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Қ. И. Сәтпаев атындағы Қазақ ұлттық техникалық зерттеу университеті

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ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
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NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

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THE DIGITAL TRANSFORMATION OF THE OIL AND GAS SECTOR IN KAZAKHSTAN: PRIORITIES AND PROBLEMS

Abstract. The fourth industrial revolution precipitately spins up, including due to digital technologies, robotization of productions, the fissile introduction of cyber systems, development of the Internet of things. In the modern world, digital technologies play a more and more critical role in the development of the national economy of the countries. They have several advantages: simplification of access for the population and business to public services, acceleration of exchange of information, and the emergence of new opportunities for business, creation of new digital technologies, products. The main objective of the state program "Digital Kazakhstan" is progressive development of a national digital ecosystem for economic growth, improving the competitiveness of the economy and improvement population quality of life. According to experts, only digitalization of Oil&Gas sector will reduce manufacturing costs and accident rate, and increase the effectiveness of geological exploration, capital investments in production projects, decrease common threats. Digitalization of mines within the Digital Mine project will allow for cutting down expenses on 4%; considering marginality of the industry of 29%, the effect will be 12-26 billion KZT in 2025 and 23-40 billion KZT in 2018-2025.

Keywords: digital economy, digital transformation, Eurasian Economic Union, oil and gas sector, IoT, AI.

Introduction. Today the main agenda for the majority of the countries in the world, including the countries of the Eurasian Economic Union, is digital transformation and creation of hyper-competitive digital economy. An organizational and technological basis of the functioning of structures and institutes of the digital economy are digital platforms (for example, the IT platform on a basis a blockchain). An essential role in them is played by uniform IT architecture, uniform digital standards, IT safety and data protection. Digital platforms provide new levels of cooperation between the companies from different industries and spheres of the economy that leads to the creation of new products and services, new network communications and also new global chains of the creation of added value and obtaining network effects. In current conditions, the integrative distributed network platforms characteristic of new neural network technological way are created.

"The digital agenda" of the Eurasian Economic Union is important for the dynamic development of the digital economy in the Eurasian economic space. Successful implementation of the digital agenda and the national projects "Digital Economy" in the countries of the Eurasian Economic Union is crucial for improving the competitiveness of the countries of EAEU in the world markets in the conditions of strengthening of innovative global hyper-competition.

The Eurasian cooperation within implementation of the Digital Economy of EAEU and Digital Eurasia programs is directed to the creation of conditions for the emergence of breakthrough and perspective through neuro and digital technologies and platforms, including technologies of wireless communication, biometrics, the virtual and complemented realities, artificial intelligence, the electronic government, network safety which use is intended to provide realization of competitive advantages of the countries of the Eurasian economic space.

The digital agenda of the Eurasian Economic Union was initiated by the decision of the Supreme Eurasian economic council of December 26, 2016 No. 21 "About the formation of the digital agenda of the Eurasian Economic Union." The digital agenda of EAEU includes a circle of questions, relevant for EAEU, on digital transformation within the development of integration, strengthening of common economic space and deepening of cooperation of state members in the digital economy.

Adoption of the document "The Main Directions of Implementation of the Digital Agenda of the Eurasian Economic Union till 2025" who were approved as presidents of the countries of EAEU at a meeting of the Supreme Eurasian economic council of EAEU in October, 2017 in the Sochi became an institutional and legislative basis for implementation of the Digital Agenda of EAEU. As the initial task development and carrying out the policy coordinated with the countries of the Union in the field of development of Internet economy, the formation of the general rules of digital trade, uniform standards of exchange of information and ensuring its protection is defined. The main directions of Digital Agenda include: digital transformation of the branches of economy and cross-branch transformation; digital transformation of commodity markets, services, capital, and labor; digital transformation of processes of management of integration processes; development of digital infrastructure and ensuring security of digital processes.

