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## **Transformation of Business Models in the Industry 4.0 and Digital Economy**

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Abstract: Digitalization forms a new type of economy. Over the past few decades, international corporations have faced various challenges: technological changes, increasing complexity of production, changing consumer preferences, etc. This has led to a transformation of business models: an increasing number of companies are using digital technologies in their operations. In the article, the authors study the stages of business models transformation and identify criteria for classifying "smart enterprises". The authors analyzed the process of digitalization in international corporations, identified their characteristics, developed a classification of enterprises in Industry 4.0 and digital economy, and provided examples for each type.

Key words: business model, digital economy, industry 4.0, digitalization, smart enterprise

Article:

A business model is a conceptual framework that supports the viability of a business, including its objectives and current plans to achieve them. All business processes are part of this model. The process of digitalization is a driver of changes in the corporate world, as it creates new technologies that have consequences for society. Digitalization changes business models of corporations and improves both productivity and the business as a whole.

Many of changes brought about by digitalization are disruptive and completely change existing realities. International corporations that have dominated the global market are facing new competitors that are redefining established industries, replacing established business models with new, more innovative and efficient models in the face of digitalization. The physical and digital worlds are increasingly intersecting, and it is necessary to work hand in hand so that manufacturing companies can also become digital (Industry 4.0)[10]. This can happen, for example, by integrating the Internet of things and services into industrial processes and creating value, by analyzing and managing data that can be used as a source of competitive advantage.

There are three ways in which digitalization affects a company's business models:

- 1) Optimization of existing business models (for example, cost optimization);
- 2) Transformation of the existing business model (for example, reorganizing existing processes, expanding the scope of a functioning business);
- 3) Development of a new business model (replacing existing traditional players in the market by offering new products/services).

The transformation of business models is mainly driven by changes in the form of new offerings (products, services, or solution packages in the form of cloud computing or predictive services). As the number of offers, such as service packages and solutions, increases, so does the relationship with customers and their loyalty. Relationships turn into long-term cooperation. In addition, in the digital economy, the scale of an enterprise's fixed assets is not an end in itself or even an obstacle, especially if they are expensive and outdated infrastructure [2].

The impressive growth in the number and volume of information databases and computing resources, combined with the digitalization of many business resources, creates opportunities in all industries and markets to commercialize new value by creating combinations of technologies.

Companies can rent or purchase the resources they need in order to save on costs. They have access to high-speed communication channels and other network resources, so they can regulate the scope of their activities without incurring the cost of maintaining their own infrastructure. To meet market demand and supply, they can rent a whole set of infrastructure services and thereby regulate the efficiency of their activities [9].

In general, the transformation of the company's business model in digital economy is carried out in four stages (table 1).

Table 1  
Transformation of the company's business model in digital economy

Level	Level	Description
1	Digital marketing	Marketing-focuses on such factors as customer experience in the production and marketing of products and services, obtaining information about competing companies and their products, and digitally integrating disparate communication channels into a single system (creating an omnichannel). The advent of social media offers companies more opportunities than ever to connect with a large, global audience than most media previously available. Performance indicators here are indicators of growth in the number of customers and the effect of return on the operation of the digital channel [3].
2	Implementation of artificial intelligence in management processes	The most important role in this area is played by integrated information systems with advanced analytics capabilities as a digital management tools. The criteria for the effectiveness of these measures are cost-effectiveness and risk management indicators. This allows companies to reach the next level of competitive advantage [9].
3	Digitalization of production	Companies transform production process, where repetitive, difficult, and complex tasks are performed by robots. The criterion for the effectiveness is not only increase in productivity, but also improving the quality of products as the human factor is eliminated [14].
4	Digitalization of business model	Companies begin to improve their business models. Due to this, develop the kinds of traditional and innovative industry competition, including improved value chains, establish partnerships in the digital ecosystem of partners, improved data analytics and competitive intelligence, digital platforms are formed [1]. These measures lead to an increase in the shareholder value of companies, which allows them to acquire new competitive advantages.
Note - Compiled by the authors on [1], [3], [9], [14]		

Digital marketing marked the start of business models transformation. Digital marketing has given businesses an advantage over traditional marketing, and this is reflected in international business as a whole. One of the main things that digital marketing is revolutionizing is the simplicity of business through localization. Apps, websites, and everything that is online can be localized. In addition, the potential of digital tools breaks down language and administrative barriers. Recently, the advent of digital and social media marketing has led brands to embrace global marketing at a much deeper level [5].

An important stage in the transformation of business models is implementation of artificial intelligence (AI) in management processes. Although the technology is still in its infancy, you can already see quite large examples of this in the everyday world. The integrated information systems (IIS) provides automation of business processes at all levels of management. Digital marketing requires modern management methods based on a marketing information system (MIS), which is used primarily to support decision-making, control and coordinate activities, and allows you to successfully apply the appropriate methods and tools [5].

Consumer expectations and the emergence of connected devices and platforms contribute to the continuous digitalization of production. While most production managers recognize the importance of this transformation, only 5% of them are satisfied with current digital strategies. In production, where repetitive, difficult, and complex tasks are performed by robots, not only productivity increases, but also the human

factor is eliminated, thereby improving the quality of products. At the same time, operators themselves spend less time waiting for products or filling out routine documentation, as information systems optimize the flow of materials and track key performance indicators.

