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FORMATION OF AN INNOVATING CULTURE FOR INTERNATIONAL COMPANIES IN THE CONTEXT OF GLOBAL DEVELOPMENT

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Otenko I. P. Formation of an Innovating Culture for International Companies in the Context of Global Development

For the third year in a row, according to the results of research by global consulting agencies, international companies-leaders consider innovation to be the number one priority among their corporate goals. Most companies declare their readiness to invest in breakthrough innovations related to digital technologies, artificial intelligence, and smartization of business processes. The criteria for the readiness of such companies are: intensification of the search for talents that generate new ideas and have the ability to implement them into reality, turn investments into results; use of new business models and a wide range of strategic tools; strengthening innovative platforms of knowledge and practice; organization or participation in ecosystems with the involvement of external partners and competitors. Leadership is based on a strong culture of innovation, which is represented by the principles, norms and rules of strategic thinking, flexibility, mobility in decision-making and implementation of decisions. The article analyzes the features of the formation of a culture of innovation by international companies that are established as leaders in creating new sources of income and values, products and markets; the common attributes of innovation culture are defined – compliance with the principles of social and environmental responsibility, possession of elements of leadership and teamwork, readiness for effective implementation of innovations, productivity and resilience to threats.

Keywords: *leading companies, culture of innovation, common signs, principles, development trends, digitalization, analysis, assessment methodology.*
Tabl.: *5.* ***Bibl.:*** *26.*

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Отенко І. П. Формування культури інновацій міжнародних компаній в умовах глобального розвитку

За результатами досліджень світових консалтингових агенцій міжнародні компанії-лідери третій рік поспіль, незважаючи на глобальну економічну невизначеність, вважають інновації пріоритетом номер один серед своїх корпоративних цілей. Більшість компаній заявляють про готовність інвестувати в проривні інновації, що пов'язані з цифровими технологіями, штучним інтелектом, смартизацією бізнес-процесів. Критеріями готовності таких компаній виступають: активізація пошуку талантів, що генерують нові ідеї та мають здатності впроваджувати їх у реальність, перетворити інвестиції в результат; використання нових бізнес-моделей і широкого спектра стратегічного інструментарію; зміцнення інноваційних платформ знань і практики; організація або участь в екосистемах із залученням зовнішніх партнерів та конкурентів. В основі лідерства лежить сильна культура інновацій, що представлена принципами, нормами та правилами стратегічного мислення, гнучкості, мобільності в прийнятті та реалізації рішень. У статті проведено аналіз особливостей формування культури інновацій міжнародними компаніями, що є лідерами у створенні нових джерел доходу та цінностей, продуктів та ринків; визначено спільні атрибути інноваційної культури – дотримання принципів соціальної та екологічної відповідальності, володіння елементами лідерства та командної роботи, готовності до ефективної реалізації інновацій, продуктивності та стійкості до загроз.

Ключові слова: *провідні компанії, культура інновації, спільні атрибути, принципи, тенденції розвитку, цифровізація, аналіз, методика оцінювання.*
Табл.: *5.* ***Бібл.:*** *26.*

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In the face of global uncertainty, increasing rates, and changes in scientific and technological development, the world's leading companies demonstrate a strategic priority for innovation, digitalization, social and ecological responsibility in their activities. According to the results of the ranking of the most innovative companies in the world, they have a high level of innovation – they create new business models and organizational forms of transformation, actively use relevant digital tools and artificial intelligence technologies, plan to increase their spending on innovation and related instruments, achieve sustainable competitive advantages in international markets, implement social measures and methods of ecological management. The dynamics of such changes can be traced by comparing the ranking results in different time periods. Thus, according to the results of the innovative rankings of the BCG consulting agency for 2023 compared to 2022, two-thirds of the leading companies

maintained their positions (Apple, Amazon, Alphabet, Huawei) and significantly improved them (Tesla, Siemens, BYD Company); among the most innovative companies of the TOP-50 there are some that have appeared in the ranking for the first time and are newcomers to the global market (for example, BioNTech, Schneider Electric, Sinopec Honeywell) and there are those that have regained their leading positions (BYD Company, SpaceX, ExxonMobil) [1].

The *aim* of the article is to analyze the common attributes of the culture of innovation of international companies in the context of global development.

The theory of scientific and technological progress proves that new economic structures arise as a result of «industrial revolutions». The announcement of Industry 4.0, considered a phase of the Industrial Revolution, was made by President Klaus Schwab at the Davos World Economic Forum in 2011. In September 2015, at the UN Summit in New York, the final document «Transforming our world: the 2030 Agenda for Sustainable Development» was presented, defining the global goals [2]. The developed world countries have already passed through five technological paradigms and at present there are processes of transition to the sixth, in which information technology plays the most important role [3] (*Tbl. 1*).