The digital agenda of EAEU is a comprehensive program of digital transformation. It means improving the competitiveness of EAEU from through digital technologies and digital platforms; it is new cooperation, only in digital measurement. In total six initiatives are approved. Among them: digital trade, digital transport corridors, digital industrial cooperation, and agreement on a turn of data, the system of regulatory "sandboxes." The Eurasian economic commission created a digital design office of EAEU which will estimate and advance the offered integration projects of EAEU in the field of the digital economy. Digital transformation represents the high-quality, revolutionary changes consisting in digital transformations in a fundamental change of structure of the economy, in a transfer of the centers of the creation of added value to the sphere of forming of digital resources and through digital processes. An important initiative is the creation of the uniform digital platform of EAEU. The digital platform represents the system of means, the possibility of their direct interaction supporting the use of digital processes, resources, and services by a significant amount of subjects of a digital ecosystem and providing. Integration of digital infrastructure of the countries of EAEU which assumes not only the introduction of uniform standards but also the general management of infrastructure, the formation of full-fledged digital transport corridors is essential. Also within EAEU, it is supposed to include three critical elements in digital integration:

The EAEU of Data X is a uniform subsystem of transfer and data exchange in electronic form. It is the platform which can be used for the exchange of information, and eventually – for the exchange of legally significant protocols between private companies;

The EAEU of ID is right space of electronic trust. It includes services of identification, authentication, authorization, digital archive. It will allow issuing, for example, references to citizens of one country in the territory of another in a digital format;

The EAEU of Geo is a geographic information system and services of a cartographic basis which promotes simplification of control of transportation and traceability of goods.

Problem Statement. According to calculations of the World Bank, implementation of the common digital agenda till 2025 will bring an additional gain of cumulative GDP of EAEU to 1% a year and also 8 million jobs and economy on expenses for the business of 50 billion dollars.

In the long term institutes of the countries of EAEU are faced by a problem of creation of the Eurasian digital ecosystems and also participation information of global standards and regulations in the world digital markets.

At the beginning of 2017, the President of Kazakhstan Nursultan Nazarbayev set the task of carrying out the third modernization which core is digitalization. In Kazakhstan, the state program "Digital Kazakhstan" which was accepted and approved in December 2017 was developed. Its main goal is to provide acceleration of national economy and improvement of population life quality by digital technologies.

In the short term projects on digitalization and technological modernization of the existing branches of economy, government institutions will be implemented, to develop digital infrastructure. In the long term, the program is aimed at "creation of the digital industry of the future." It has to provide long-term

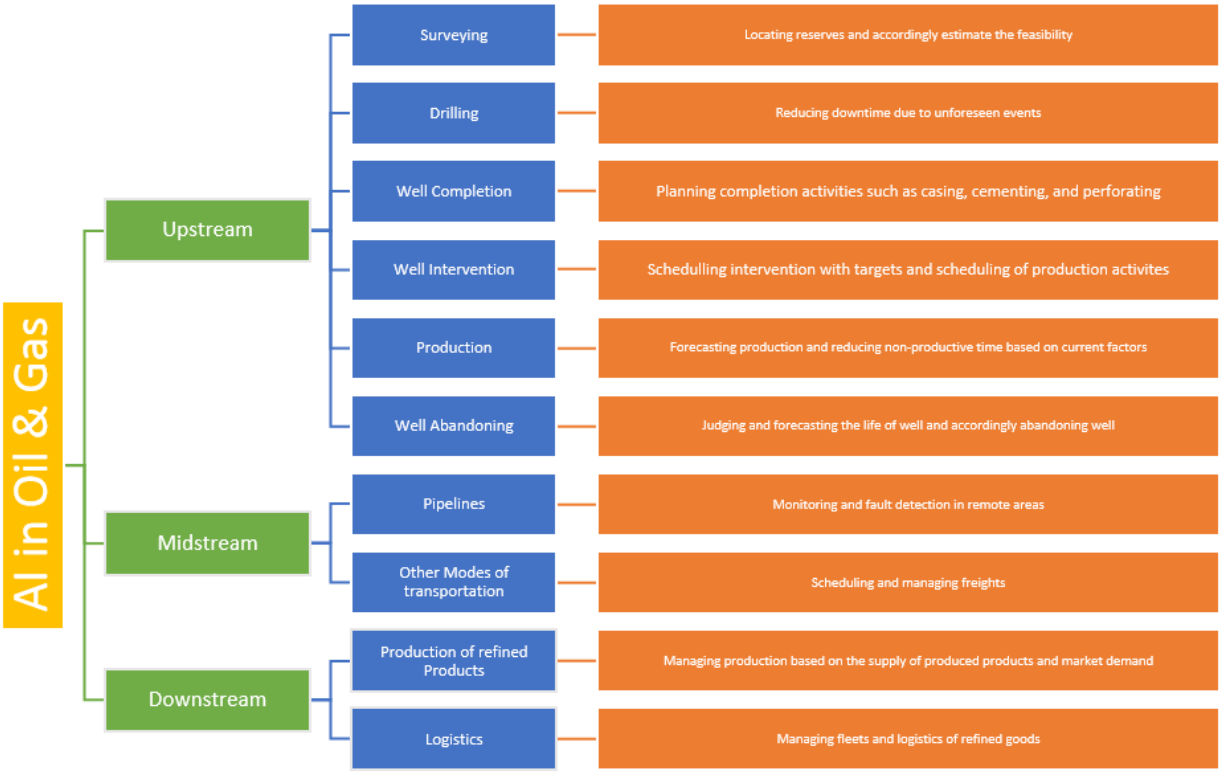
stability and start of the digital transformation of the country due to increase in the level of development of the human capital, creation of institutes of innovative development and in general progressive evolution of a digital ecosystem.

