result of joint activities of distributed

competence centers [17].

### 3.3.3 Data integration service SYNTEGRA

Today, SYNTEGRA, a data integration service that provides interactive analytics, can help modernize data storage and management, optimize company reporting, and provide real-time analytics. SYNTEGRA provides data models and dashboards. This service is available by subscription. SYNTEGRA is implemented using Microsoft Data Services and Power BI.

SYNTEGRA includes: data integration; creation of data models, metrics; automation of data update; cloud infrastructure; technical support; training of business users to work and edit dashboards.

Advantages of using SYNTEGRA data integration service for business: reporting with updates every hour; group access rights policies; interactivity, availability of reports via the web; professional data model collection; high-tech data integration on a cloud platform.

### 3.3.4 Aruba technology

No less interesting than the previous software solution presented by us in today's virtual real conditions, is the solution of Aruba for tracking contacts in the fight against COVID-19.

Aruba technology helps to locate (Aruba access points 300/500 series): a platform for tracking contacts and analyzing location data based on two technologies (BLE, WiFi); allows you to implement flexible solutions based on Aruba Partner Ecosystem using USB interface.

Aruba is a solution for tracking office contacts in the office using WiFi technology (Table 4), which is implemented by the following chain type:

*access points "listen" to Wi-Fi devices of users → the application in the cloud or on server analyzes location data transmitted from Aruba Central or Airware (AI/ML models) → personnel service receives a message about an employee who is ill → tracking contacts (searching for contacts of all employees with infected colleagues) → tracking locations (determining the average time spent by a sick employee in different areas office).*

Table 4. Aruba contact tracking technology: a comparison of Wi-Fi and BLE

	Wi-Fi based	BLE based
Cost	Included	Asset Tags Meridian Licenses
Accuracy	~10 m accuracy	~2-5 m accuracy
Deployment	Central: Feature drop On-prem: Airwave upgrade / Central	Meridian asset tracking Enable BLE

	dashboard	radios on APs
Additional Hardware	None	Asset tags
Data Exportability to other BI tools	CSV & Templates for PowerBI and Tableau	CSV & Asset tracking APIs
Est. Availability	July / August	July (beta)

Source: author's development

Aruba is a solution for tracking employee contacts in the office using Meridian BLE (Bluetooth Low Energy) technology is as follows: Employees receive BLE tags → Aruba access points “communicate” with employee tags → Meridian cloud application determines the location of tags → Data is transmitted for processing and visualizations in the external application → Personnel receives a message about a sick employee → Personnel determines the number of the employee’s tag and searches for contact information in the external application → Tracking contacts (searching for contacts of all employees with infected colleagues) → Tracking locations (determining the average time spent by the sick employee in different areas of the office). Key features of Aruba are that:

1. Uses BLE (Bluetooth Low Energy) technology;
2. Modern points of Aruba WiFi 300 & 500 series provide the necessary coverage;
3. The solution is scaled to 1,000 labels;
4. Battery life 3-4 years;
5. Exact indication of the location on the map, not the approximate area.

BLE is:

- 1) Bluetooth Low Energy – one of the two Bluetooth standards, often called Bluetooth Smart;
- 2) Used for wireless transmission of information over short distances. Depending on the type of BLE lighthouse from 25 to 300 m;
- 3) Uses the 2.4GHz band. To reduce the level of energy consumption and increase the efficiency of information transmission, the entire frequency range is divided into 40 channels, divided between it by 2MHz;
- 4) Available on all smartphones and tablets released since 2012;
- 5) There are two BLE standards: iBeacon (Apple), Eddystone (Google);
- 6) Battery life: from 3-4 days (printed beacons) to 8 years;
- 7) The cost of a lighthouse is from 2 to 40 dollars.