In the formation of the sixth technological paradigm, information technology is the key backbone factor. This is especially true for the production of complex science-intensive products. Continuous information support of the life cycle of an innovative product is provided by CALS (Continuous Acquisition and Life cycle Support) technologies [4]. The CALS conception was developed in the 70s of the last century by the US Department of Defense. The need for its appearance was determined by problems related to the efficiency of management, the quality of information support for logistics processes of supply, the operation of military equipment and the optimization of funds for armaments. The main tasks are the creation of a single information space, prompt data exchange, feedback from customers (federal bodies), manufacturers, and consumers of military equipment. The leading idea of the CALS conception is the continuity of the processes of development, communication, ordering, production and operation of military equipment.

The conception of Cyber-Physical Production Systems (CPPS) is characterized by the features of «smart manufacturing», the introduction of Cyber Physical Systems (CPS) for production, i. e. built-in drives and sensors, microcomputer networks and the connection of machines to the value chain [5]. These can be, for exam-

Table 1

Evolution of technological paradigms

Technological paradigm	Innovation Explained
1. Mechanization of the textile industry and development of production of construction materials	Innovations: Kay's flying shuttle (1733), Wyatt's spinning machine (1735), Hargreave's and Arkwright's spinning machines, Robertson's and Horrocks' mechanical looms (1760). Innovations in the fields of ferrous metallurgy (replacement of charcoal with bituminous coal) and metalworking. The economic boom ensured the development of transport infrastructure
2. Creation of the steam engine, which became the basis for the development of heavy industry	Characteristic features: large-scale railway construction, production of various machines and mechanization of labor, rapid growth of ferrous metallurgy, coal mining industry, transport engineering
3. Intensive development of electrical engineering. Technical re-equipment and growth of the extractive industry	Electrical engineering ensured a rapid growth in the mechanization of production and labor productivity, and progress in ferrous metallurgy (the introduction of steel rolling technology and blast furnace technology) and mechanical engineering accelerated
4. Development of the automotive and chemical industries. Advance development of the electric power industry	Complex mechanization of production, automation of many basic technological processes, widespread use of skilled labor force, growth of production specialization
5. Intensive development of information and communication technologies (ICT)	ICT are represented by: electronic components and devices, electronic data storage, carriers, transformers, connectors, computers, accounting machines, radio and telecommunications equipment, laser equipment, software services and maintenance of computer equipment
6. The key factors are the development of nanotechnology, which is characterized by the transformation of substances and the design of new material objects, the use of cellular technologies in the modification of living organisms, including methods of genetic engineering	The core of the new paradigm is created by a combination of key factors with the electronics industry, information technology, and software. The main trends are the transition from integrated automated production management systems to the systems that support all stages of the product life cycle from market research to the operation of the finished product and its recycling (CALS technology). This is especially concerned the complex science-intensive products

Source: developed on the basis [3].

ple, intelligent factories and machines that can become active and act independently, organize and optimize themselves. In order for as many players as possible to implement and manage the CPS system, it is necessary to develop new technologies for coordinating business models, processes, methods and tools. At the same time, it is necessary to find ways to quickly integrate such CPS into existing enterprises.

Thanks to cyber-physical systems, the business relations of participants in production processes are transformed, integration between the processes of production and services is carried out «in a single digital (cyber-physical) system, where all elements of the economic system are simultaneously involved in the form of physical objects, products and processes, as well as their digital copies (mathematical models); all physical objects, products and processes become part of an integrated IT system due to the presence of a digital copy and an element of «connectivity»; due to the availability of digital copies (mathematical models) and being part of a single system, all elements of the economic system continuously interact with each other in a near-real time, simulate real processes and predicted states, and provide constant optimization of the entire system» [3, p. 13].

The conceptions of «Smart manufacturing» and «Digital Manufacturing» (*Tbl. 2*) are united by the idea of creating a smart production system based on the use of artificial intelligence, integrated computer systems using 3D visualization, analytics and collaboration tools, fifth-generation technologies (5G technologies), and the Internet of Things. The conceptions of smartization and digitalization are derived from conceptions such as design for manufacturing (DFM), computer-integrated manufacturing (CIM), flexible manufacturing, and lean manufacturing, which substantiate the need for an integrated approach to product and process design [6].

The instrumentarium of the digital economy has significantly expanded due to the use of digital platforms that represent business models that are the results of