Realization of "Digital Kazakhstan" will be carried out in five key directions: digitalization of the branches of economy; transition to the digital state (concept of the SmartCity); realization of a digital Silk way; development of the human capital; creation of an innovative ecosystem.

Data Analysis. KazMunaiGas creates a new operational model, where the number of top manger will be decreased and process models will be developed for back offices. Projects are divided into two parts which include methodology and automation. According to Salov, digitalization is impossible without structural, organizational changes in the company. It is impossible to achieve results only at the expense of information systems if not to reconstruct business. The main objective is achievement that the share of processes which would be carried out using information systems equaled to 80 percent. One of the aims which the Kazakhstan oil industry workers pursue during digitalization to increase a between-repairs interval up to 600 days, now this indicator is 140-250 days. The community of engineers in an oil and gas complex defines digitalization so: it is not difficult, but it is difficult because each direction in an oil and gas complex creates digital filling in the industry which has to be used. The strategic resource of the oil and gas industry is smart technologies (IoT).

According to experts, only digitalization of Oil&Gas sector will reduce manufacturing costs and accident rate, and increase the effectiveness of geological exploration, capital investments in production projects, increase in oil recovery. Oil has various components: upstream (exploration and production), midstream (possession transport and storage of oil and gas) and downstream (oil refineries) – and AI can assist in helping in each area from advances in sensors and software to managing large amounts of collected data.

According to Markets and Markets research, Artificial Intelligence ("AI") in the oil and gas industry is expected to grow from 2017 to 2022 (USD 2.85 Billion). This growth is due to the adoption of big data technology, digitalizing the oil and gas industry through adopting a variety of predictive algorithms, analytics, automation systems and more. In 2016, ExxonMobile collaborated with Massachusetts Institute



Retrieved from https://bigdata-madesimple.com/is-ai-the-solution-that-the-oil-gas-industry-needs/

Figure 1 – AI in Oil and Gas sector

of Technology ("MIT") to create "self-learning, submersible robots for ocean exploration." These robots have the ability to detect natural seeps in the ocean floor. According to National Geographic, these seeps, or leakages, occur "when oil escapes into the water column from highly pressurized sea floor rock." Other oil companies such as Royal Dutch Shell ("Shell") are incorporating virtual assist features.

Creation of digital oil and gas innovations and technologies is generally bound to Hi-Tech ideology. The ecosystem of digital oil and gas economy is based on digital collecting and transmission of the geodata coded in discrete alarm impulses. Digitalization of collecting and transfer of geodata will be a key factor in the development of digital oil and gas production.

According to McKinsey, IoT has a total potential economic impact of 3.9 Trillions to 11.1 Trillions (USD) by the year 2025. With a potential economic impact of 930 Billions (USD) from mining and O&G companies within the next ten years, it's no surprise that the O&G industry is interested in leveraging IoT.

