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Experience in the management of business processes with the use of digital technologies by Russian companies of a petrochemical complex

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Abstract. This article discusses the prospects for the introduction of modern technologies in the business processes of industrial enterprises in the framework of the fourth industrial revolution. The factors determining the vector of development of modern technologies are revealed. The classification of tasks of the enterprises of non-resource sector of economy under which high technologies of "Industry 4.0" are introduced is given. The article also considers the impact of modern technologies on the business processes of industrial enterprises in the context of types of technologies. The analysis of the data of industrial enterprises, which are part of the largest petrochemical holding of the Russian Federation for compliance of the implemented technologies with the tasks of the considered enterprises is given. The study presents data on the possibilities of modern technologies and the results of the impact of technology on the business processes of enterprises.

1. Introduction

Currently, there is a growing interest in the technologies of "Industry 4.0", the digital economy is destroying the usual models of industry markets, which in turn increases the competitiveness of their participants. The positive impact of digitalisation is to determine the growth prospects of industrial enterprises and industries in general.

The demand for oil and gas chemical products is growing rapidly among the branches of the non-resource sector of the economy. The consumers of petrochemical products can be found in almost all industries: construction, engineering, energy, agriculture, medicine, electricity, space, etc. The demand for petrochemical products continues to grow, and, according to experts, will increase fivefold by 2030. Petrochemistry is a link between the oil and gas industry, processing and high-tech industries. At the same time, the petrochemical complex is the basis for further technological development. In this regard, the enterprises of the petrochemical complex must meet the requirements of the market, which in the era of technological breakthroughs is shifting towards customisation of the industry, so the transition to industry 4.0 and deep end-to-end automation of all activities of the enterprise requires fundamentally new technologies that change the usual business models. [7, 8]

In addition, the high demand for industry 4.0 is due to the interests of stakeholders. The lack of funds at high costs for the development and implementation of innovative and technological solutions with an incomprehensible economic effect does not allow to use high technologies to the full in the operating activities of the enterprise. Thus, the main task of the fourth industrial revolution is the evidence base of the efficiency of digital transformation of production. For the present study, petrochemical enterprises belonging to the largest petrochemical holding of the Russian Federation have been selected, those which have applied new technologies in their business processes. New

technologies and their impact on the business processes of enterprises of the non-resource sector of the economy are the subject of the study.

The purpose of the study was to assess the impact of modern technologies on improving the efficiency of individual business processes of petrochemical enterprises. The achievement of the goal in the study required the formulation and solution of the following problems: to study the experience of industrial enterprises introducing modern technologies in the framework of the fourth industrial revolution; to identify the factors constraining the development and introduction of new technologies in the workplace and the factors contributing to the emergence of new technologies; to classify the tasks of enterprises of the non-resource sector of the economy, under which new technologies are introduced; to determine and classify the results obtained by the introduction of high technologies; to formulate the directions of the introduction of high technologies in the petrochemical industry.

2. Results and Discussion

As a rule, specific cases of using elements of "Industry 4.0." in Russian companies are discussed at specialised events (conferences, forums). One of the first Russian companies to embark on the path of introduction of "Industry 4.0" technologies is the group of companies of petrochemical holding - SIBUR. The level of technological equipment of the group's enterprises is currently one of the highest in Russia. The enterprises of the holding have already managed to reduce the cost of production due to automation, the level of which reached 84% last year. The holding implements such advanced solutions as advanced process management system (APC), production system (MES), laboratory system (LIMS), enterprise management system (SAP ERP), business process management system (BPMS). The holding was one of the first to introduce virtual reality (VR) technologies into the process of personnel training in repair, assembly/disassembly and maintenance of equipment. Employees of the group's enterprises begin to use mobile devices in their work, which contain information on the state of the equipment and current tasks. Data Science tools – online advisors and predictive Analytics - are also used in the holding to improve the reliability and efficiency of the equipment, identifying defects at an early stage and foreseeing the optimal set of parameters to optimise performance. Intellectual video surveillance, video analytics and technical vision system, allowing, respectively, to prevent emergency situations, analyse the environment and control the quality of products, are widely used in the company. Today, the holding company is studying the possibility of using wearable devices with telemetric modules – these can be "smart helmets" or bracelets that allow to track the location of the employee, his health status and much more up to the efficiency of activity [5.9].