Table 2

Conceptions of digital business transformation

Conception	Characteristic features
«Industry 4. 0» is interpreted as: the digital transformation of industrial production systems (McKinsey, BCG; a new stage of organization and control in relation to the value chain (PwC); the Fourth Industrial Revolution (WEF); the ways in which smart, connected technologies are embedded in organizations as well as in people's daily lives (Deloitte)	Main features: not limited to direct production in the company, but also includes the complete value chain from suppliers to customers and all business functions of the enterprise and services; provides broad support for the entire life cycle of systems, products and series, distributed both spatially and organizationally; specialization of the Internet of Things, which is applied to the manufacturing and industrial environment and involves the collection of data in real time, leading to solving the problem of huge data analysis and cybersecurity
«Smart manufacturing» is defined by the characteristics, technologies, and factors that describe a production system as «smart». Key factors: legislation; innovative education and training systems; data exchange systems	Characteristics: content awareness, modularity, heterogeneity, compatibility, and positionality. Technologies: Intelligent Control; energy saving and efficiency; cybersecurity; cyber-physical production system; visual technology; Internet of Things and Services; cloud production; 3D printing and additive manufacturing; IT-based data analytics and production management
The conception of «Digital Manufacturing» has evolved from initiatives such as design for manufacturing (DFM), computer-integrated manufacturing (CIM), flexible and lean manufacturing	The main idea is the need for joint design of the product and process. The essence boils down to the use of an integrated computer system consisting of modeling, 3D visualization, analytics, and co-working tools to simultaneously define product creation and manufacturing processes
«Open production» is a new model of socioeconomic production, in which physical objects are produced in an open, common and distributed way and are based on the principles of open design and open source	Comprised of open knowledge, software, and developer communities, whose members are linked to the production units (companies) that directly fund their members and maintain the collaborative infrastructure of the common ones on which they depend, sharing the benefits in such a way that the benefits go back to open developer communities
«Internet of Things in Industry» is a new generation of control systems that operate through communication between devices or sensors. The idea is to combine the physical and virtual worlds with the help of machines	The main feature of the business model is that the manufacturer of machinery, equipment or other physical assets can keep them in its ownership, thanks to control over the state of assets and new management and maintenance capabilities. Data helps to monitor and control production processes, reduce costs and waste

big data modeling and characterize new sectors of the economy. Thus, digital platforms act as a universal communication base that allows different groups of industrial relations to interact online.

It should be noted that global digital platforms have strong market positions, act as bilateral or multilateral markets with an infrastructure provided by online cooperation and conducting transactions between different partners. Thus, it is known from the 2019 report on the state of the Digital Economy [7] that «more than 90% of the Internet search engine market belongs to Google; Facebook accounts for 2/3 of the global social media market, and its platform is the most popular social media platform in more than 90% of countries; about 40% of the world's online retail sales are made through the Amazon network, and its subsidiary Amazon Web Service accounts for about the same share of the global cloud infrastructure services market».

The essence of the conception of «Internet of Things in Industry» (IoT) is considered as a huge network of interconnected devices and sensors that can interact with each other, collect and exchange data via the Internet (software, communication technologies, sensors) without constant human control. Modern IoT systems are one of the innovative business models of management systems. Experts often combine the use of artificial intelligence and the Internet of Things and give optimistic forecasts for their use not only in industry, but also in healthcare, the environment, transport, utilities, etc. Thus, according to the consulting company Analytics, in 2021 there were more than 12 billion IoT devices, and in 2025 their number is predicted to increase to 22 billion; IDK has more optimistic forecasts – up to 41.6 billion; Juniper Research, a consulting agency, said that the global IoT market will increase from $31 billion in 2022 to $61 billion in 2026 [8].

These conceptions are united by the sign of the uniqueness of choice for each State for their practical application in economic, scientific and technological development. Therefore, views on the priority of this or that conception in the theoretical basis of «Industry 4. 0» differ due to the focus on certain national features of the transformational changes of business processes, industries and markets. However, all of them require some attention to study the experience of the world's leading countries for the formation of Ukraine's competitiveness, its successful integration into the world economic space.

According to the classification of the Organization for Economic Co-operation and Development (OECD), the information technology (IT) industry, namely the production of computer, office equipment and software creation (this category also includes the provision of consulting services for digital business transformation and support for information and communication infrastructure), as well as the production of electronics and telecommunications equipment are classified as high-tech industries [9]. The countries that are developing this industry at the fastest pace are included India and China. Over the past 10 years, the powerful development of the IT services sector has been observed in their export, which is growing many times faster than the entire export service as a whole. According to the Digital Economy Report [7], the volume of export services provided in 2018 using digital technologies reached $2.9 trillion, which amounts to 50% of the world's export service.

At that, it should be noted that in the ratings of the most innovative companies, the largest part of the leading positions is occupied by companies in the IT sector, and the key feature of the formation of a culture of innovation by companies in other industries is the large-scale use of innovative information and communication technologies and products: artificial intelligence, artificial intelligence of things, digital platforms, etc.

The methodology for analyzing the advanced practices in the innovative development of world companies is based on the view of sustainability of their leadership positions in the global business environment by highlighting common features of the culture of innovation, new business models that make up the unique value of innovation for the consumer. Such business models are based on the formation of organizational capabilities and strategic capital that allow companies to constantly innovate, create value and share it with consumers, involving them in these processes. An example of such engagement is the Google platform, when the consumer decides individually how he will use it (personalize) taking into account his needs (for example, entertainment or education). Researchers [10] call this phenomenon, when the value of an innovation is determined by individual experience and customer involvement, $N = 1$. At the same time, the transition of companies to the option of global supply chains and interaction with specialized manufacturers has significantly expanded the conditions for access to local and global resources (especially human resources), which are indicated by the parameters $R = G$. Thus, in a formalized form, the business model $N = 1$ and $R = G$ clarifies the nature of changes that create the basis for achieving competitive advantages in the global business environment [10]. Thus, innovation is seen by leading companies as a process of shaping customer expectations or as a constant response to changes in consumer needs, behaviors, and experiences. Thanks to the use of new approaches in management, information and analytical tools, personnel with skills, abilities, and knowledge, these companies demonstrate significant resilience in the global business space, creating innovative values and competitive advantages faster than competitors.