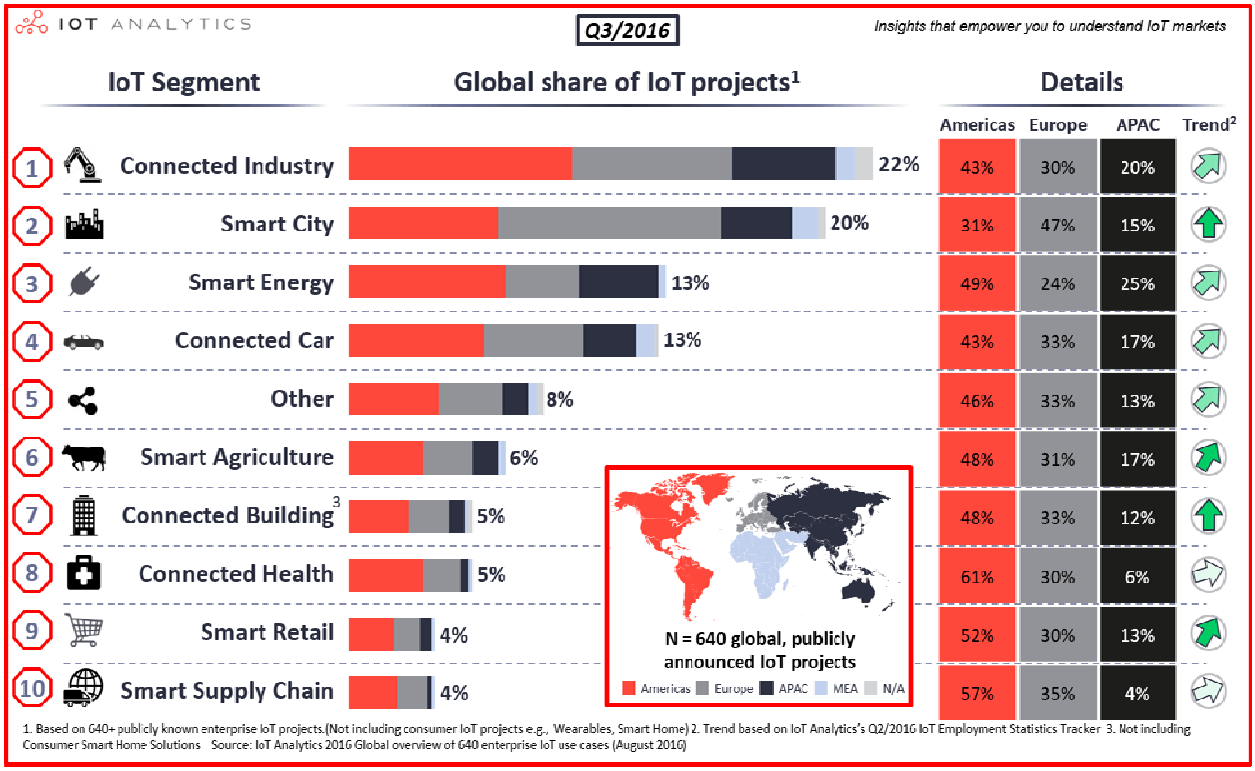


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Figure 2 – The top 10 IoT application areas

In fact, IoT applications in this industry are predicted to increase GDP by as much as 0.8percent, or $816 billion, over the next decade. That's why 62% of oil and gas CEO' priorities include digitalization.

The Internet of Things (IoT) in the oil & gas industry is the network of physical objects connected to the Internet. Wearable devices, vehicles, equipment, buildings, and just about any other thing can be embedded with electronics, software, sensors, and network connectivity. The ability to transfer data without requiring human interaction enables previously unprecedented amounts of data to be collected and exchanged with other devices, or through a central platform. Increasingly, forward-thinking oil & gas organizations are focusing their IoT initiatives less on underlying sensors, devices, and "smart" things and more on developing bold approaches for managing data, leveraging "brownfield" IoT infrastructure, and developing new business models.

Benefits of IoT in Oil&Gas sector are better field communication, reduced costs of maintenance, real-time monitoring, digital oil field infrastructure, reduced power consumption, mine automation, greater safety and security of assets, and thus higher productivity.

IoT will improve energy efficiency, remote monitoring and control of physical assets, and productivity through applications as diverse as home security to condition monitoring on the factory floor.

Benefits of IoT in Operational Excellence:
– Predictive maintenance.
– Pipeline and equipment monitoring.
– Location Intelligence.
– Emissions monitoring and control and release management.

Predictive maintenance is performed based on the current condition of a piece of equipment. For example, if a coil is running too hot, its failure is imminent and requires a technician to diagnose the cause. Predictive maintenance allows O&G companies to leverage the remote monitoring of equipment through sensors to make important decisions about whether or not something needs to be shut down, fixed, replaced, etc. Sensors that collect data send companies an alert when machines need to be maintained, preventing expensive equipment failure, wasted money, and manpower.

The upstream service (geological discovery and drilling) is area of high risks. IoT helps to prevent the major risks because they based on near-real-time data. That fact decrease non-productive time (NPT) and increase a company profit.

