

DIGITAL TRANSFORMATION - AN APPROACH IN PETROLEUM INDUSTRY IN A LOCAL, REGIONAL AND GLOBAL CONTEXT

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Rezumat: Într-o nouă eră în care organizațiile din industria de petrol și gaze naturale se concentrează tot mai mult - în afacerile lor- pe reducerea cheltuielilor și pe creșterea productivității, transformarea digitală este una dintre soluțiile cheie în ceea ce privește eficientizarea proceselor tehnologice din acest sector foarte important pentru omenire. Digitalizarea nu numai că îmbunătățește eficiența, dar are un rol esențial în siguranța și securitatea explorării, exploatării și dezvoltării acestui domeniu și nu numai - ajută atât la abordarea altor domenii operaționale fundamentale, cât și la atingerea obiectivului de reducere a emisiilor de dioxid de carbon. În opinia noastră, organizațiile din domeniul petrolului și gazelor trebuie să înțeleagă că transformarea digitală este o parte importantă a direcției în care se îndreaptă această industrie. Organizațiile, de asemenea, trebuie să facă față acestei mari schimbări și, în primul rând, trebuie să gestioneze eficient schimbarea organizațională pe care inevitabil transformarea digitală o aduce.

Abstract: In a new era where organizations in the oil and natural gas industry are increasingly focusing - in their business - on reducing expenses and increasing productivity, digital transformation is one of the key solutions in terms of streamlining technological processes in this sector very important for humanity. Digitization not only improves efficiency, but plays an essential role in the safety and security of exploration, exploitation and development in this field and beyond - it helps both to address other fundamental operational areas and to achieve the goal of reducing carbon dioxide emissions. In our view, oil and gas organizations need to understand that digital transformation is an important part of where the industry is headed. Organizations also have to deal with this big change, first of all they have to effectively manage the organizational change that digital transformation inevitably brings.

Keywords: oil, gas, digital transformation, efficiency, security, safety.

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1. Introduction

In a global context where governments are setting increasingly ambitious targets to reduce carbon dioxide emissions while also addressing a greater presence of renewables in their local energy mix, the oil and gas industry needs to turn to new clean technologies - to find the best strategies to re-establish itself in the new era of the energy sector and beyond. It is estimated that in the new era of the oil industry - despite an explosion in prices - oil and gas will provide, until the year 2050, more than 50% of the energy needs at the global level.

As organisations in the oil industry accelerate the pace of their economic diversification strategies, this is driving an even greater and faster adoption of sustainability measures across the industry.

So, digital transformation in the oil and gas industry refers to the process of using digital technologies to improve operations and business performance. The aim of digital transformation is to help oil and gas organisations become more agile, efficient and competitive in a market where change is rapid. Applying digital technology, in the medium to long term, reduces costs and, of course, increases profitability. Digital transformation in the oil and gas industry can therefore catalyse the drive towards technological process efficiency.

Optimism, regarding the abundance of resources in a new era of political and technological trends, must be that of adapting to the current requirements in which oil industry organizations activity. Thus, in the near future, we certainly expect to see more organizations involved in the digitization of the oil industry, which we will talk about next.

2. Digitisation of the oil industry

In a complex world, nobody can do everything. In the quest for cost reduction and profitability in the short to medium term, both operators and organisations in their field need to collaborate more, exploring multiple strategies to succeed in this digital transformation. Clearly, more and more oil and gas organisations are testing - often successfully - a growing range of technologies and solutions to help them become more sustainable, reduce costs and, at the same time, reduce carbon dioxide emissions into the atmosphere.

There are many different components of digital transformation, but some common examples include the use of data analytics for production optimization, the use of drones and robots for exploration and maintenance, and specifically the use of virtual reality for training and simulations (*see Fig. 1*).

An offshore platforms approach to better use of data, specifically properly implemented data analysis systems and tools can overcome the operational complexity of offshore platforms, quickly delivering returns of up to 40-50 times

the initial investment and thus reducing environmental impact by reducing costs, accidents and bottlenecks.



