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Fifth industrial revolution

The concept of the Fourth Industrial Revolution (Industry 4.0)
The fourth industrial revolution (Industry 4.0) is the transition to fully automated digital production, controlled by intelligent systems in real time in constant interaction with the external environment, going beyond the boundaries of one enterprise, with the prospect of joining a global industrial network of Things and services.

In a narrow sense, Industry 4.0 (Industrie 4.0) is the name of one of the 10 projects of the state Hi-Tech strategy of Germany until 2020, which describes the concept of smart manufacturing (Smart Manufacturing) based on the global industrial network of the Internet of Things and Services (Internet of Things and Services) .

In a broad sense, Industry 4.0 characterizes the current trend in the development of automation and data exchange, which includes cyber-physical systems, the Internet of Things and cloud computing. It represents a new level of organization of production and management of the value chain throughout the entire life cycle of manufactured products.

Change of technological structures followed by a sharp jump in productivity and economic growth (industrial / industrial revolutions)

The first industrial revolution (late 18th - early 19th centuries) was due to the transition from an agrarian economy to industrial production due to the invention of steam energy, mechanical devices, and the development of metallurgy.
The second industrial revolution (the second half of the 19th century - the beginning of the 20th century) was the invention of electrical energy, followed by in-line production and the division of labor.
The third industrial revolution (since 1970) is the use of electronic and information systems in production, which ensured intensive automation and robotization of production processes.
The fourth industrial revolution (the term was introduced in 2011, as part of the German initiative - Industry 4.0).

Despite the active introduction of various types of infocommunication technologies (ICT), electronics and industrial robotics into production processes, industrial automation, which began at the end of the 20th century, was predominantly local in nature, when each enterprise or division within one enterprise used its own (proprietary) control system (or a combination thereof) that were incompatible with other systems.

The development of the Internet, infocommunication technologies (ICT), sustainable communication channels, cloud technologies and digital platforms, as well as the information "explosion" of data escaping from different channels, ensured the emergence of open information systems and global

industrial networks that go beyond the boundaries of a single enterprise and interact with each other. . Such systems and networks have a transformative impact on all sectors of the modern economy and business outside the ICT sector itself, and take industrial automation to a new fourth stage of industrialization. Components of Industry 4.0

Elements of the Internet of Things
Artificial intelligence, machine learning and robotics
Cloud computing
big data
additive manufacturing
cybersecurity
Integration system
Modeling
augmented reality
Many of these elements have been successfully applied in practice for a long time, but it is their combination into one integral system that will allow us to develop the concept of Industry 4.0 and provide a new level of production efficiency and additional income through the use of digital technologies, the formation of a network of suppliers and partners, and as well as the implementation of innovative business models.

A Cybernetic View of the Fourth Industrial Revolution
The prospects for the onset of the "Fourth Industrial Revolution", caused by a new stage in the development of technologies, were actively discussed in 2016-2017. What is its essence? What characterizes and what will the next round of progress lead to? Answers to these questions are provided by the material prepared for TAdviser by expert Leonid Chernyak.

The idea of another industrial revolution is not new, but the discussion of this topic has escalated after the Davos Economic Forum and the speech of the president of this business club, Klaus Schwab, in January 2016. The implications of Industry 4.0 have been the subject of discussion at various similar forums, including the St. Petersburg forum held in June 2017. Due to the specifics of such meetings, they discuss not the causes and driving forces (they are taken for granted), but the consequences, including global geopolitical, economic and social ones, as well as problems to be solved at the national level.

The point of view of the business elite is most fully stated in the document of the Swiss bank UBS "Extreme automation and connectivity: The global, regional, and investment implications of the Fourth Industrial Revolution". Unlike the mass of other popular publications, it does not contain excessive pathos and all sorts of subjective forecasts.

The same scientists and engineers who directly make this revolution usually profess purely technocratic convictions. For them, the revolution

is reduced to the sum of new, but already quite well-known technologies today: cloud computing, big data, cyber-physical systems, artificial intelligence (AI), 3D printing, the Internet of things and some others. An illustrative example is the article "The Fourth Industrial Revolution" in the Russian-language Wikipedia.