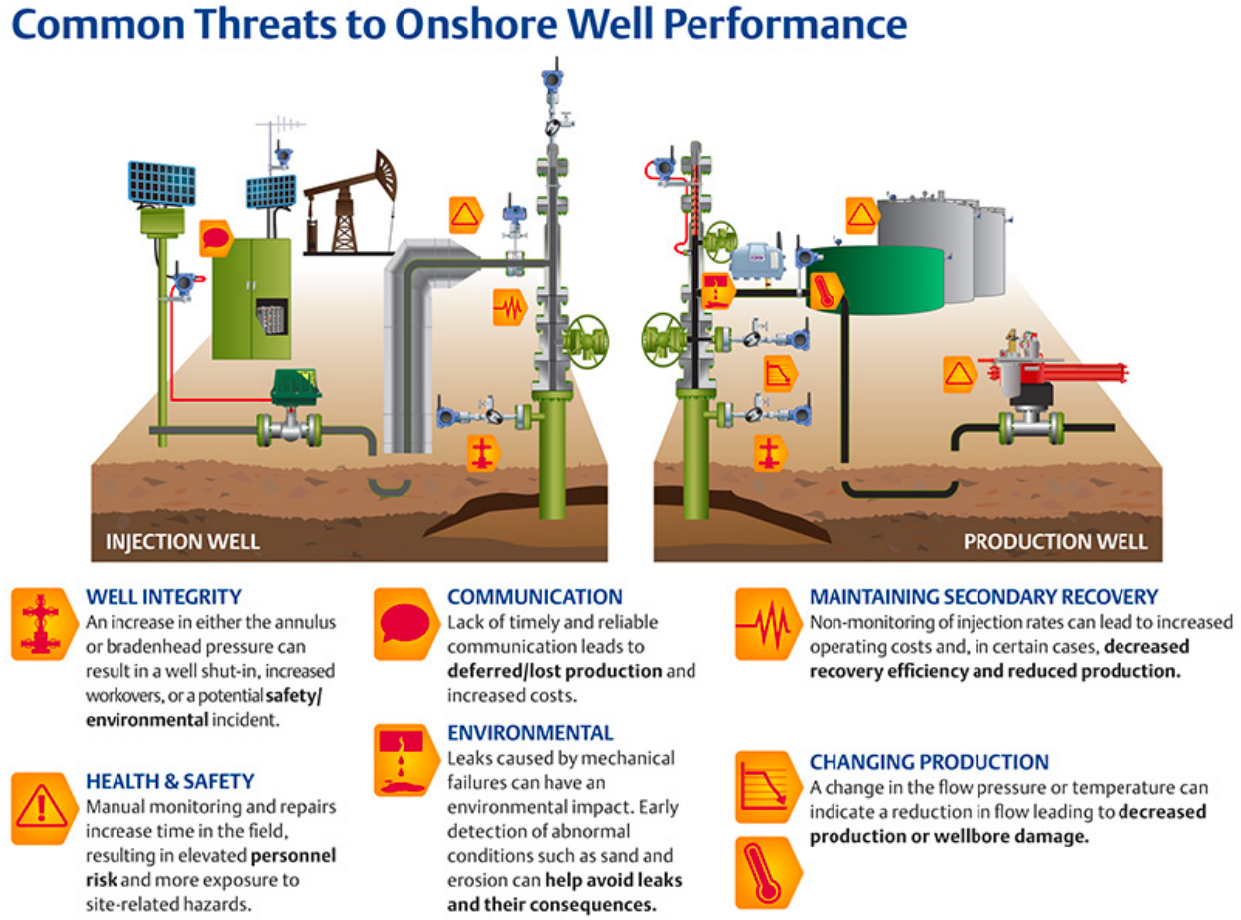

Figure 3 – Main Problems in oil and gas sector

The majority of O&G facilities need to be monitored on a regular basis. This is possible through remote services that allow facilities to react to problems through predictive maintenance. With tank levels' pressure and flow rates monitored daily along with various other controls, these machines are not exempt from wear and tear and often need regular service.

Benefits of IoT in Operations:
– Real-time machine and sensor integration.
– Real-time alerts.
– Link to enterprise resource planning data to trigger maintenance workflow.

– Plant dashboards and trend analysis.
– Asset information network.
– Fleet operations monitoring.

With the O&G industry under constant pressure to improve safety and operational results and to produce significant returns, asset tracking, and equipment monitoring have become the fastest growing wireless sensor network oil and gas IoT applications. Due to oil's dramatic price volatility, companies are spending more time analyzing their investments and internal operations to see where reductions or changes can take place while still maintaining the business and maximizing asset utilization.