Source: www.google.com (processed)

Fig. 1. Overview: Offshore platform
(use of data analysis systems and tools with digital technology)

Advances in technologies (*see Fig. 2*), falling cost through digitisation and exponential growth in device connectivity offer not just a real opportunity to beat global supply chain management competition, but also potential material externalities for society at large.



Source: www.google.com (processed)

Fig. 2. Digitisation of the oil sector (*Upstream, Midstream and Downstream*)

Figure 3 shows the "supply chain diagram" of the oil industry in a local and regional context.

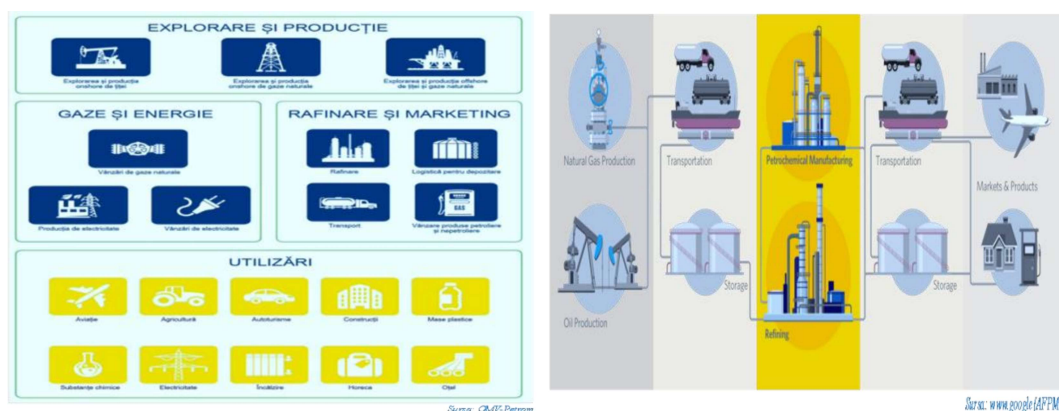


Fig. 3. Diagram of the "supply chain" of the oil industry

Table 1, according to a report *World Economic Forum*, shows that \$ 2.5 trillion could be made digitisation of the petroleum industry.

Table 1. Value estimated digitisation of petroleum industry

Digitisation	Value estimated [\$ trillion]	Comments
Petroleum industry	\$ 1.00	-
External impact of the technological process	\$ 0.86	-
Other	\$ 0.64	<ul style="list-style-type: none"> ➤ 170 billion savings for customers ➤ 10 billion productivity improvements ➤ 30 billion from water savings ➤ 430 billion from emission reductions
TOTAL	\$ 2.5	-

Of note, with up to an estimated \$1 trillion in capital and exploration/operating expenditures put at stake over the next few years, organizations that have a head start in digital transformation over their competition will have a major advantage.

3. Digital technologies transforming the oil industry

In the era of digital transformation, the role of data analytics in decision making is growing dramatically, and organisations that understand this are putting a focus on how they collect, manage, analyse and derive value from the data they collect. Considering that the COVID-19 pandemic has accelerated the digital transformation, accelerated the focus on other challenges of our time and the

importance of people, the environment and global change, today a threat to the oil industry is competition from the renewable energy industry. To overcome these disruptions and remain competitive in the energy market, oil and gas organizations must move faster toward digital transformation.

It is worth noting that when we talk about digital transformation in the petroleum industry today, most researchers identify it with **Industry 4.0** solutions (*Industry 4.0 Platform was created in 2013 by Bitkom, VDMA, ZVEI*).

What is Industry 4.0?

Industry 4.0 is the fourth industrial revolution defined by cyber-physical systems, IoT (Internet of Things), cloud and AI (Artificial Intelligence). When we talk about manufacturing organisations, Industry 4.0 implies a major transformation of all manufacturing by merging digital technologies and the Internet with conventional industry.

Globally, organisations are embracing digital technology to reshape their operations and reap the benefits. Digital technologies are helping nearly every organization rewrite its strategy, and the oil and gas industry can't be left behind. So the potential benefits of digital transformation are clear - safer operations, higher productivity and cost savings.

