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# Digital economy development with an emphasis on automotive industry in Russia

## Desarrollo de la economía Digital con énfasis en la industria automotriz en Rusia

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**ABSTRACT:**
The onset of the Fourth Industrial Revolution provokes a variety of changes, particularly in the economic sphere. The construction of a digital economy is a priority for the current stage of Russia's development. A new design paradigm in the conditions of the Russian digital industry formation is explored. Theoretical and practical aspects of this paradigm are presented. The purpose of the study is to analyze the national industrial sector current state in the context of the digital economy development. The first Russian example of using the technology of "digital twins" in design - the project "Cortege" - the development of a single modular platform and design of limousine, sedan, minivan and suv is considered. It laid the foundations of the digital industry within the emerging digital economy in Russia and demonstrated great potential.
**Keywords:** project «Cortege», digital twin, digital economy, Russian industry

**RESUMEN:**
El inicio de la Cuarta Revolución Industrial provoca una variedad de cambios, particularmente en la esfera económica. La construcción de una economía digital es una prioridad para la etapa actual del desarrollo de Rusia. Se explora un nuevo paradigma de diseño en las condiciones de la formación de la industria digital rusa. Se presentan aspectos teóricos y prácticos de este paradigma. El propósito del estudio es analizar el estado actual del sector industrial nacional en el contexto del desarrollo de la economía digital. Se considera el primer ejemplo ruso del uso de la tecnología de "gemelos digitales" en el diseño - el proyecto "Cortege" - el desarrollo de una plataforma modular única y el diseño de limusina, sedán, minivan y suv. Puso los cimientos de la industria digital dentro de la economía digital emergente en Rusia y demostró un gran potencial.
**Palabras clave:** proyecto de "Cortejo", gemelo digital, economía digital, la industria rusa.

## 1. Introduction

The Fourth Industrial Revolution is a new era in the development of mankind, characterized by the blurring of boundaries between physical, digital and biological technologies. There are artificial intelligence, the Internet of things, biotechnology, unmanned vehicles, 3D printing, nanotechnology, and quantum computers. The revolution will lead to systemic changes. In the opinion of K. Schwab (2016): "The nature of the changes taking place is so fundamental that world history did not yet know such an epoch - the time of both great opportunities and potential dangers". They will affect all spheres of business, economy, society, politics and will require new forms of organizing the work of the government and the private sector, in particular, new forms of production organization. P. Kidd (1994) believes that the modern production model can be viewed as a structure that is supported by three main resources: innovative management structures and organizations, a base of skills of experienced and authorized people, as well as accessible and intelligent technologies. Agile manufacturing (E.S. Balashova, E.A. Gromova, 2017; R. Dubey, and A. Gunasekaran, 2015; V. Hallgren, and J. Olhager, 2009; C. Larman,2004; R. Nagel, R. Dove, S. Goldman, and K. Preiss, 1991) becomes especially relevant in the context of the formation of the new Revolution. This model is able to solve the most urgent modern problems, which consist of uncertainty and rapid changes in business environment. Agile manufacturing is a strategy for achieving a sustainable development through adaptation to all challenges of the environment. One of the key enablers of the model is rapid prototyping (P.W. Balsmeier, W.J. Voisin, 1997; A. Gunasekaran, 1998; J. Sharp, Z. Irani, and S. Desai, 1999) which is relatively new class of technology used for building physical models and prototype parts from 3D computer aided design data by the concurrent engineering team. Now, in the modern high-tech industry, the emphasis in global competition is transferred to the design stage.