To analyze the attributes of innovation culture, the results of the ranking of the most innovative companies in the world, conducted annually by the consulting company BCG, were used (*Tbl. 3*). The integral development indicator (*I*) was calculated based on the financial state-

ments of Apple, Alphabet (Google), Amazon, Microsoft, Samsung, Siemens for the period from 2010 to 2022 for each year according to the following indicators: equity, current assets, operating and net profit, share price, sales income, goodwill. It should be noted that according to the results of the analysis of the dynamics of changes in the integral indicator, the largest decline was observed for each company in the period from 2019 to 2021, which is explained by the consequences of the COVID-19 pandemic. In general, trends in changes in the integral indicator, the equity indicator (which is related to the capitalization of companies, activity in the use of forms of strategic partnerships, alliances, M&A), and sales income (confirming the efficiency of transforming innovations into a result, their growing commercialization) are of a similar nature. For the period from 2010 to 2020, the integral indicator of all surveyed companies tended to decrease, although the rating indicators included in the top ten leaders improved. Companies such as Apple, Alphabet (Google), Microsoft, which are representatives of the IT sector, are constantly in the leading positions of the top ten companies due to the focus of their strategic priorities on the growth of innovations from ideas to their implementation and commercialization.

The culture of innovation of international companies is characteristic of obtaining competitive advantages for business through innovative achievements based on the implementation of the provisions of the circular or cyclic economy. An example is the activities of the aerospace company Space Exploration Technologies Corporation, (SpaceX, USA), which moved to the 12th position in the BCG list of innovative companies (+1 compared to 2022) [1]. The company has developed the Falcon 1, Falcon 9, Falcon Heavy reusable launch vehicles and the Dragon spacecraft. In order to control the quality and cost of development, production and testing, most products are created using vertical integration technology (i. e. rocket engines, launch vehicles, spacecraft, avionics and all software are manufactured at Hawthorne's own facility). The company is a member of the Hiperloop vacuum train project. In addition to these achievements, SpaceX is the largest satellite operator in the world. The main achievement is that for the first time, a private company launched the Crew Dragon spacecraft carrying two NASA astronauts to and from Earth orbit (May 30, 2020). To reduce the cost of Falcon 9 launch vehicles, a floating platform is used. The Interplanetary Transport System is a reusable space transport project to deliver humans to Mars. In December 2021, Elon Musk announced the launch of a program to extract carbon dioxide from the atmosphere and convert it into rocket fuel [11].

The German concern Siemens has achieved significant success in innovative development (see Tbl. 3). The company operates in more than 200 countries around the world and specializes in the areas of electrification, automation and digitalization. In a strategic partnership, this company implements digital transformation in discrete and continuous production for various industries: a portfolio of solutions for the digital enterprise has been developed, constituting comprehensive solutions and services for the integration and digitalization of the entire value chain. The company's innovation culture is built on the active use of artificial intelligence, edge computing, 5G communications, autonomous autoloaders, blockchains, and additive manufacturing [12]. This verifies the fact that the use of so-called circular economy (4IR) technologies, which are divided into digital, physical and biological, is relevant for innovative enterprises. Thus, 59% of the 1500 «circular companies» actively use digital technologies, 28% and 13% – physical and biological technologies. The use of physical and biological technologies is considered to be a less «mature» process, «limited in part by the need for significant capital investment or research time frames», «requiring significant operational changes for widespread implementation or research of ethical and regulatory considerations» [13; 14].

The chemical industry, pharmaceuticals, finance, and transportation invest quite heavily in robotics compared to other industries. Some chemical and pharmaceutical companies are experimenting with combining artificial intelligence and quantum computing in their search for new materials and drugs. Thus, according to Eurostat, 20% of all research and development (R&D) expenditures in the world are products of the pharmaceutical industry. Until 2018, the global market was growing by 5–6% annually, and the sales volume of each of the top 10 best-selling medicines on the world market in monetary terms in 2018 exceeded $6 billion. After the COVID-19 pandemic, its growth value has exceeded by 34%, which is equal to $1.485 trillion [15].

Moderna (sixth position in the ranking, see Tbl. 3) is one example of the most powerful impact of artificial intelligence on technologies for the development of vaccines and therapeutics. Moderna has made extensive use of digital technology and artificial intelligence to accelerate the development of an mRNA COVID-19 vaccine. Moderna actively uses inter-organizational forms of cooperation with other companies. An example is joint research with Merck & Co to fight skin cancer. «The mRNA-based therapies evidenced by the Phase 2b results can reduce the risk of recrudescence or death from melanoma by 44%. Using a proprietary algorithm where the process begins with an analysis of the patient's tumor to identify cancer-causing mutations, and then individualized neoantigen therapy is developed to maximize each patient's immune response to a specific tumor mutation» [1]. Moderna also announced a partnership with IBM in research using artificial intelligence and quantum computing to advance and accelerate the development of mRNA-based breakthrough therapies.