The use of digital technologies and how they are transforming the oil industry, such as: Big data; AI (Artificial Intelligence); IoT (Internet of Things/Things); RPA and AI (Robotic Process Automation and Intelligent Automation); AR and VR (Augmented Reality and Virtual Reality); Blockchain (Data Integrity) place a strong emphasis on Cyber Security (CS) and Industrial Control Systems (ICS) security, but also on worker protection and security, industrial assets, i.e. critical infrastructure and physical security (*see Fig. 4*).



Source: www.google.com (processed)

Fig. 4. Overview: Using digital technologies

Of course, it is no coincidence that the focus on **Industry 5.0** is accelerating. Today, *Industry 5.0* is a complement to Industry 4.0 and focuses mainly on a sustainable, human-centred and resilient industry.

Consequently, to reduce costs, optimize and increase efficiency, investments in digital technologies are extremely important to oil industry organizations that obviously want to remain competitive in the market.

3.1. Modern orientation technologies specific to the drilling of wells

Today – in the DIGITAL ERA – several modern orientation technologies are established that can answer these problems, such as:

- Rotary Steerable System,
- Reel Well Drilling,
- Geosteering Drilling
- Autonomous Directional Drilling (*see Fig. 5*),

and which, use bottom motors and measurement devices while drilling (MWD), providing access to real-time data.



Source: www.google.com

Fig. 5. Overview: Autonomous Directional Drilling

For example, Autonomous Directional Drilling is a significant step forward for the industry's digital transformation, helping organizations achieve new levels of well construction efficiency, consistency and sustainability. This technology

allows - within the drill string - a self-steering bottom assembly (BHA) capable of drilling through any section of the wellbore. As one of the four pillars of autonomous directional drilling, downhole automation capabilities drive directional adjustments as conditions are encountered to significantly increase penetration rates (POR) and improve well quality, leading to a potential for higher production and lower emissions.

4. Adopting an approach where technological advances reshape the oil and gas industry

In the near future, digital technologies will help almost every industry change its operations system. It has been known since the 80s that the oil industry was among the first industries to implement two of the major technological advances, such as *Big Data and Digital Innovation*. But today, in terms of harnessing the transformative impact of digitalisation, it seems to have lagged behind other industries.

Considering the speed with which digitization transforms various industries and not only, organizations in the oil industry must be aware of the fact that it offers an improvement in environmental safety, but also a reduction in costs.

A study - carried out by the interested parties - shows that the modernization through digital transformation of businesses in the oil industry is currently the main engine of technological processes, projects, but also of applications in asset management, therefore forming the key elements of modernization programs in a global context. However, due to the complexity of exploration and exploitation operations, for many oil organizations, the vision towards digitization remains a challenge.

The basic challenge is, the path to digitization at a pace that encourages innovation, obviously without compromise. Also, the complexity of technology, training of human capital, competing priorities, cost of investments, safety and security are the main issues that could become a barrier. Of course, any oil industry organization that can effectively collect and leverage its own data, or manage its information to reduce costs, will be better placed against the competition.

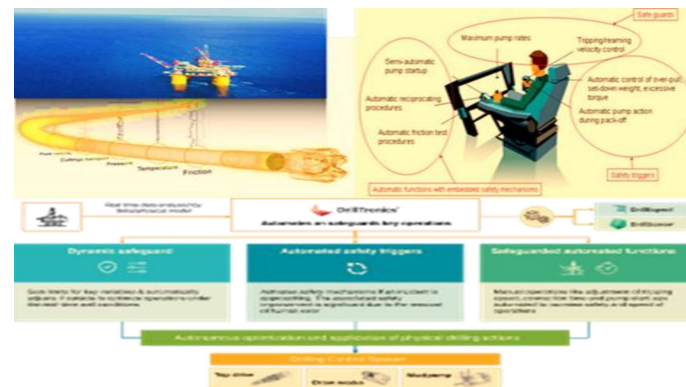
Therefore, a holistic approach that involves human capital depending on the technological processes in the petroleum industry, digital transformation is the key to generate more value.