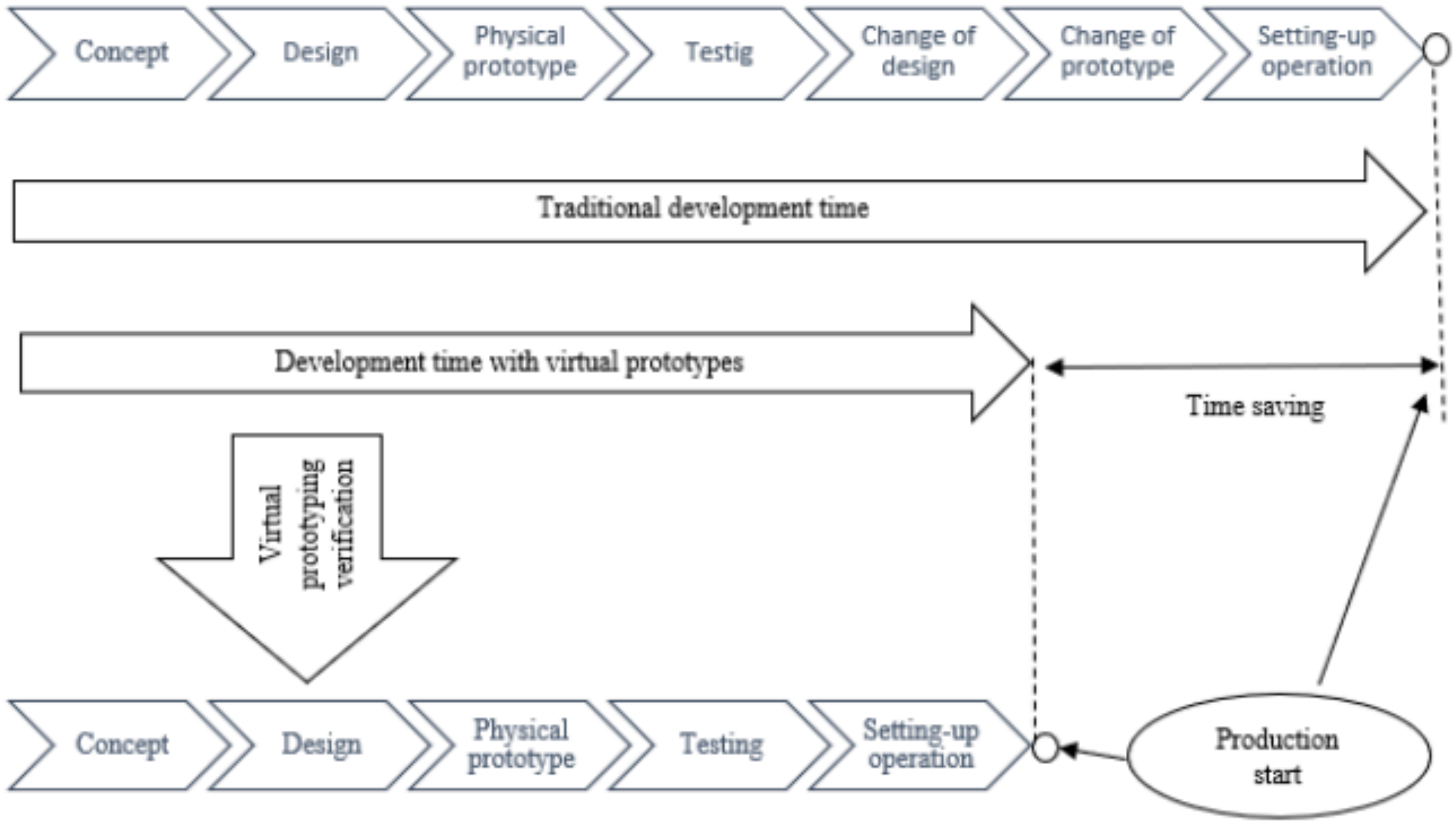
The theoretical and practical aspects of the new design paradigm in the framework of agile manufacturing are explored by many scholars. Among them the following scientists are highlighted: R. Nagel, R. Dove, S. Goldman, and K. Preiss (1991), P. Kidd (1994), A. Gunasekaran (1998), R. Dubey and A. Gunasekaran (2015), C. Larman (2004), V. Hallgren and J. Olhager (2009), J. Sharp, Z. Irani, and S. Desai (1999), P.W. Balsmeier, and W.J. Voisin (1997). The construction of the digital economy requires the use of modern advanced production technologies. Based on the studies carried out by the above authors, it can be argued that this concept has been widely used, both at the practical and theoretical level. Unlike the developed countries, it has not yet received significant development in Russia. That's why, the purpose of the study is to analyze the national industrial sector current state in the context of the digital economy development.