BLE beacon includes the case (there are cases for external use), the processor on the basis of ARM, Bluetooth Smart module, the antenna which is

connected to the processor, the power supply battery. Aruba Meridian allows you to get a map of the room, find the necessary objects/goods, route from the current location, API for integration with other applications. Aruba Meridian:

- The first task is to create your access token;
- To generate your access token, from the Meridian Editor web console, in the left-hand navigation pane, click Beacons, and then click Generate your access token to get started;
- The values you’ll need are shown in the Controller Configuration section.

SMEs need tailored policies to support innovation in terms of the formation of Industry 4.0 and Main policy choices for innovation tools of the ecosystem of Industry 4.0 are presented by us in Table 5 and Figure 3.

Table 5. SMEs need tailored policies to support innovation in terms of the formation of Industry 4.0

	Financing	Other
Non-innovative SMEs		Build basic capabilities and provide incentives to innovate
Innovative SMEs	Project-based Financial support Loan guarantee	Develop innovation networks
NTBFs	Equity financing (venture capital, business angels) Seed capital Tax neutrality	Incubators, science & techno parks
Science-based Spin-offs		Conducive regulation in public research organization

Source: author's development

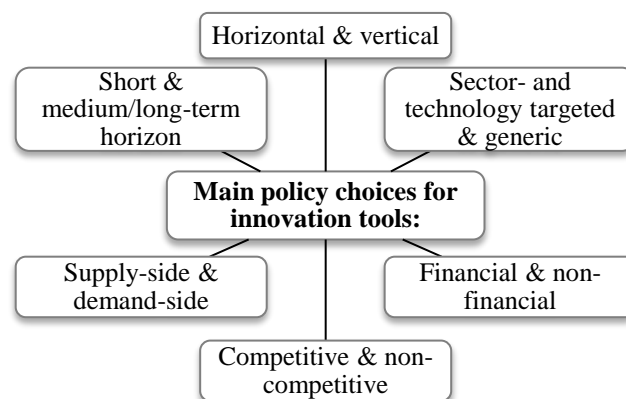


Fig. 3. Main policy choices for innovation tools of the ecosystem of Industry 4.0

Source: author's development

We believe in “angel capital”, which in the seventh world is a decisive force in the range from 0 to 100 thousand euros and is able to make a significant contribution to the development of

startup industry. For example, the United Kingdom has significantly increased the efficiency of investment, creating benefits for “angels” 7 years ago. The investor, in fact, gets a choice: either pay a few thousand taxes, or invest in a startup. This not only ensured the inflow of investment, but also allowed to involve a large number of people in innovation. As a result, everyone won – both business and the state [4, p. 21].

### 3.4 Industrial automation of Ukraine

The beginning of the real implementation of standards in Ukraine in the field of industrial automation began on September 1, 2019 by the order of UkrNDNC № 249. It was this order that put into effect national standards harmonized with European and international standards, the method of confirmation and validity in Table 6. We consider it necessary to note that on this issue of national standards in Ukraine in the field of industrial automation, their harmonization with European and international standards have not risen and this is only the first attempt.

Table 6. Implementation of national standards and their harmonization with European and international standards aimed at accelerating the digitalization of enterprises