The use of digitization means that manual processes can be automated more extensively, resulting in fewer points of contact between workers and technological processes. For example, digitizing the manual portions of the daily process of drilling operations can save time while also reducing safety risks. Today, to accurately capture data from a hydrocarbon reservoir, through a digital technology approach, organizations use 3D and 4D digital scanning. This helps to

monitor operations and to streamline technological processes, increasing production and at the same time reducing operational costs.

In terms of the offshore digitization initiative, today's drilling operations on offshore platforms range from DrillTronics (Drilling Automation), DrillScene (Real-time Well Transient Monitoring), DrillExpect (Drilling Simulation) to implementation integrated project Drill Well on Simulator, providing the oil industry with advanced modeling and analysis, respectively leading global services. For example, DrillTronic (*see Fig. 6*) reduces risk and ensure maximum drilling efficiency through automatic functions:

- automatic tripping;
- automatic friction tests;
- automatic reciprocation;
- automatic start of mud pump.



Source: www.google.com (processed)

Fig. 6. DrillTronics Functions and Data Flow

Also, for reliable data transfer over not too long distances, in terms of communication based on various radio and telecommunication technologies, some organizations in the oil industry use SHDSL technology. Thus, 4G/5G networks are used through which the transmission of measurement data is carried out wirelessly (*see Fig. 7*)

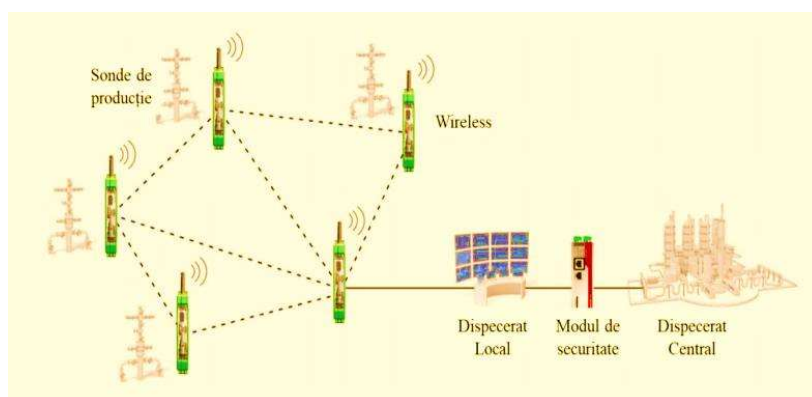


Fig. 7. Flow diagram: Wireless transmission of measurement data

Only a strategic approach to this digital transformation, with investments matched to the needs of the entire supply chain, will ensure the building of durable implementation for a safe and sustainable future of the oil industry.

So, at a global level, the common approach to the challenges generated by digital transformation maximizes the benefits of organizations in the oil industry.

Conclusions

A first conclusion regarding the digitalization of the petroleum industry, organizations must have strategies that are based on the application of new technologies, but also on the preparation of human capital to carry out remote operations. Of course, at different speeds, at local, regional, global level digitisation takes place as a necessity to integrate into the infrastructure established by new technologies. Not only do they take over from humans tasks that were once, in the not too distant past, performed manually and repetitively, but they can even create entire specific, fully automated processes on their own, without the need for human intervention, where applicable.

In the future, offshore - on marine platforms, robots will be able to carry out more operations autonomously and, at the same time, replace workers on the ground, reducing costs along the value chain.

The second conclusion, in the near future, offshore - on marine platforms, robots will be able to carry out more operations autonomously and, at the same time, will replace workers on the ground, reducing costs along the value chain. Digital transformation of the petroleum industry organisations must address all elements of the operating model (so, from strategy and capabilities to organisational structure). Petroleum industry organisations must therefore approach digitization from the perspective of building new capabilities and leveraging technology across all key aspects of value chain.

A third conclusion refers to the White Paper of the World Economic Forum, which highlights that new technologies support the oil industry by:

- 20% costs reduction in drilling-extraction;
- 25% costs reduction in maintenance and inspection;
- 20% costs reduction in labour.

As a general conclusion, digital transformation means progress and growth, with trillions of dollars already being spent globally on the digital shift. It is already a recognised fact that every organisation that benefits from this trend where operations and relationships are fully digitised, or at least improved in this respect, will generate growth far beyond traditional operating models.

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