Asset management is one of the core areas in the industry that can significantly influence operational performance. Operation productivity can be improved by optimizing production and making production more predictable through enterprise asset management (EAM).

With asset tracking, assets are integrated into one unit to enable companies to digitally transform their operations and monitor multiple wells or sites simultaneously. For instance, a single pump failure can cost a company as much as $300,000 and a lost day of production.

IoT sensors can monitor key pipeline equipment more accurately and cheaply. It can allow companies to survey potential drilling sites and point out the exact location for a pump and filter replacement refining the process and provide greater insight. Additionally, the use of sensors permits oil companies to monitor a large number of processes along with inventory and oil and gas shipments.

According to PWC Company digital transformation will include the following trends:
– Touch devices.
– Integrated Center of Operating Control (ICOC).
– Drones for observation.
– Request for rendering oilfield service services (NSU) in real time.
– Analysis of data in real time.
– Intelligent devices.
– 3D-printers and drones for delivery.

By means of touch devices on drilling rigs, wells and installations of a system of collecting and preparation it is planned to carry out detection of the abnormal temperature changes, pressure and an expense.

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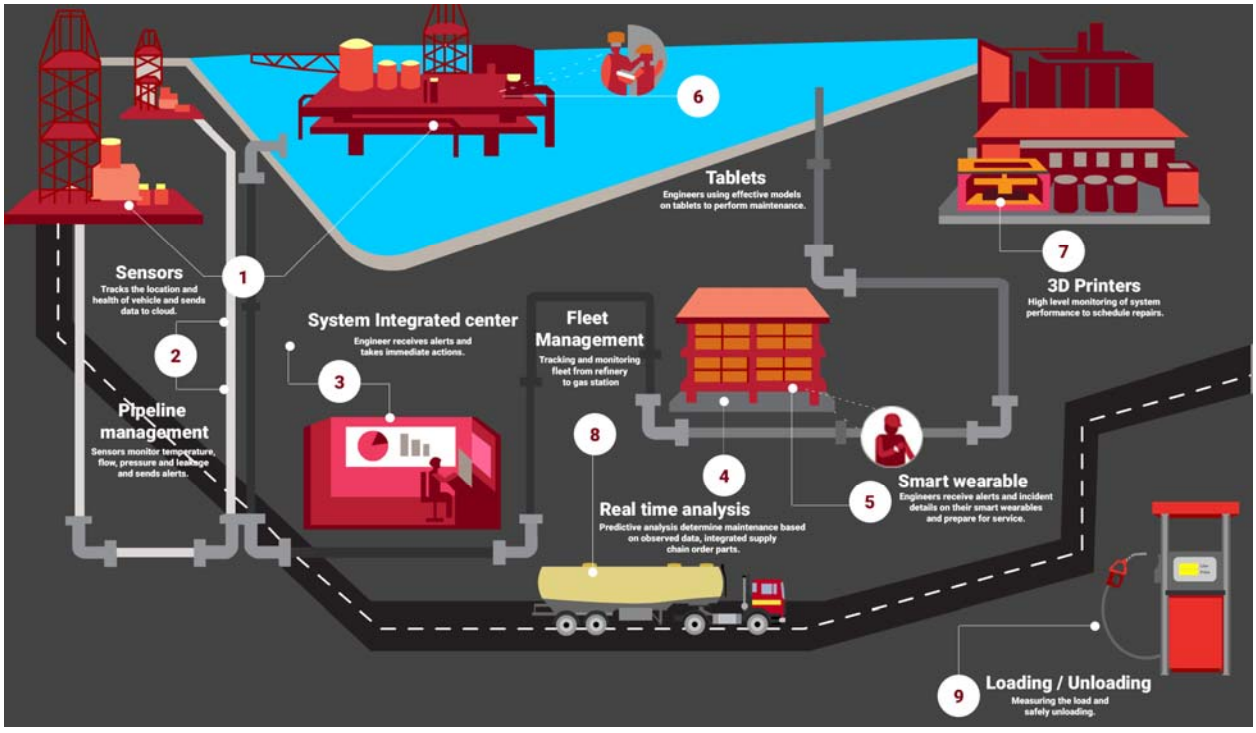

Figure 4 – Fixation of Problems by Smart Technologies

The specialist of the center of the integrated operations (CIO) in the critical situation will receive warning sign and begins to conduct diagnostic testing by an interactive or virtual three-dimensional model. The air drones examine the offshore drilling rig, the external systems of collecting, preparation and transport of products and in real time transfer pictures and video records to CIO. CIO engineers define the need for concrete services and create an inquiry for suppliers of oil and gas services. The most welcome offer is accepted in real time. So the company can order necessary equipment as a result of monitoring. The workers and engineers obtain warning signs and information in case of trouble on mobile devices. That will help to prepare in real time replacement of broken detail by 3D printer. The oil gas sector employees usually need a particular time to reach a place of destination. With the digital mobile operator, they will have direct access to the recommendations of experts, online to information and an opportunity to print on the 3D-printer small details in place.