## 2. Method

The aim of modern production technology is to ensure the correct operation of the first part in the shortest possible time and in the most cost-effective way. As the complexity of the product increases and the competitive life cycle of the product decreases, the implementation and testing of physical prototypes become the main bottlenecks for successful and effective production.

Currently, there is no opportunity to save time and costs for manufacturing and testing physical prototypes to detect weaknesses and optimize design. Instead, "virtual prototyping" technology is used in design processes to reduce the costs and time of hardware testing and iterative improvements to the physical prototype. A virtual prototype is a computer simulation model of a physical product that can be represented, analyzed and tested as a real machine. Iterative change of the virtual machine model in the design process and implementation of design changes until performance requirements are achieved will significantly shorten development time and development costs. Advantages and opportunities for saving time by virtual prototypes are illustrated in the figure 1.

**Figure 1**
Comparison of the traditional design process and the design process with virtual prototypes, developed by the authors




If complex modeling capabilities are not available throughout the design process, the optimization of physical prototypes is often based on a trial version and an error based on past design experience, leading to an expensive and time-consuming development process. In the "virtual prototyping" approach, you can quickly analyze several design options to achieve the optimal prototype that best meets the requirements. The development of virtual design is provided by using high-performance computer technologies and software development tools. Virtual prototypes are useful not only for the design process, but also for virtual initial launching or modeling of operations on a digital model.

In recent years, initiated mainly by the automotive and aviation industries, the development of modern software tools for modeling product properties has significantly improved.

The appearance of «digital twins» has become a logical result of the development of the concept of digital production and the Industrial Internet of Things. «Digital twins» have become a very useful tool. They allow to improve maintenance operations and simplify the technical support of the product, save money, reducing the number of failures and extending the life of the equipment. It can be assumed that with the development of the Industrial Internet of Things, «digital twins» will become more detailed, and will work to maximize the return on investment in equipment and its maintenance, in parallel with this, stimulating product design improvement.

According to A. Borovkov, head of the center of computer engineering, in modern realities "the creation of a «digital twin» can ensure victory in the competition. This is now the most relevant topic for the creation of the digital industry within the digital economy."

An example of the machine tool in the company "Siemens" shows how far digitalization has progressed, and what advantages machine builders have. A virtual metal cutting machine can realistically simulate the control of an identical control on a real product. The results of this project were impressive: the deviation of this machine from its "digital twin" was less than 1%. The run-in time of the machine was reduced by more than 70%, and the productivity during operation was increased by more than 10%.