On the other hand, according to experts, the impact of modern technologies on the improvement of business processes of industrial enterprises is different in terms of types of technologies and the period (at the stage of implementation and in the future), in addition, according to expert estimates, the larger the enterprise, the stronger the impact of digitalisation on business processes (table 1).

Table 1. The impact of digitalisation on the company's business process

Technology	The impact of technology on business process, %	The impact of technology on business process in future, %
Internet of things and automation of production	60	65
Digital design and modeling	58	55
Virtualisation technologies, remote access	57	67
Mobile technologies and cross-channel communications	55	60
Supercomputer system	42	50
Social networks	41	52

Big data and business analytics (BI)	38	34
Cloud technologies	36	48
Dialogue interfaces	34	41
Robotics	31	41
Additive technologies (3D printing)	31	43
Distributed registry technologies (Blockchain)	29	31
Artificial intelligence and machine learning	28	37
Virtual, mixed and augmented reality systems	22	38
Biological communication systems	22	31
Unmanned transport systems	21	31
Quantum technology	17	19

Source: built according to the data provided by NRU HSE (National Research University. Higher School of Economics)

The main technologies of "Industry 4.0" causing the greatest interest among the industrial enterprises of the chemical industry are the following (See table №2):

Table 2. Chemical Industry Trends in the use of "Industry 4.0" technologies

Name of the technology	Characteristics
Automation and robotics	Automated systems installed as software or hardware robots; features: work autonomously or collaborate with people
Sensors	Record physical conditions (machines, environment, etc.) and transmit data to make effective decisions
BIG DATA	Large amounts of structured and unstructured data
AI (Artificial Intelligence)	Intelligent devices replace people in solving problems, eliminating the human factor and make their own decisions
3D-printing	Additive technologies to enhance the technology and improve the condition of the equipment
IoT	A network of objects or devices equipped with sensors capable of collecting and exchanging data over the Internet.
Clouds	Data storage, access to data is possible to the set circle of persons from any location

Source: The Digital Transformation Initiative World Economic Forum 2017

In addition to the above given, there are technologies that are specific to petrochemical enterprises. Among them, the following are of particular interest [4]:

- Data Science - mathematical and algorithmic methods optimised for effective detection of complex patterns. This is a set of techniques and practices for solving advanced data analysis

problems, including: preparation (cleaning), modeling with the use of machine learning methods, evaluation and verification, visualisation;

- counselor "Overfitting the model to the column K-410" as well as counselor "Product Quality LDPE" - Recommender systems the "Digital Guide" feedback. It allows you to get an accurate forecast of production, quality, information on equipment failures, as well as get recommendations for further actions. In turn, the presence of such a forecast allows you to make effective decisions. The basis of predictive analytics are algorithms for statistical modeling of specific devices, which can significantly increase the profitability of production. This system, based on the accumulated data such as: the technical parameters of the workpiece, its processing, consumption of tools, materials, provides recommendations on the quality of the final product, energy efficiency and productivity;

- SAP-based ERP systems are a designer of interrelated modules for production process control. SAP ERP enterprise resource management system covers all areas of financial and management accounting, personnel management, operational activities and services of the company. Provides full functionality required for the implementation of self-service information services and SAP ERP analytics;

- corporate information system based on ERP (enterprise resource planning) methodology and aimed at achieving optimal business process;

- predictive monitoring "Compressor M-1" - a method of management of maintenance and repair using analytical models that are based on the analysis of big data to monitor the condition of the equipment to predict the occurrence of an emergency. Allows you to choose the optimal mode of operation of the equipment, promotes the transition from planned repairs to support based on its actual condition, to the increase of operation safety and cost reduction;