Global Reach

IoT is removing the physical barriers so O&G companies helping reach broader target audiences and opening up new global business opportunities.

O&G sites aren't typically found next to your local grocery store. The majority can be found in dangerous and remote locations that are not conducive to the health and safety of neither workers nor the planet. Reservoirs can be submerged to depths of up to 3,000 meters offshore and rigs may be far offshore, sitting near faultiness where dangerous circumstances could happen at any time.

Discussion. Smart oil and gas complex should be oriented (table 1) on a significant increase in labor productivity, a significant reduction in labor and material resources, a decrease in capital and operating costs, leveling of anthropogenic impact on the environment.

Table 1 – The advantages of using digital technology

Indicators	Traditional	Digital	Smart
Growth of upstream service, %	1.0	4.0	10.0
Increase in oil reserves, billion tons	5.0	10.0	15.0
The cost for automation, %	0.5-1.0 or 0.75	1.0-2.0 or 1.4	2.0-4.0 or 3.0
Reducing cost of upstream service	2.0	5.0	15.0
The growth of Labor productivity, %	1.0	5.0	10.0

The most important task that the oil business wants to decide with using digital technology - this increases the degree of extract 's oil resources: they provide an opportunity not only to concentrate huge amounts of data on the state of oil fields but also to use them in complex decision-making models for optimizing oil recovery for each particular borewell. To do this, the main production structures (including platforms, wells, pumps, pipelines, compressors and etc.) combine with using telecommunications at single system what allows in a quasi-continuous mode to monitor all technological processes of exploration and production.

The list of breakthrough digital innovative technologies of oil and gas production:

1. Field of intelligence in development time - passive borewell monitoring.
2. Field of drilling - drilling systems without the Badger Explorer drilling rig.
3. Field of development - smart flooding, fiber-optic development monitoring systems, giggling modeling.
4. Field of production - smart borewell, bionic borewell.
5. Field of environmental protection - real-time environmental monitoring .

According to experts, the latest digital technologies are most important for the oil industry, based on which they are possible:

– Remote telemetry. Smart digital sensors located at significant distances from control points allow seismic exploration of productive horizons and gravity surveys, electromagnetic monitoring, and measuring surface geophones and geophones in wells. The small increase in the accuracy of seismic prospecting methods in the productive horizons of an oil field will increase the recovery of residual oil reserves by 3–7 %.

– Visualization. 3D format interpretation of large and complex arrays of data helps groups planning development of oil fields to optimize the location of the and well directed but also minimize errors in time and depth of penetration, accelerates the rate of production and reduces costs.

– Rational sinking and its completion. Real-time drilling data from the deep seabed helps engineers avoid many technological mistakes. So, sensors of low temperatures, pressure, and other parameters allow you to optimize the productivity of new horizons, reduce the negative impact of various impurities, identify water breakthrough zones, etc.

– Automation. The widely used technologies of remote monitoring and control make it possible to automate data collection, as well as reduce the number of production personnel. Modern technologies to optimize production and forecasting significantly improve the characteristics of production processes and help prevent potential accidents.

– Data integration. Combining collection systems and data management about productive horizons, well condition and the entire technology allows exploration and mining organizations to make effective decisions. It opens up the possibility to further analyze the current situation, develop an optimal management strategy and reduce the fixed costs.

The organization of the management of oil production from remote centers through electronics means not only improving mining technology or increased use of digital technology but also changing the right direction in which the processes of oil production have so far developed.

Conclusion. Technology is disrupting the status quo in the oil and gas industry. AI and robotic solutions can help us create models that will predict behavior or outcomes more accurately, like improving rig safety, dispatching crews faster, and identifying systems failures even before they arise. As a result of the implementation of the Digital Kazakhstan program, taking into account the above approaches, the following planned indicators can be achieved by 2021:

– the number of Internet users - 81 %;

– the level of digital literacy of the population - 81.5%;

– labor productivity growth in ICT - 5.9 %;

The oil & gas industry is on way to understand the potential of digitalization (IoT and AI). The collaborative usage of predictive and edge analytics for various processes in the industry can lead to safer and efficient operations. It's well known fact that information controls business. Most of potential investors see as main risk of O&G in cybersecurity.