DSTU EN 61508-1: 2019 (EN 61508-1: 2010, IDT; IEC 61508-1:2010, IDT)	Functional safety of electrical, electronic, programmable electronic systems related to safety. -//- Part 1. General requirements
DSTU EN 61508-2: 2019 (EN 61508-2: 2010, IDT; IEC 61508-2:2010, IDT)	-//- Part 2. Requirements for electrical, electronic, programmable electronic systems related to safety.
DSTU EN 61508-3: 2019 (EN 61508-3: 2010, IDT; IEC 61508-3:2010, IDT)	-//- Part 3. Software requirements
DSTU EN 61508-4: 2019 (EN 61508-4: 2010, IDT; IEC 61508-4:2010, IDT)	-//- Part 4. Definition and abbreviation
DSTU EN 61508-5: 2019 (EN 61508-5: 2010, IDT; IEC 61508-5:2010, IDT)	-//- Part 5. Examples of methods for determining security completeness levels
DSTU EN 61508-6: 2019 (EN 61508-6: 2010, IDT; IEC 61508-6:2010, IDT)	-//- Part 6. Guidelines for IPP 61508-2 and IEC 61508-3
DSTU EN 61508-7: 2019 (EN 61508-7: 2010, IDT; IEC 61508-7:2010, IDT)	-//- Part 7. Overview of methods and measures
DSTU EN 61512-1: 2019 (EN 61512-1: 1999, IDT; IEC 61512-1:1997, IDT)	Prescription production management. -//- Part 1. Models and terminology
DSTU EN 61512-2: 2019 (EN 61512-2: 2002, IDT; IEC 61512-2: 2001, IDT)	-//- Part 2. Data structure and how-to
DSTU EN 61512-3: 2019 (EN 61512-3: 2008, IDT; IEC 61512-1: 2008, IDT)	-//- Part 3. Models and presentations for general and local recipes
DSTU EN 61512-4: 2019 (EN 61512-4: 2010, IDT; IEC 61512-4: 2009, IDT)	-//- Part 4. Recipe production records
DSTU EN 62264-1: 2019 (EN 62264-1: 2013, IDT; IEC 66226-1: 2013, IDT)	Integration of enterprise and production management systems. -//- Part 1. Models and terminology
DSTU EN 62264-2: 2019 (EN 62264-2: 2013, IDT; IEC 66226-2: 2013, IDT)	-//- Part 2. Objects and attributes for integrating enterprise and production management systems
DSTU EN 62264-3: 2019 (EN 62264-3: 2017, IDT; IEC 66226-3: 2016, IDT)	-//- Part 3. Models of activity management of production operations
DSTU EN 62264-4: 2019 (EN 62264-4: 2016, IDT; IEC 66226-4: 2015, IDT)	-//- Part 4. Attributes of object models for integration of subsystems of production operations management
DSTU EN 62264-5: 2019 (EN 62264-5: 2016, IDT; IEC 66226-5: 2016, IDT)	-//- Part 5. Commercial and production transactions
DSTU EN IEC 62443-4-1: 2019 (EN IEC 62443-4-1: 2018, IDT; IEC 62443-4-1: 2018, IDT)	Safety of industrial automation and control systems. -//- Part 4-1. Requirements for the residential cycle of development of safe products.
DSTU ISO 22400-1: 2019 (ISO 224001-1: 2014, IDT)	Automated production control systems. KPIs for production process management. -//- Part 1. Overview, General Provisions and Terminology
DSTU ISO 22400-2: 2019 (ISO 224001-2: 2014, IDT)	-//- Part 2. Definition and description
DSTU ISO 22400-3: 2019 (ISO 224001-10: 2018,	-//- Part 10. Describe work operations for getting data



IDT)

*Source: author's development*

In addition to legislative reform, a key factor is stability in both the political arena and the economy. As Ukraine currently ranks 76th in the ease of doing business index, there is still work to be done. Further simplification of the regulatory framework will lead to market liberalization and, thus, will contribute to the formation of a more attractive business climate for foreign investors.

In addition, a stable and predictable tax regime and customs clearance process will also contribute to investment attractiveness, and a number of positive changes are already being taken into account (for example, replacement of corporate income tax and income tax of non-residents with a source of origin from Ukraine (income repatriation tax in Ukraine) by income distribution tax to limit the outflow of funds from Ukraine and encourage reinvestment of profits again in the company their development) [4, p. 25].

However, again, it is necessary to explain the perception of the reality of investing in Ukraine in world economic space. Some investors believe that the risks of doing business are unacceptably high in Ukraine, often based on a limited understanding of risks and/or a willingness to consider ways to transform companies and stimulate economic growth. Responsible promotion of Ukraine as an attractive area for investment is a collective commitment of business community [4, p. 25].