- Big Data - these are various tools, approaches and methods of processing both structured and unstructured data in order to use them for specific tasks and purposes. Huge amounts of data are processed to ensure that a person can get specific and desired results for their further effective use. It is becoming impossible to process large volumes of the heterogeneous and rapidly incoming digital information by traditional tools. The data analysis itself allows you to see certain and invisible patterns that a human cannot see. This allows us to optimise all areas of our lives-from public administration to production and telecommunications;

- APC - Advanced Process Control - is a wide class of automation systems based on various technologies and methods that allow to optimise the technological process. APC manages the installation in automatic mode in "real time", interacting with the basic regulation (regulators APCS). APC is a sort of "autopilot" for the processing plant but with a much more advanced set of optimisation functions. The" heart " of the APC is a mathematical statistical model of the process, which allows to predict its behaviour in the near future. Properly configured APC allows you to: optimally and consistently manage the TP; adapt to changing economic conditions; proactively compensate for disturbances; stabilise the process better than the operator does;

- mobile M&R (Maintenance and Repair) is an application for mobile bypassing of equipment that will eliminate the pile of paper logs, the need to search for the information about the work of previous shifts, will allow to quickly collect data about the equipment in the vicinity of the installations, as well as will show safety instructions at any time. The application for obtaining a digital work order-admission already has a wide functionality: it offers to choose the parameters of the work, to fix the scheme of the object, to tighten the activities and possible risks, to choose the responsible ones, to remotely agree on the tolerances from the abundant device;

- virtual reality is an augmented reality glasses that give the opportunity, considering all agreements, to receive consultation of the expert for hours, accordingly, reducing the time of repair;

- 3D- printing - this is the construction of a real object based on a 3D-model created on a computer. Then the digital three-dimensional model is saved in the STL-file format, after which the 3D printer, which displays the file for printing, forms a real product;

- drones, UAVs-unmanned aerial vehicles, their configuration depends on the industry of the company and the work performed by it: drones to collect information should be small and

maneuverable, as well as for warehouse accounting - they fly between the shelves, read the RFID-mark on the product or barcode from the box; monitoring of the assets of the enterprise: flying around the territory, it will record data on the number of certain objects, the area of sowing and the cultivated land.

These technologies are widely used in enterprises of non-resource sector of the economy and allow to solve problems related to improving the quality of products, document management, cost reduction, minimising various risks and losses, as well as to optimse the business processes of the enterprises under consideration (table 3).

Table 3. Compliance of implemented technologies with the tasks of business processes of enterprises

Enterprise	Implemented Technologies	Tasks covered by the Technology
OOO "SIBUR Tobolsk"	Automation of production processes, Projects Data Science; counselor "Overfitting the model to the column K-410"	improving product quality; reducing costs; decreasing the number of accidents; eliminating the human factor
JSC "SiburTyumenGaz"	SAP-based ERP systems	improving the quality of document management; minimising the burden on financial services; cost reduction; decreasing the human factor
LLC "Tomskneftekhim"	Data Science projects, Advisor "LDPE Product Quality"; predictive monitoring "Compressor M-1"; the project "Digital factory" (pilot): Big Data; Video analytics; Advanced Process Control (APC); mobile Maintenance and Repair (M&R); Virtual Reality (VR); 3D printing; medical gateway; drones	improvement of product quality; reduction of the cost of finding and training staff; decrease in the number of accidents; shortening the time of repairs and downtime due to them; elimination of the human factor; enhancement of security; increase in profit

Implemented technologies in industrial enterprises are an add-in to the business processes of the studied enterprises, covering a number of tasks, allow to eliminate their "bottlenecks". In turn, the main problem of "Industry 4.0" is the unproven economic effect of the introduction of technologies into production processes [5]. The degree of influence of technologies on business processes depends on the goals of the enterprise, on the complexity of the problem to be solved in the conditions of growing competition, on the solvency of the enterprise, on the interest of management in solving existing problems, on the physical condition of the fixed assets and innovative involvement of the enterprise, therefore, it is rather difficult to prove the economic effect of the introduction of modern technologies with the use of existing methods.