A secure browser platform has intrinsic functionalities in terms of knowledge collaboration once connected to big data database. The collaboration is at multiple level, internally and externally. Internally by creating a workspace shared by a team and linked to the main database through publish/synchronize action, the ability for every user to share the same workflows and results. A services companies has a strong interest in developing plugins that his clients will use, because the client will be able to make a full use of the data taken in the wellbore. On the other side, an oil company will have access to a larger number of workflows, and thus a larger number of services companies to choose from for a logging work.

In the same way, a tool manufacturer interest is having client hearing about the full potential of a tool, and what better way than promoting it through the full capability of the tool measurements. A consultant strength results in the data processing to get the maximum knowledge out of information from measurements taken on wellbore. Another aspect of the collaboration is the ability to interact faster with the academic work, accelerating the spread of new techniques and measurements.

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ҚАЗАҚСТАНДАҒЫ МҰНАЙ-ГАЗ СЕКТОРЫН ЦИФРЛАНДЫРУ: БАСЫМДЫҚТАР МЕН ПРОБЛЕМАЛАР

Аннотация. Қазіргі әлемдегі сандық технологиялардың үлкен рөлі. Сандық технологиялардың негізгі артықшылықтары: халықты және бизнесті әлеуметтік қызмет көрсетуге оңайтылған қол жеткізу,тарту, жедел

алмасу бизнес үшін жаңа мүмкіндіктердің пайда болуы, жаңа сандық технологиялар мен өнімдер. Мемлекеттік бағдарламаның басымдығы "Цифрлық Қазақстан" ұлттық экономикалық өсу, бәсекеге қабілеттілік үшін сандық экожүйелер және халықтың өмір сүру сапасын жақсарту болып табылады.Сандық трансформация мұнай-газ секторының өндірістік шығындары мен санын азайтады және геологиялық барлау жұмыстарының тиімділігін арттырады, өндірістік жобаларға күрделі салымдар салады.Технологиялар көмегімен "Зияткерлік кен орны" кен орнында құрауы мүмкін шамамен 3%, қалпына келтіру жұмыстары пайдалану режимі 15-20%-ға қысқарады. Жабдықтар жөндеу санын жылына 20-дан 15-ке дейін қысқартуға мүмкіндік береді. Ақылды технологияларды енгізу артықшылықтармен қатар бірқатар маңызды проблемалар бар, олардың бірі қайта мамандандыру қажеттілігі болып табылатын түсіну қажет.

Түйін сөздер: сандық экономика, сандық түрлендіру, Еуразиялық экономикалық одақ, мұнай-газ саласы, интернет заттар, Жасанды интеллект.

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ЦИФРОВИЗАЦИЯ НЕФТЕГАЗОВОГО СЕКТОРА В КАЗАХСТАНЕ: ПРИОРИТЕТЫ И ПРОБЛЕМЫ

Аннотация. В современном мире цифровые технологии играют огромную роль. Основные преимущества цифровых технологий: упрощённый доступ населения и бизнеса к социальным услугам, ускоренный обмен информацией, появление новых возможностей для бизнеса, создания новых цифровых технологий, продуктов. Приоритетом государственной программы "Цифровой Казахстан" является прогрессивное развитие национальной цифровой экосистемы для экономического роста, конкурентоспособности экономики и улучшения качества жизни населения. Цифровая трансформация нефтегазового сектора уменьшит производственные затраты и число несчастных случаев, и увеличит эффективность геологоразведочных работ, капиталовложений в производственные проекты. С помощью технологий «Интеллектуальное месторождение» дополнительная добыча на месторождении может составить около 3%, время восстановления работы скважины сократится на 15-20%, щадящий режим эксплуатации подземного оборудования позволит сократить количество ремонтов с 20 до 15 в год. Необходимо понимать, что внедрение так называемых умных технологий имеет наряду с преимуществами ряд существенных проблем, одной из которых является необходимость переквалификации персонала. Одним из основных факторов риска является так же проблема кибер безопасности.

Ключевые слова: цифровая экономика, цифровое преобразование, Евразийский экономический союз, нефтегазовая отрасль, Интернет Вещей, Искусственный интеллект.

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