Moderna's CEO, Stéphane Bancel, has publicly acknowledged the «digital shift» as a key reason for bio-

Table 3

Analysis of the features of the business culture of the world's most innovative companies

Ranking for 2023, integral indicator (I)	Company, features of business culture
1	2
1. Apple from 2010 to 2023 (except for 2018 when it took the 3rd position) occupies the first position; ***I = 0,131***	Apple's business culture is known for strict adherence to the rules of accountability, consistency between functions and the employee's area of expertise. Each project has a «directly responsible person». The company has a relatively simple executives compensation policy that does not include benefits and grants stock options to executives every two years. A feature of the culture is the high level of security of the company to combat information leakage and preserve corporate secrets; the security team includes representatives from the National Security Agency, the Federal Bureau of Investigation, and the US Secret Service
2 . Tesla in 2023 has risen three positions compared to 2022 (+3)	The American corporation Tesla Motors has released a series of electric vehicles, where the main focus of developments in these electric vehicles is aimed at ensuring a high level of environmental friendliness and safety. A third of the company's 6000 employees are engaged in research and development in the fields of energy and environmental technologies
3. Amazon for the period from 2019 to 2023 occupies the 3rd position; from the 11th position (in 2010) to the 2nd position (2018); ***I = 0,1646***	The world's largest platform in the e-commerce and public-cloud computing markets by revenue and market capitalization. The company's activities include the production of electronics and media content, the resale of goods and content from other manufacturers, the provision of retail space to third-party sellers, hosting, cloud computing and information storage, shipping of goods, advertising services, and subscriptions for access to paid content. Trading is carried out mainly via the Internet
4. Alphabet held the No. 1 position in 2020. From 2010 to 2019, it had the second position in the ranking; ***I = 0,2327***	The creation of Alphabet Inc. was driven by a desire to make Google's core business «cleaner and more accountable» while giving more autonomy to groups of companies that operate outside of Internet services. Invests in internet search, cloud computing, and advertising technology. Google has such online products as the Gmail email service, the Google+ social network. The company has desktop products: the Google Chrome browser, the photo app Picasa, and the instant messaging app Hangouts. In addition, Google is developing the Android mobile operating system, which is used on a large number of smartphones, as well as the Google Chrome OS operating system and Google Glass devices
5. Microsoft has decreased its rating by three positions (–3) compared to 2022; ***I = 0,2643***	Microsoft is known for actively using organizational tools – mergers and acquisitions (M&A) strategies, as well as partnerships and alliances to fill strategic needs to contribute to its «innovation agenda». An example is the company's investment in OpenAI and the integration of ChatGPT
6. Moderna has improved its rating by one position (+1) in 2023	Moderna has made extensive use of digital technology and artificial intelligence to accelerate the development of an mRNA COVID-19 vaccine. Moderna applies its own technology platform. In collaboration with Merck, the company has joined to fight skin cancer through research. The mRNA-based therapies evidenced by phase 2b results can reduce the risk of melanoma recurrence or death by 44%. Moderna recently announced a partnership with IBM in research to use AI and quantum computing to advance and accelerate the development of mRNA-based breakthrough therapies
7. Samsung has downgraded the rating by one position (–1) compared to 2022. The company was one of the top three from 2012 to 2014; ***I = 0,1709***	Samsung uses every tool available to improve productivity through innovation at many stages of the value chain. The company is a global innovation leader in R&D, patents, and innovative vehicles such as laboratories and incubators. It invests heavily in research and development, spending more than $17 billion on it. About 10,000 researchers and developers are involved in the development of future technologies, the company has a solid patent portfolio: 6300 patents were granted in 2022 (the highest number in the United States). The company is developing new products and looking for new markets, moving from displays and electronic components to robotics, smart home products, automobiles, medical equipment, virtual assistants, and 5G connectivity. The company has captured significant market shares of smartphones, QLED TV, and IoT products
8. Huawei: relative to 2022, the position has not changed	A Chinese company, one of the giants in the field of telecommunications. On June 29, 2023, Huawei announced the launch of a new 5.5G communication standard, the test launch of which is scheduled for the first half of 2024. In September 2023, a new model of the Huawei Mate 60 smartphone is released, made, according to the company, exclusively using Chinese technology; the processor, which includes a 5G modem, was developed by HiSilicon Technologies (a subsidiary of Huawei) and manufactured by SMIC