The reason for this was the turbulent economic and political situation that Ukraine has faced recently, which has undoubtedly affected the opportunities of domestic investors and “the appetite” of foreign investors in the market of mergers and acquisitions. In modern conditions, when the idea of national consciousness is raised to a high level, and patriotic citizens are becoming more and more, it seems necessary to use the method of color coding of visual information, for example, using the colors of national flag. Such an institutional method of identifying a national producer, firstly, will be associated with the expression of the status of product, secondly, will satisfy the patriotic feelings of citizens and, thirdly, increase funding for agricultural production in Ukraine.

As part of the publication problem, it is impossible not to mention the current and much-needed for the rapid formation of Industry 4.0 bill #7206 “Buy Ukrainian, pay Ukrainians!”, Which provides a number of advantages, including: the ability to improve the model of public procurement

Ukraine, overcoming unemployment, emigration, raising incomes. Main innovation of the bill is the introduction of mandatory consideration of the criterion of local component with a weight of at least 20% in the structure of the reduced price for specialized items of procurement. Local component is calculated through the level of resource localization of production of the subject of procurement according to a transparent formula established by law, according to the methodology to be approved by the government. Idea #7206 is very simple – you pay salaries to Ukrainians, use Ukrainian raw materials, materials, components, energy, finances – get a “bonus” weighing up to 20% in the structure of given price. The more “Ukrainian” products in terms of their “resource content”, the greater the advantage it will have for the state as a buyer.

In addition, today in the world there is fierce competition for the right to be the location of high-tech companies. In order for Ukraine to survive in a global environment, the government needs to develop strong investment incentives for the development of non-commodity businesses, in order to create a need for innovative professionals with digital competencies.

Only on this basis it is clear that in the future Ukraine may become a more significant player in the global investment landscape [19, p. 25]. The focus of innovation policy in terms of the formation of Industry 4.0 should depend on the stage of the country's development is shown in Figure 4.

STAGE 1	STAGE 2	STAGE 3
Building management and organizational capabilities; Start collaborative projects; Need to develop STEM skills and engineering; Need for basic infrastructure – NQI and incubation; Elimination of barriers to physical, human and knowledge capital	Building technological capabilities; Incentivize R&D projects; Link industry academia; Improving quality of research, innovation and export infrastructure	Long-term R&D and technological programs; Minimize innovation gap between leaders and laggards; Collaborative innovation projects

**Fig. 4.** The focus of innovation policy in terms of the formation of Industry 4.0 that depends on the stages of development of the country (should depend on the stage of the country's development)

*Source: author's development*

*Source: generalized by author's*

The socio-economic effects of the development of Industry 4.0 in the conditions of virtual reality should include: the growing rate of expansion of cluster network space; wide introduction of advanced IT technologies in business processes of enterprises that transform the basic features of economic processes and expand communication opportunities, gradually advancing the world community to new digital era; global transformations or shifts, which are accompanied by the emergence of innovative business models, disruptive impact on traditional business strategies and radical changes in production, consumption, marketing and marketing; formation of a hybrid environment in which new economic and social ecosystems are created, based on modern IT technologies, adapted to interaction through digitized financial and material resources and functionally aimed at creating added value [8, p. 99] and the search for reserves of economic growth. Useful examples of different countries regarding national strategies and their implementation in terms of economic growth are presented in Table 7.

Table 7. The OECD is working with countries on National Strategies and their implementation in terms of economic growth

<p>1. Supporting the implementation of National Strategies:</p> <p><i>Georgia</i>                      Financial literacy survey using the OECD Toolkit in 2016                      National Strategy designed and launched in 2016                      Preparing an Action Plan to outline concrete implementation steps, roles of responsibility                      Creating a finding model for implementation</p>
<p>2. Evaluation of National Strategies:</p> <p><i>Hong-Kong/Netherlands/Peru/UK</i>                      Evaluation approach to be integrated the NS, linked to indicators/feedback mechanisms                      No one approach for all but clear lines of responsibility, multiple and transparent flows of data, incentives for accountability                      Manageable governance structure and open feedback from implementing stakeholders                      Communication strategy for evaluation results                      Dedicated funding</p>
<p>3. Improving the financial literacy of youth and in schools:</p> <p><i>Armenia/Kyrgyz Republic</i>                      Developing core competencies, based on the OECD CCs for youth                      Agreeing on clear lines of responsibilities                      Adapting, existing school curricula                      Committing, resources to teacher-training                      Developing content                      Evaluating pilots</p>