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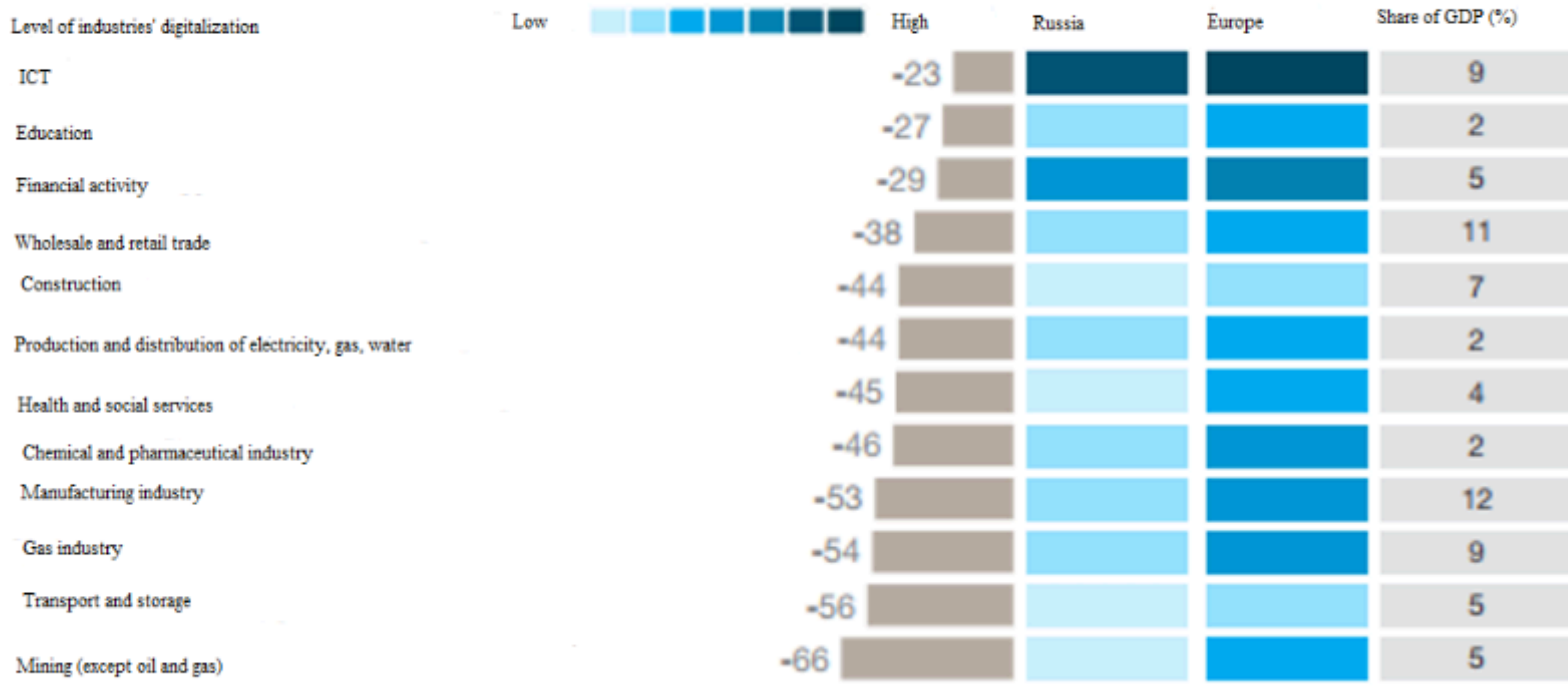
# 3. Results and Discussion

## 3.1. The current state of the Russian industrial sector in the context of the digital economy development

The digital economy is the basis of the Fourth Industrial Revolution. Consequently, the implementation of modern digital technologies in different fields of activity, primarily in industry, is a priority for the national economy development. Many efforts and actions need to be applied to the development of the digital economy in Russia (A. Bril, O. Kalinina, I. Ilin, 2017; V.V. Glukhov, I.V. Ilin and A.B. Anisiforov. 2015; I. Rudskaya, and D. Rodionov, 2017; I. Ilin, A. Levina, A. Abran, O. Iliashenko, 2017; T. Kuladzhi, A. Babkin and S.A. Murtazaev, 2018). For the first time the task of forming a digital economy was identified by the President of the Russian Federation V.V. Putin in his annual address to the Federal Assembly in 2016: "... launch a large-scale system program for the development of the economy of a new technological generation, the so-called digital economy". Approved by the decree of the Government of the Russian Federation of July 28, 2017, No. 1632-r, the Digital Economy of the Russian Federation program, guided by the "Strategy for the Development of the Information Society in the Russian Federation for 2017-2030" defines the main tasks and objectives. Russia has already begun preparations for a new industrial revolution: the state program "National Technology Initiative" aims to create conditions for Russia's global technological leadership by 2035.

Figure 2 shows the level of digitalization of Russia in the context of individual sectors of the economy, which clearly demonstrates the lack of investment in the development of digital technologies. Despite the fact that some industries are approaching the world level (ICT, education, financial activities), in many key sectors Russia is lagging behind the leading European countries. In terms of the level of digitalization, the most important industries for Russia – mining, manufacturing and transport-lag behind the European countries most. Currently, the level of digitalization of extractive and processing industries worldwide is relatively low. Advanced production technologies should change this situation. For our core industries, this is an opportunity to make a qualitative leap.