1	2
9. BYD Company has appeared in the ranking for the first time	Specializing in automobiles, alternative kinds of energy, IT technologies, a leader in the production of energy saving systems and batteries around the world. The company is accused of using unfair advertising, unauthorized copying of technologies and commercial espionage. The company is suspended from any M&A transactions in the US, UK, Australia and India.
10. Siemens has improved its rating by 10 points compared to 2022 (+10). In 2010, the company was ranked 51st; ***I = 0,2638***	Siemens is one of the leaders in the use of M&A strategy. In 2018, it spun off 25% of Siemens Healthineers med-i cal device business to incentivize entrepreneurial independence. Siemens Healthineers has taken advantage of the flexibility to bet big on healthcare. In August 2020, the company announced the acquisition of long-standing partner Varian Medical Systems for $16.4 billion. The acquisition of Varian positions Siemens Healthineers as the player with the largest number of comprehensive integrated portfolio in cancer care, through screening, diagnosis, treatment

tech's success. By prioritizing the digitalization of the mRNA production process, Moderna has been able to secure the rapid development of vaccines and medicines. Digitalization, the impact of its elements, still require time and investment, require analysis and assessment of the capabilities and limitations. But «given the potential of transformative technologies, especially for innovation, they are worth the effort» [1].

One of the ways to transform innovative technologies into a profitable business is clustering – the creation of high-tech clusters along the chain «science – innovation – production» [16]. Thus, in the EU countries there are clusters for which conditions have been created at the national level to attract the private sector on the basis of high-tech industries: electronic technologies and communications, computer science (Switzerland, Finland); biotechnology and bioresources (the Netherlands, Germany, France, Great Britain); pharmaceuticals and cosmetics (Denmark, Sweden, France, Italy, Germany); agricultural and food production (Finland, Belgium, France, Italy, the Netherlands); oil and gas complex and chemistry (Switzerland, Germany, Belgium); machine building, electronics (the Netherlands, Italy, Germany, Ireland); health care (Finland); light industry (Austria, Italy, Sweden, Denmark, Finland); forest complex (Finland). Measures that ensure the development of clusters on the basis of high-tech industries represent: stimulation of investment and business activity in priority types of economic activity of the fifth and sixth technological paradigms; reduction of taxes and fees, financing of scientific developments; orientation of educational and personnel policy to meet the needs of the new innovation space; coordination of participants in the production process and carriers of innovations; formation of a sufficient amount of resources (financial, labor, etc.); increasing the efficiency of capital in science and education and establishing interaction between business and science.

Economic development, the preservation of the stability of social and cultural systems, should be aimed at reducing the number of conflicts in society. Therefore, harmonization, systematic coordination and balancing of economic, social and environmental components in business systems at all levels is a task of enormous complexity. In particular, the interconnection of social and environmental components leads to the need to preserve the same rights of present and future generations to use natural resources.

The interaction of social and economic components requires the achievement of justice in the distribution of material goods among people and the provision of targeted assistance to the poor strata of society. And, finally, the relationship between environmental and economic components requires a costal assessment of man-made impacts on the environment. Solving these problems is the most important challenge of today at the national and international levels – for governments, authoritative international organizations and all progressive people of the world.

As noted in Pedro Matos' study «ESG Principles and Responsible Institutional Investment in the World» [17, p. 64]: «In 2017, 85% of S&P 500 companies published their sustainability reports, starting from 11% in 2011». Such interest of world leading companies in the information transparency of ESG criteria is determined by the need to certify their commitment and compliance with the principles of social responsibility, in order to increase the level of their competitiveness and investment attractiveness for investors. Such data has now become widely available, and how it can be obtained through the various websites of independent consulting agencies such as RAEX-Europe, S&P Global Score (SAM), Sustainalytics ESG Risk Rating, MSCI ESG Rating.

However, as noted by a number of researchers [18; 19], these ratings differ significantly from each other and can become a competitive platform for «green PR», since obtaining real data on the activities of small companies is quite difficult for emerging markets; the lack of such data presents a certain problem for conducting a thor-

ough analysis; data from various open sources are used – regulatory and government documents, printed publications, online resources; very often, data is disclosed in networks under social influence and is not a tool for objective measurement.

It is believed that traditionally ESG parameters are disclosed based on the results of activities, which reflect how vulnerable a company can be to ESG risks and how to manage such risks. This means that ESG rankings allow you to reveal the situation in terms of a significant number of environmental and labor protection indicators – the equivalent of CO_2 emissions, labor force protection.

There are also some discrepancies in the measurement of social factors, which is confirmed by discussions among research scholars of issues related to the nature of the impact on the value of a company of the type of management with a gradual change. Therefore, practitioners are suspicious when compiling ESG ratings, among the reasons for the impact are:

1) company size – large companies can get better ESG parameters, as they can allocate more resources to the preparation and publication of ESG reports and control reputational risks;
2) the «geography» of ESG reporting differs for companies registered in regions with higher requirements;
3) belonging to a particular industry, as the normalization of ESG parameters by industry can oversimplify them;
4) ESG parameters may have retrospective significance and do not explain how compliance with ethical standards in the company's behavior improves its sustainable results.

Such discrepancies are primarily explained by a lack of understanding of the importance of social responsibility for the firm, insufficient agreement on the methodology used for the relevant measurements, ambiguity of views on occupational health and safety, while ESG providers, under common law, emphasize investor protection and stronger protection of shareholders' rights, as well as enhanced protection of other aspects of corporate governance. Therefore, the inconsistency is reduced after taking into account the factor of legal origin.