Both positions have every right to exist, however, for all their opposition, they are united by a common weakness - the lack of systemicity necessary in this case. The fact that this revolution, like any other, is an extremely complex and, we emphasize, systemic phenomenon remains aside. It cannot be viewed solely as a "black box" and as a future inevitability, reducing everything to reasoning about certain consequences, as politicians and economists do. And it is just as wrong to dissect the revolution into separate components, missing the dialectical connection between them,

which, in fact, creates an explosive synergistic revolutionary effect. This kind of public "bipolar disorder" is found in the authors of most materials about any revolution, from the Great French to the latest "colored".

From the history of the issue
According to one royal dressmaker, "everything new is well forgotten old." Surprisingly, many features of Industry 4.0 were quite plausibly predicted by Nikola Tesla. In 1926, in an interview with a correspondent of the then extremely popular magazine Collier's, he said, among other things:

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With the advent of wireless systems, the entire Earth will turn into one huge brain. We will be able to communicate with each other almost instantly, regardless of distance. Moreover, with the help of television and telephone, we will be able to see and hear each other as beautifully as if we were sitting face to face, separated by distances of thousands of miles; and the devices that will allow us to do this will be amazingly convenient compared to our phones today. A person can carry them in his pocket. We will be able to watch and listen to events - a presidential inauguration, a sports championship, earthquakes or battles - as if we were there. And when wireless power transmission is commercialized, there will be a revolution
In the 21st century, the "one huge brain" predicted by Nikola Tesla and devices that can be carried in your pocket are already a reality, but the great electrical engineer could not have imagined the emergence of such things as cybernetics and artificial intelligence, computers and computer networks.

Data is the new oil
If we analyze the specific features of all four industrial revolutions, we can identify a characteristic trend, namely, the constant increase in the importance of automation and control systems. This trend largely explains the specifics of the current Fourth Revolution.

To illustrate this statement, let's single out those three "pillars" on which any of the industrial revolutions stands, and see how their meanings are transformed during the transition from one historical period to another. These whales, in turn, are based on the achievements of fundamental and applied science.

So, the first whale is raw materials, as well as sources and methods of energy transfer, the second is technology, and the third is the organization of production and management.

At the end of the 18th century, coal and iron were the main raw materials, the main technology was steam and the conversion of thermal energy into mechanical energy. As for mechanization and organization of management, they, as such, were absent at that time, except that there was a Watt regulator on a steam engine. In the second half of the 19th and beginning of the 20th century, with the advent of electricity, opportunities opened up for the start of work on the scientific organization of labor, conveyors, and the ideas of Taylorism appeared. Somewhat later, works appeared on the theory of automatic control and various kinds of tabulators.

As a natural consequence of this process, cybernetics arose in the late 40s - a scientific direction specializing in control. In the sixties, with the advent of computers, technological and organizational management systems acquired even greater importance. At the end of the 20th century, the role played by control systems has become comparable to the importance of the technologies they control. Such technologies have appeared, the existence of which is simply impossible without automation.

This simple analysis shows that for more than two centuries there has been a continuous improvement in automation systems - from a centrifugal regulator to modern, computer ones.

The difference between the latest control systems of the era of the Fourth Industrial Revolution can be called quantitative. The sensory revolution, which began with RFID sensors, computer networks, media data collection and accumulation, and other technologies have made it possible for control systems to receive almost any information about the world around them. There is so much data that they are called Big Data.

Features of the four industrial revolutions
The response of society to the explosion of data can be compared to the counting of the Pirahã Indians in the rainforests of Brazil. They and

Only three numerals are used: one means "one or two", another means "several" and the third means "much more" or simply "a lot". Perhaps we should not talk about Big Data, but about data in general.

In the foreseeable future, data will occupy a significantly higher position in the economy than that occupied by hydrocarbons
More recently, in the 1990s, let's say at the level of relational DBMS, data was not considered as some kind of independent entity. Even experienced experts called data a "bag of bits and bytes", and if they thought about the fundamental difference between data and information, then only a few. In the 2000s, data was talked about as “new oil”. This expression was first used by the English mathematician Cliff Humby in 2006. In 2016-2017, analysts argue that in the foreseeable future, data will occupy a significantly higher position in the economy than that occupied by hydrocarbons. It is no coincidence that the term “data-driven” has come into use in the application to economics, programming, journalism, science and other areas driven by data.

“Data driven” involves making decisions based on data, not on intuition or personal experience. Simply put, the idea of "data-driven" arose when it became possible to collect data in sufficient volumes and analyze them to make objective decisions. Hence the passion for Big Data, various kinds of technologies for mining data and texts, and the like. By themselves, these data have no value, and the added value is obtained by analyzing them for the emergence of useful and consumable information.