So, currently there are several methods for assessing the economic efficiency of IT projects in the enterprise: financial and economic; quality; probabilistic. The choice of specific methods for determining the effectiveness of IT projects depends on the specifics of the situation. There are no exact recommendations in this regard, as each project has its own individuality, the enterprise has its own specific goals. Therefore, what is so important for one company may not matter for another (table 4).

Table 4. Cost of introduction of new technologies, according to experts of the companies

The scale of the enterprise	Cost of implementation,

	mln. RUB.
Small market scale	1
A simple organisational structure, the small scale of the market	2
Medium enterprise	6
Large enterprise	10
Broad market coverage	150
Large-scale enterprise at the Federal level	1000

Source: built by the authors according to [6]

According to the table, the cost of implementing new digital solutions in the enterprise can vary significantly depending on the size of the enterprise and the complexity of its organisational structure. The analysis of the studied enterprises reveals the dependence of the improvement of business processes on the introduction of technologies.

3. Conclusion

According to experts, the projected results from the introduction of new technologies in the business processes of enterprises of the non-resource sector of the economy, depending on the scale and specifics of the enterprise tend to increase in the forecast period, as well as the growth of interest in technology (table №5).

Table 5. Potential results of the Industrial Revolution for non-resource sector enterprises

Application area	Opportunities	Result
Production Quality	digital quality management; advanced process control (APC); statistical process control (SPC)	10 – 20 % reduction in quality assurance costs %
Time to introduce the product to the market	fast modeling and experimentation; concurrent engineering; open innovation/collaboration with customers	reduction of time of introduction to the market by 20 – 50 %
Equipment operation modes	smart energy consumption; Informatisation of production; optimisation of equipment operation in real time	3 – 5 % increase in productivity
Loading of production equipment	the flexibility of the routing; flexibility in the use of equipment; remote monitoring and control; predictive maintenance; an augmented reality to maintain	30 - 50% reduction of equipment downtime
Efficiency and safety of labour	human-robot interaction; remote monitoring; digital performance management	45 - 55 % increase in productivity of technical functions due to automation of labour
Logistics	3D printing on site; real-time supply chain optimisation; optimisation of batch sizes	20 - 50 % cost reduction of storing inventory

Source: "Digital Russia: New Reality", July 2017, McKinsey, forecast to 2025.

The impact of new technologies on business processes can be grouped by classification criteria: reduction of logistics costs; reduction of document flow, optimisation of production processes. Among the main opportunities of digitalisation it should be noted: increase of labour productivity, decrease in risk of injuries of the personnel and probability of accidents, increase of efficiency of work of the equipment, increase of efficiency of decision-making, increase of satisfaction of clients and increase in sales volume, decrease in time of introduction of a new product to the market [1]. In turn, the implementation of these prospects requires the following measures: the development and implementation of long-term and comprehensive development programs in the field of digital technologies, activities to disseminate best practices and the formation of an innovative culture, monitoring of advanced technologies, knowledge accumulation, evaluation of economic efficiency, prototyping and piloting the most promising solutions, preparation of normative reference documentation for the implementation of the circulation of promising solutions [3].

Table 6. Factors impeding and conducive for the development of new technologies in the non-resource sector of the economy

Factors impeding the development	Factors conducive for the development
Resistance to changes in the company	State sponsorship
Lack of specialists	Reduced tax burden
High cost of solutions	Saving resources of the enterprise
The specificity of the climate (low temperature)	-

When implementing the above given measures, it is necessary to take into account the factors limiting the use of high technology in the non-resource sector of the economy (table 6).

The analysis of the studied objects shows the possibility of using new technologies in business processes, as they carry a high growth potential for business, but with due consideration of the conditions: the employment of highly qualified digital professionals, the integration of these technologies will require significant financial resources, due to the high cost of technology, as well as interaction with high-tech companies engaged in the development of the technologies under consideration.

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Preface

Papers