Thus, it is necessary to find a consensus on ESG standards that socially responsible investors could use to vet potential investments. Environmental criteria define the company's role as a conservationist; social criteria – the level of management of personnel, suppliers, customers and society; corporate governance refers to the management of a company, executive remuneration, auditing, internal controls, and shareholder rights.

A successful track record of social responsibility among innovative leaders can be noted in the use of innovative technologies to improve employee safety, such as robotics, drones or non-destructive testing. The BMW Group topped the first-ever Corporate Responsibility Index (CRI) presented by the Bertelsmann Foundation [20; 21]. BMW (Germany) is a leader among manufacturers of engines for airplanes, vehicles – bicycles, motorcycles, trucks and cars. The company's financial turnover is more than $75 billion. The German manufacturer employs more than 100,000 people. This concern reacts very quickly to scientific and technological changes and moves in the direction of environmental friendliness, it is a constant leader in electrification and remains so in the sale of zero-emission models. In addition to innovations related to the improvement of engine design, the company is actively engaged in the development of new efficient materials for its own vehicles and integrates strategic CSR measures into its activities through compliance with environmental and social standards and respect for human rights; protection of natural resources; reduction of CO_2 emissions in the supply chain (*Tbl. 4*).

The BMW Group is limiting the use of critical raw materials and reducing the amount of cobalt in the cathode material for fifth-generation batteries by up to 10% and increasing the amount of secondary nickel by up to 50%. The use of renewable clean energy sources for the production of battery cells reduces CO_2 emissions by 17% compared to a car produced without these means. By 2030, the BMW Group plans to increase the production of electric vehicles to seven million, two-thirds of which will be fully electric [22].

Environmental feasibility in innovation is adhered to by the Indian company Tata Motors, which started as a manufacturer of locomotives and freight cars, and is currently the largest manufacturer in India (the company owns the rights to Jaguar and Land Rover brands). The ecological component of innovation activity consists of inventions to replace hydrocarbon fuels with more environmentally friendly alternative fuels. For example, compressed air is used in the operation of the OneCAT electric vehicle [23].

The American diversified corporation General Electric occupies a leading position in the world market of industrial production as a manufacturer of locomotives, power equipment, nuclear reactors, gas turbines, aircraft engines, medical equipment, household lighting, equipment for photography, military products. The staff consists of more than 36 thousand experienced process engineers. Since March 2022, the company has left the russian market due to russia's invasion of Ukraine. The company actively develops and uses new products in information technology – artificial intelligence, big data, industrial inspection robots. The photographs and measurements of temperature, vibration level and gas concentration, obtained using artificial intelligence, and big data analysis make it possible to identify and monitor working conditions in hazardous industries [23].

In Ukraine, the assessments of the level of compliance of domestic enterprises with the best international practices and principles of corporate governance effi-

Table 4

Successful experience of integrating corporate social responsibility (CSR) measures into the activities of companies

Company	CSR activities
BMW Group – implementation of the innovation and social projects	The BMW Group was the first car manufacturer to introduce the position of Environmental Officer, an employee responsible for compliance with environmental production standards. Over the past ten years, the automaker BMW Group has reduced emissions from its new cars sold in Europe by 40%. The introduction of advanced technologies can significantly reduce fuel consumption and gas emissions. The BMW Group also supports large-scale educational programs, deals with road safety problems, and participates in the treatment of patients with HIV/AIDS. The «BMW Group» automaker Herbert Quandt and the Eberhard von Kuenheim Foundation contribute to the development of contemporary art, jazz, classical music, design and architecture
UAE Airlines «Emirates» – support of local communities and charitable projects in the countries where the company is the largest carrier (India, Pakistan)	Supporting major sporting events and organizations, including the FIFA World Cup and the International Cricket Council. Emirates Airlines is the general sponsor of the famous British club Arsenal, giving its name to the new stadium and placing the logo on the players' shirts. For £ 100 million, for the time period until 2021, the company had acquired the opportunity to associate itself with one of the most expensive sports brands in the eyes of the club's 27 million fan army. One of the main tasks of the airline in the field of corporate citizenship is to create a positive image of Dubai outside the UAE and the Middle East region
«Microsoft» has integrated social responsibility measures into its business strategy, and CSR initiatives have become part of its corporate culture	Annually organizing hundreds of specialized events, the company's employees have donated more than $1 billion to socially important projects during the time period of 30 years. The project, called «Yo soy empleo», was aimed to employ Spaniards in times of crisis. €26.5 million was invested in the program, while a quarter of the sum was invested in communications. The social initiative provided comprehensive support for unemployed citizens: providing financial assistance, organizing trainings, retraining specialists and legal advice. As a result of the project, 10 thousand people were employed, 55% of whom got a permanent job, 13% the opportunity to implement their own projects. Of all employed professionals, 40% were under the age of 35 and had not been able to find a job for 14 months until that point

ciency began in 2016. According to the methodology of the IBI-Rating Agency [24], 5 areas were assessed, each of them containing 5 questions. At the same time, the Agency took into account the requirements of the current legislation, the principles of corporate governance approved by the Organization for Economic Cooperation and Development (OECD), as well as the recommendations of the relevant association – the Corporate Governance Professional Association (CGPA).