The centerpiece of the new economy is Data Science and data scientists. Under the umbrella name Data Science, there are many different, not yet systematized methods and technologies for analyzing large amounts of data, and there is no true data science that could be called by this name yet. Data Science is nothing more than a generalized name for the sum of technologies for the production of data products.

Data products are familiar to everyone, first of all, from search engines - we consume search results without thinking about where, how and by whom they are generated. Today, selling content is becoming big business, the Internet contains a huge number of different kinds of data-driven applications, but all this is a passive use of data. Active data products can be called those where there are people involved in the process of creating such products, and there are technologies for their creation.

Data scientists perform four main tasks:

1. Converting the original "raw" data into a form suitable for analysis.

2. Actually data analysis.

3. Data interpretation.

4. Application of data to practice.

Unlike natural raw materials, when using data, their quantity does not decrease, but rather increases, which is a qualitatively new phenomenon. The creation of technologies for working with data avalanche-like forms the need for new technologies. The economy has never known such a phenomenon of positive feedback. By analogy with "electrification" and "computerization", they now speak of "datification".

Extreme possibilities and cybernetic approach
Even an average modern car speeds up to 200 km / h, that is, its power and dynamics are not restrictions for an ordinary owner. The main thing in it is safety, convenience, efficiency and the like. Roughly the same can be said about Industry 4.0 information systems. They are distinguished from the past by the absence of noticeable restrictions. They have extreme productivity (extreme productivity), providing extreme automation (extreme automation) and extreme connectivity (extreme connectivity).

Extreme performance is obvious. These are multi-core processors, in-memory computing, SSDs, clouds, big data analytics and everything else that makes up modern computer technology.

Extreme connectivity is understood as the conditions under which barriers associated with distance, time, or some other restrictions on the interactions between people and machines, people and people, machines and machines disappear. In essence, this process began in 1982 with the creation of the Internet running over the TCP / IP protocol, although the actual term internet, as an abbreviation for internetworking, was proposed several years earlier.

Much later, the term Internet of Things (IoT) was proposed, then the "industrial Internet" Industrial Internet of Things (IIoT), and more recently, in connection with the advent of blockchain technology, the "Internet of Value" (Internet of Value, IoV) and, finally " Internet of Everything" (Internet of Everyting, IoE). IoE connects people, data, processes and things.

Extreme automation is, first of all, the methods of artificial intelligence in all spheres of human activity - in business, in public administration and even in private life.

And. Note that we are talking about the so-called "weak AI", which does not imply the creation of "smart" machines that represent a danger to mankind - robots and the like.

Weak AI is a system that does not have a mind and computer mental abilities (Non-sentient computer intelligence). They are focused on solving purely applied problems. The most famous and accessible example of weak AI is the Siri (Speech Interpretation and Recognition Interface) question-and-answer system developed by Apple for iOS. This app uses natural language processing to answer questions and make recommendations. Siri adapts to each user individually, learning their preferences over time, but it's narrow in every sense.

Weak AI also includes work on automating driving, deep machine learning systems and natural language processing (Natural Language Processing, NLP). This should also include the Internet of things Internet of Things (IoT), machine-to-machine interaction (M2M), cyber-physical systems and some other things.

The combination of extreme connectivity with extreme automation on a foundation of extreme productivity opens up the possibility of creating large systems built on the basis of a cybernetic approach. Until now, the application of the cybernetic approach has been limited to technical systems. As for business or public administration, here decisions were made and are often made on an intuitive level, and computer systems, such as ERP, serve only as auxiliary tools.

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The cybernetic approach to business management, based on decision-making dictated by objective data analysis (data driven decision), will make it possible to get rid of the chronic disease of any management systems of any enterprises, for which there is a figurative name HiPPOs (Highest-Paid Person's Opinions, "decides by the one who gets more"). This decision-making rule is inherent not only in business, but also in any administrative systems where money is also accompanied by official positions. The optimality of such solutions in the overwhelming majority is questionable.

How to create a digital enterprise. 6 stages on the way to Industry 4.0
Read about what criteria a company must meet in order to consider itself a participant in the Fourth Industrial Revolution.