Direct economic effect of digitalization of key business processes in enterprises is difficult to assess, so it is advisable to focus on indirect economic effects, including indicators of the level of quality and productivity of their work in terms of different industries. Qualitative changes in the course of digital transformation in general should be assessed through indicators of business and community satisfaction with the implemented programs, which include: creation of digital infrastructure, support of domestic developers and manufacturers in IT field, regulatory mechanisms, training of competent personnel, digital specialists, development of e-medicine, IT systems in transport and e-logistics, energy efficiency, e-security, e-education and many other areas of life [8, p. 100].

Digitalization is precisely the element that can significantly positively affect the quality and efficiency of planning and management processes in the enterprise. The ultimate goal of the implementation of digitalization processes in economic activities of enterprises is to gradually increase the profitability of production and improve investment attractiveness in various sectors of the economy.

For example, in Ukraine there is no effective infrastructure and appropriate incentives for the emergence of powerful developers in industrial engineering. Their quality and quantity can dramatically affect industrial innovation, R&D, export marketing, etc. The activities of industrial engineering companies are aimed at finding and developing new industrial products, generating ideas, industrial design, prototyping, etc.. Finding a relevant strategy for this problem, stimulating the emergence and growth of this important segment, especially for sectors such as food and processing industry, metallurgical engineering, agriculture – will quickly create and develop industrial engineering industry and make it attractive for investment.

## 4 Conclusion

As a result, it should be noted that indeed the digitalization of business processes of enterprises opens new horizons and opportunities for the formation of added value in almost all sectors of the economy. In addition, in the post-pandemic period, digital technologies will become an integral part of the socio-economic life of Society 5.0 and identify key vectors for the development of government digital policy. Digitalization is becoming a driver

for the development of Industry 4.0, as it is able to increase the efficiency of the economy at all levels of aggregation, the formation of new quality and standard of living. The use of digital technologies lays the foundations for the process of modernization of traditional sectors of the economy and stimulates the emergence of new innovative industries that accelerate Ukraine's economic growth and bring to a new level of competitiveness in global economic system in virtual reality.

Thus, key decision should be to conduct large-scale but focused educational initiatives to integrate best ICT practices in industrial sectors with the involvement of relevant associations, vendors, international brands, etc. It is necessary to form focus groups of experts – knowledge carriers and promoters – and “fuse” them with industrial sectors. The result should be the creation of “industrial ICT reactors”, ie joint competent groups – representatives of ICT and industry, focused on cooperation and development of new products and services. This approach will allow ICT to penetrate the industrial sector and affect the emergence of new developments, R&D, innovation.

Based on the results of our research, we came to the conclusion that the lack of state support for enterprises seeking to introduce digital technologies into production slows down the digitalization process in Ukraine; imperfection of the regulatory framework for digitization of industry and production in terms of the formation of Industry 4.0; lack of priority of digitalization in the strategy of state development; technological backwardness from the leading countries of the world, because in some sectors of the economy we have 3 and 4 technological systems. Considering the positive effect of digitalization for business, we can identify a number of opportunities: increase productivity; reducing the level of fraud, increasing the level of transparency and ease of operations; production automation; expanding sales channels through new opportunities that open up virtual reality.

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### **Contribution of individual authors to the creation of a scientific article (ghostwriting policy)**

**Kateryna Kraus**, research of analytical technologies of digital transformation of enterprises, visualization of the presented material.

**Nataliia Kraus**, assessment of digitalization of business processes, selection of literature and its analysis.

**Oleksandr Manzhora**, generalization of features of industrial automation in Ukraine.

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