Standardization of business processes in enterprises is one of the attributes of the culture of innovation. Standardization of innovation activity is inextricably linked with standardization of related industries, namely Project management, ISO 21500:2012, Knowledge management, CWA 14924-1:2005, PAS 2001:2001, AS 5037-2005, Risk management, ISO 31000:2009

The following countries have made significant achievements in the field of development and implementation of innovation standards: Brazil (ABNT standards), European Union (CEN standards), Japan (JISC standards), Spain (AENOR standards), France (AFNOR standards), Great Britain (BSI standards), Germany (DIN standards) and Portugal (IPQ standards). In turn, ISO standards have combined the best practices.

The new version of ISO 9004:2009 «Managing for the sustained success of an organization – A quality management approach») is an international consensus on the relative management tools, use of which enables any organization to achieve sustainable success.

The ISO 14001:2015 standard, which sets out the requirements for an environmental management system, is one of the most recognized standards in the world and a key business tool for many organizations that consider their environmental impact [25]. Compliance with the ISO 14001:2015 standard involves the integration of environmental requirements into strategic decision-making for enterprises, creates significant opportunities for sustainable development, ensuring sustainable competitive advantages and attracting investors. The main benefits of ISO 14001:2015 environmental management system certification are presented in the *Tbl. 5*.

The new version of ISO 9004:2009 provides for changes in the environment and/or context of the organization that may require innovation to meet the needs and expectations of stakeholders (customers, consumers, business partners). The methodology consists of measures to: identify innovations; establish and maintain an effective innovation process; ensure provision of appropriate resources. The ISO 10018:2012 standard establishes the

Table 5

Benefits of Implementing an Environmental Management System

Benefits	Explanation
Formation of an ecological image	Availability of an environmental management system to identify and control the impact of the enterprise on it
Compliance to legal requirements	A framework to identify, monitor, and comply with various environmental requirements for business processes. Obeying laws and ensuring compliance. Informatization of society in relation to the definition and compliance to the legal, regulatory and contractual requirements. Socialization of the image and increase of authority
Improved cost control	Using an environmental monitoring system to identify, control, and reduce the number of environmental incidents that can cost the company the expenses of covering fines, cleanups, and reparations. An environmental management system is used to reduce costs by conserving energy and saving materials
Ensuring the improvement of business processes	The element of continuous improvement is an integral part of the requirements of ISO 14001, which helps an enterprise move from small to more significant improvements in all organizational processes. With the help of a set of systemic measures, a positive image of the company is formed, costs are reduced, opportunities are created for employees to find new and more effective ways to reduce environmental impact and save time and resources for the implementation of business processes
Knowledge, personnel turnover	Employees who are dedicated to improving the company are more involved in other aspects of the business. Given the choice between working for a company that cares about the environment and one that doesn't, most people prefer the former. Involving employees in group efforts to reduce a company's negative environmental impact often leads to increased employee concentration and retention. Thus, a system of motivation and involvement for staff training is created

principles of personnel participation in the implementation of quality management systems based on ISO 9001, and also recognizes the sequence of procedures in implementation: identification of opportunities («necessity is the mother of invention»); finding a connection between opportunities and proposed solutions; turning ideas into practical solutions; implementation of decisions.

The ambiguity of views on corporate social responsibility necessitates the definition of the relevant general principles of corporate governance, the implementation of which will ensure the expediency of managerial decisions and the effectiveness of their implementation when doing business in international markets. Such principles are generally recognized and widely accepted in the world standards and rules of corporate governance. Without their application, the free functioning of the investment market is impossible. The essence of these principles boils down to the maximum openness and fairness of corporate governance processes, the existing conditions for free access to relevant information for all participants in this process.

CONCLUSIONS

The main tendencies in the development of the world economy are the models of «circular economy», based on the provisions of the implementation of closed cycles of production processes, turnover and resource consumption, environmental protection, stimulation of the development and implementation of product and process innovations. The implementation of such provisions is impossible without active smartization and digitalization, the creation of digital platforms for business, and its relationship with consumers. The use of innovative technologies, from nanotechnology and genetic engineering to artificial intelligence, transforms all business processes, causes changes in global value chains. The use of these technologies can be traced to the best practices of high-tech leading companies. The most common phenomenon is the use of digital technologies, which account for 59% of all leading companies included in the ranking of the most innovative companies in the world, 28% and 13% are physical and biological technologies respectively. This fact is determined by the significant need for investment in the research, development and implementation of physical and biological technologies of 4IR, the need to comply with the requirements for operational changes in the production processes of innovative products. Companies that are aware of the impact of artificial intelligence become idea generators and clearly define priorities for investment, have competent personnel in the field of innovation and demonstrate a willingness to implement innovations. ■

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