**Figure 2**
A comparison of the levels of digitalization in Russia and Europe, developed by the authors




Now one of the most important areas of "Technet" of the «National Technology Initiative», which is extremely in demand in the high-tech industry, are «digital twins». The term "digital twin" is used to describe a digital virtual copy that is created and developed simultaneously with a real system. This technology was first used in Russia for the implementation of the project "Cortege" - for the development of a single modular platform and design of limousine, sedan, minivan and suv. It was within the framework of this project that multilevel matrices of targets and resource constraints were developed, with about 50 thousand characteristics. At least 50 thousand virtual crash tests were conducted. This know-how in designing allowed reasonably to significantly reduce the volume of full-scale tests, which in the traditional design paradigm are used to finalize the product to the requirements, respectively, the test time and cost of production. Tens of thousands of virtual tests were performed and a «digital twin» was obtained, on the basis of which a prototype was made, which actually passed all the necessary tests from the very first. As a result, in June 2016 in Berlin sedan received the first time at an independent test site the highest score on passive safety.

### 3.2. The current state of the Russian industrial sector in the context of the digital economy development

"Cortege" is a platform developed by the Central Research and Development Automobile and Automotive Institute "NAMI" for the creation of domestic vehicles intended for the transportation and escort of the first persons of the state, as well as other persons subject to state protection. Cars are produced under the brand name Aurus (Aurum+Russia).

7 may 2018 V. Putin attended the ceremony of inauguration of the President of Russia on the limousine of project "Cortege". The length of the limousine is 6620 mm, it is the largest presidential car in the world. Under the hood 41231SB installed a 6.6-liter V12 with direct injection and dual system bicarbonate (actually the engine used four turbines). Engine power is 860 HP, torque is 1000 Nm. The prototype of this engine was shown at the international motor show in Moscow in August 2016. The engine is created by «NAMI», but according to the cylinder-piston group it is unified with the 4.4-liter V8 sedan EMP-4123, which was created in cooperation with Porsche Engineering.

The engine is aggregated with the 9-speed automatic transmission KATE R932 of Russian design. In addition to the "original" number of stages, the R932's feature is the lack of a traditional torque converter: the torque is transmitted here by means of four planetary rows. The absence of a transformer increases the efficiency of the gearbox, while smooth switching is ensured by short-time slipping of special friction elements. The KATE R932 box is capable of "digesting" the torque to 1000 Nm. The engine and the box are assembled by an electric motor, that is, the transmission is hybrid. The drive is full.

The volume of budget investments in the project "Cortege" reaches 12.4 billion rubles. Total investment in the project is estimated at 22-24 billion rubles.

By the end of 2018 it is planned to produce commercial vehicles for free sale. Limousines, sedans and minibuses will be manufactured at the Likino Automobile Plant (GAZ Group), and suvs will be assembled at the UAZ plant in Ulyanovsk (Sollers). In 2019, the release of the series "Cortege" should be up to 500 units. In the future, an increase in the number is planned, and the joint venture created by «NAMI» and Sollers will promote the brand. D. Manturov, the Minister of Industry and Trade of the Russian Federation, believes that the project has "good prospects for entering commercial lines".

## 4. Conclusions

Following the results of the research, it is necessary to draw the following conclusions:

1. the Forth Industrial Revolution has a huge potential to transform Russian industry, which was traditionally been considered quite conservative in the use of digital technologies;

2. rapid prototyping using advanced computer technology helps to reduce product development time and reduce non-value-adding activities at the development stage. This helps to increase the sensitivity of the entire system to customer requirements;

3. the creation of «digital twins» is one of the most promising optimization directions provided by the Forth Industrial Revolution;

4. the main achievement of the project "Cortege" is the creation and demonstration of the possibilities of a new design paradigm, the creation of a digital platform, a system of intelligent assistants, which, of course, opened the door to the future and provided a technological breakthrough, laid the foundations of the digital industry in the emerging digital economy;

5. for the first time in the history of the domestic automotive industry, all Aurus machines are hybrid cars. At the same time, the platform is designed so that in the case of creating the necessary infrastructure it can be reoriented to the assembly of already clean electric vehicles.

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