Next step is digitalization of business models: the integration of marketing information systems with corporate information systems, external systems and information sources and the transition to marketing knowledge systems are the main trends in this direction. These systems allow you to monitor the state of the external environment and automate marketing business processes within the extended value chains that include business partners (suppliers, sales channels) and customers. Such systems serve as a powerful tool for supporting the decision-making process of the company's management staff. Thus, an increasing number of companies are using digital technologies to modernize their operations in order to manage productivity and improve efficiency. Database management systems, client-server platforms, and enterprise planning software are the main points of innovative implementations in organizations of various industries.

The authors summarize the impact of digitization on the companies' performance (table 2).

Table 2  
Impact of digitization on the performance of companies

Factor	Impact of digitalization	Effect
Time to enter the market	Integrated design Fast simulation	Reduced market entry from 20 to 50%
Balance of supply and demand	Creating product value based on Data-driven technology Demand prediction based on Data-driven technology	Increase prediction accuracy to 85% or higher
Inventory	Optimization of the supply chain in real time	Reduced inventory costs from 20 to 50 %
Quality	Digital quality management	Reduce quality control costs by up to 20%
Staff	Automation Digital performance management	Increase productivity by up to 50%
Note - Compiled by the authors [13]		

Depending on different levels of digital technology use the authors of the article propose a classification of enterprises in industry 4.0 and the digital economy (table 3). The authors used the case study method in their research. This method was chosen as a very popular form of qualitative analysis and involves an observation of international corporations' business models. The case study deals with the processes of digitalization in international business. The collected information about "smart enterprises" deepens the perception of digital technologies and gives a clear understanding of their impact on the transformation of business models.

The results of the study highlighted the main criteria for a "smart enterprise": data collection using sensors, connecting mechanisms to the Internet, storing data in cloud services, processing information based on big data algorithms, availability of human-machine interfaces and a digital platform. Based on case study analysis, the authors propose a classification of enterprises in Industry 4.0 and the digital economy. The classification shows the transformation from "Enterprises with elements of digitalization" to "Factory of the future".

Table 3  
Classification of enterprises in Industry 4.0 and the digital economy

Level of digital technology use	Concept	The use of digital technologies	Examples of enterprises
1	Enterprises with elements of digitalization	Individual digital solutions, robotization of production units, automation elements	Many leading European, American and Japanese companies

2	Digital factory	Using a complex of digital models, modeling tools, and 3D visualization	<p>1) Boeing, which has implemented a virtual platform for collaborative development of new aircraft, gathering collective expertise from more than 100 companies to work together, online or offline, to develop the best ideas and create a 787 Dreamliner that is more cost-effective and fuel-efficient [6].</p> <p>2) Samsung, which used virtual prototyping to build new hybrid converter systems and as a result improved development performance by more than 50 % [6].</p> <p>3) Bombardier Aerospace, which created a digital model of the plant and evaluated development and production scenarios before actual construction and equipment delivery began. Digital 3D models were developed with a focus on optimizing site loads, determining the best production rhythm, and staffing. The simulation reduced the size of the new plant by up to 50 % compared to previous standards, and improved productivity and quality through the detection of bottlenecks and errors [6].</p> <p>4) General Electric company, which installs sensors on manufactured equipment and connects them to a cloud platform, managing the operation of equipment around the world, as well as actively using 3D printing, which has reduced costs and improved product quality [11].</p>
3	Smart enterprise	Unmanned production based on digital models, artificial intelligence and flexible integration	<p>1) Cascade – the largest manufacturer of paper, cardboard and textile products, using the KepServerEX platform from Kepware and supports transparent communications across all 17 factories, several dozen paper machines and almost 90 lines processing on this platform, allowing you to exchange data with any of the machines in the production, where almost 500 PLCs are installed. As a result, Cascade improved its operational efficiency by 5 % and provided a foundation for future scaling of its new systems [6].</p> <p>2) Bosch group of companies, which creates a network production base for "Factory 4.0", intelligent equipment for smart factories in the pharmaceutical and food industries, and also offers a set of software developed by Bosch Software Innovations, which allows you to optimize the entire process of equipment maintenance [7].</p>
4	Virtual factory	Cyberphysical system, artificial intelligence, covering the entire product creation chain	Siemens electronic plant in Amberg, where 75% of production operations are performed by robots and computers, and big data and cloud services allow you to track all stages of the production cycle for each product[12].
5	Factory of the future	Customization and individualization of production	<p>1) Harley-Davidson, whose digital redesign allowed customization, reducing the production cycle from 21 days to six hours, which led to the fact that "every minute and a half the motorcycle came off the Assembly line, fully configured for its future owner" [15].</p> <p>2) Netflix, which switched to original and exclusive content, creating value for consumers who can't watch content elsewhere. In addition, as the company expanded its global presence, it focused on local language productions, catering to specific tastes of the country and region [8]. In 2018, the company</p>

			<p>spent \$ 8 billion on exclusive content. The result is not only a volume of content that is difficult to match, but also consistently high quality. Netflix is also increasing its capitalization due to new trends, namely the transition from television to streaming platforms. Consumers who are dissatisfied with the high price of traditional cable services and are willing to choose a cheaper alternative, such as Netflix. Netflix makes it easy for consumers to cancel a subscription, making initial sign-up easier. As narrow TV packages become more common, the price of Netflix is becoming more attractive as a primary service or add-on.</p> <p>Working with Amazon Web Services, Netflix can quickly deploy thousands of servers and terabytes of storage in a short time. Netflix has collected the most detailed data to better know its customers on a case-by-case basis.</p>
<p>Note - Compiled by the authors on [6], [7], [8], [10], [11], [12], [15]</p>			

As a rule, only by creating a production from scratch, it is possible to start immediately with the stage of a digital factory or "smart" enterprise, while changes in existing production occur gradually by introducing new technologies, management methods and digital systems.

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