Propaganda myth or "sign of trouble"
The “Fourth Industrial Revolution”, for short 4IR, is positioned as a massive introduction of robotics and digital control technologies, which will reduce the dependence of industry on labor costs and give an additional impetus to the localization of the real sector. In fact, 4PR is a globalization and universalization of the principles of "distributed" production and access to finance. No more, but no less. And there is nothing fundamentally new in this approach: its key elements were tested back in the 1980s both at the production and management levels[1].

There is no new energy platform. We use roughly the same energy platforms as 30 years ago, and the advertised "alternative" energy sources are actually the most archaic (apart from the question of their profitability).
There is no new transport platform. Mostly technologies from the 1980s are used, even in the field of space exploration. Despite shifts in the social accessibility of certain types of transport (primarily high-speed transport), there was no strategic breakthrough. Reducing logistics costs is achieved mainly through organizational measures.
There was no mass introduction of fundamentally new materials. There are advances in the field of new materials and the creation of new properties for old materials, but nothing globally revolutionary is happening in practice.
There are no revolutionary changes in the field of energy efficiency of production. Although there are some, we emphasize, evolutionary shifts in reducing the energy intensity of social life, which, however, are not always adequate in terms of "cost-effectiveness".
Consider the principles of one of the key economic innovations of the 1980-90s - Toyota Production System. If we put aside the ideological and motivational part (“kaizen”), they mainly affect the service, logistics and management components of the production process. The principles of Toyota, in essence, are managerial post-industrialism, i.e. managing not so much resources as time and space, key components of the post-industrial world. This approach is absolutely consistent with the ideas of 4PR.
From a strategic point of view, the cumulative effect of the changes in the 1980s was greater. But they were not considered capable of changing the essence of economic relations. And the totality of these changes

was not seen as a globally catastrophic event that could bury the entire previous economic order. There are only prerequisites for the restructuring of some, but by no means all aspects in the functioning of the real sector of the world economy. That will inevitably have serious social consequences. But in itself it is not a revolution.

From the point of view of the strategic effect, the development of the "digital economy" and the 4IR are not so much complementary as mutually competing models for the further development of the

global economy. Especially from the point of view of points of withdrawal and models of redistribution of "investment rent". In the "digital economy", the key type of "production" is the possibility of generating "rent" from the investment "air". In 4PR, quite real resources and production remain the source of investment rent.
In fact, there is no real technological - and indeed economic - basis for 4PR, precisely as for a "revolution in industry" does not exist. There are currently only two aspects on the global “agenda” that can be considered truly “revolutionary”: new global logistics and new technologies for global finance.

But until the moment when the new logistics (the new Trans-American Canal, the Great Silk Road, the North-South transport corridor, the pipeline system bypassing economic limitrophes, the Trans-African transport corridor) starts to play a truly global role, another 5 years must pass. 7 years. Naturally, provided that opposition to these projects does not go into an openly forceful phase. In the meantime, the "new logistics" remains only a political and informational factor.

The only element of the 4PR, which in practice has a "revolutionary" significance, is the question of a radical restructuring of financial communications and financial and investment relations in the modern economy.

However, the main question arises: what is the focus object of investment processes in the course of the 4IR? Of course, at the initial stage, large investment resources will be required for the technological renewal of existing assets and for solving the inevitable social issues that arise in connection with this. And the first 5 years of the "revolution" can be quite investment-friendly, although socially extremely dangerous - and, probably, fraught with serious costs in the developed countries of the industrial world, where a relatively high standard of living and the preservation of the industrial structure of society are combined.

Industrialized countries make up a significant part of not only the developing world, but also the European Union, from Germany, where the structure of the economy corresponds to the industrial model even more than in Russia, and ending with Italy. Not to mention Poland or Spain. Instead of a division between the "northern" and "southern" flanks of the EU, a watershed appears according to the industrial/post-industrial criterion. And it can turn out to be much politically sharper and socially sharper.
On a time lag of 5-7 years, and in historical terms this is an extremely close prospect, there is a risk of a “bubble” forming, in which even the resources “extracted” from financial speculations will not be able to find economically viable assets for investment. After all, one of the most important positive circumstances of 4PR is proclaimed to be a fast and relatively comfortable system in economic and managerial terms, which allows for quick operational readjustment. The task of periodic complete renewal of fixed assets, the most capital-intensive element of the modern real sector, is leveled.

That is why the key component of the 4WP is not modernization as such, but the geographical cascading of technological processes, as well as the scaling of production depending on the size and dynamics of markets. And this, by the way, will be a big challenge for the post-Soviet space.

But then the system of calculating competitiveness, which is characteristic of both industrial and post-industrial capitalism, is no longer relevant. The basis is not efficiency, elevated within the framework of financial and investment capitalism to the rank of the highest value, but adaptability, the ability to quickly adapt to changing markets both qualitatively and quantitatively, accessible from the point of view of economically justified logistics. And this is a completely different picture, not only in terms of global issues related to the redistribution of technological and logistics rent, but also in terms of practical investment planning.

The question arises: where should the investment flow be directed? “In the first approximation”, the

following directions are seen as such:

Geographic mobility of assets. Compact uninhabited enterprises outside recognized and well-to-do industrial centers. A sharp decrease in requirements for logistics support. Transition to Lego assembly. In this case, engineering and adaptation of production to the needs of regions or macroregions (glocalization) becomes the main investment focus.
Basic technological solutions. key

a large technological rent will arise and be collected precisely at the level of basic technologies, as well as the development and production of key components, the contribution of which to the total cost of production may be small.
Human capital. Organization of social production (and not just production) space around the assets and social support and trade infrastructure 4PR. But the scale of this potential "investment area" is hardly too large - it will be necessary to equip the infrastructure of sales rather than production.
The proclaimed industrial revolution is almost a return to handicraft adaptive, customized production, but - and this is very important - with the removal of restrictions on access to investment resources and a sharp increase in the "connectivity" of technological and operational processes, which is achieved through the widespread use of "blockchain" technologies. » in addition to the financial sector. The “factory-industrial” model is losing the advantage of scale, which was already one of the key ones in the first half of the 2000s.

Even a superficial consideration of the issue of 4PR brings us to the conclusion: it is definitely not in the industry, but, first of all, in financial and logistical support. As well as the possibility of the final separation of the management link from the assets.

If we use the Soviet paradigm, then from the unchanged triad “director-party organizer-chief engineer”, oddly enough, the “party organizer”, whose function will be to ensure social stability in production, remains in demand within the new system. "Director" (not in the sense of position, but in the sense of function) can become an equally "remote" figure. Such as now is a "shareholder". And the “chief engineer” can be partially automated (diagnostics), partially outsourced (change of engineering solution).
And the very concept of "property" in the new economy becomes, at least, "mosaic". But if the property is "mosaic", then how much can we talk about preserving the traditional approach to investment? To what extent is it possible in principle to invest in property, the real beneficiary, which exists only in a “dispersed form” in the blockchain network? Is it possible to invest in such property resources that are liquid outside of virtual finance?

It is also important that the "investment cycles" formed in recent years in the global economy turned out to be burdened with a gigantic volume of investment derivatives and surrogates. Economic priorities with distorted market motivation began to play an excessive role. For example, stimulating investment in countries with high unemployment and cheap labor. Classic examples: Bangladesh, African countries, Pakistan, India. But it is worth remembering the industrial part of Latin America, a number of Asia-Pacific countries classified as "industrial" tigers.

We state: in the conditions of excessive “humanization of investment priorities”, it is extremely difficult to implement the principles of the 4IR. In order to successfully at least start the “fourth industrial revolution”, even in the systemically inferior form as it is currently interpreted, it will be necessary to dehumanize the investment, and then the operating space. Simply put, the 4IR operating space must become "socially irresponsible."

But then the ideal space for the “revolution” becomes the “investment wasteland”, where there is no depressing social and humanitarian burden.

For 4PR, it will be necessary to “clear” the space of previously established socio-economic obligations and reset the investment cycles formed over the past 25-30 years. Starting with the transfer of relations between the “conditional West” and China into the mainstream of exclusively economic competitive interaction. "China" is also a conventional concept, in which the PRC acts as the dominant center of a wider industrial space. Relations between the West and China constitute the key "investment cycle" in the modern economy, which has become too economically "cumbersome", acquiring various "political burdens". But it is impossible to "zero" this cycle without global consequences.

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Hence the question: is not the imposition of the idea of the imminence and inevitability of a new industrial revolution part of the preparation for a global investment default? And this is precisely what is hidden under the flowery term "revolution". After all, only after this default, after the inevitable (albeit temporary) regionalization of global finance, will it be possible to assess the consequences and prospects of the new situation not from the point of view of the 4PR slogans, which are attractive in themselves, but from the point of view of their real socio-economic content.

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