

Digital transformation in the oil and gas industry

The arrival of digital and related technologies¹ has impacted a number of industries during the past decade. By investing in them one by one, key players in the on-line and digital sectors – led by Google, Apple, Facebook and Amazon – have raised awareness among historical players of potential growth tied to the digital transformation of their activities, along with the risk that their core businesses will face threats. The energy sector is no exception to this trend. Following an earlier note which discussed the involvement of key players in the on-line and digital industry in the energy sector², this second note focuses on the action – and reaction – to digital technology by players within the energy sector, particularly oil and gas companies.

As with sensors, where a sharp decline in average prices has been accompanied by an growing number of available services, the technology is increasingly accessible and reliable. Digital technologies offer countless opportunities to the oil and gas sector. The various stakeholders are aware of this and view digital technology as the way of the future. However, not all of them are moving ahead at the same rate. Within this industry, with its very high investment levels, changing gears with regard to data — a wealth of historical knowledge — takes place slowly, and no clear shift has yet taken place. In 2014, the energy and utilities industry ranked only 13th among industries most likely to adopt cloud-based solutions (Fig. 1).

If actual commitment to digital technologies by oil and gas companies is occurring at variable rates, the industry's economic climate is playing a fundamental role. The collapse of oil prices in 2014, persistently low prices since that time and the resulting need to find savings are factors driving the industry toward digital solutions. Consequently, there are questions regarding the strength of this

commitment. What effect could gradually rising oil prices have on advances made by the companies? Once committed to their digital transformation, in which direction will the industry's key players move? Isn't reliance on digital solutions just one way to maintain reasonable margins in a particularly gloomy business climate? Or would it be a structural shift, unrelated to changing oil prices, that would lead stakeholders in the oil and gas business to adopt new economic models, impacting both the competitive landscape and the governance of the industry?

Digital technologies, solutions in the face of declining oil prices

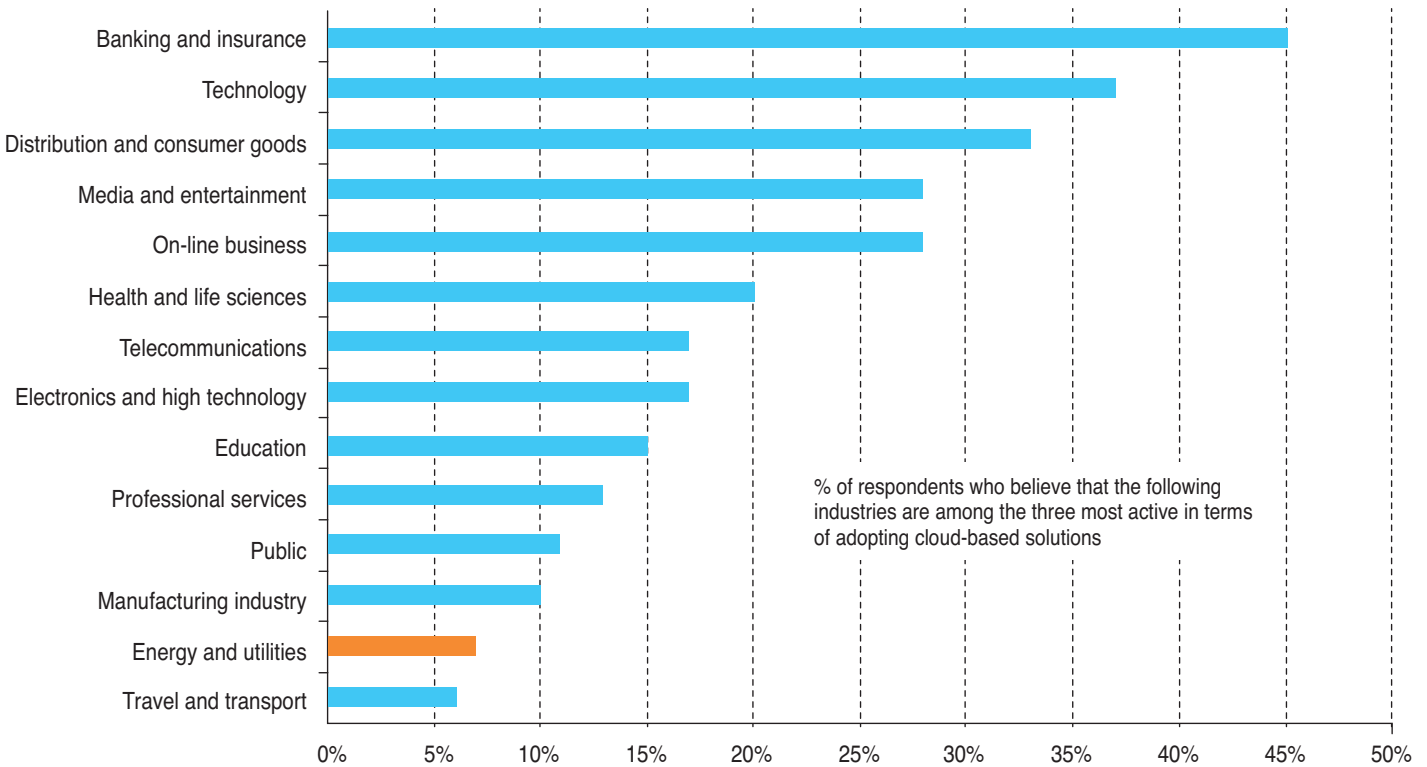
The collapse of oil prices which began in June 2014 launched a new period of austerity for players within the oil and gas industry. With prices falling from around \$110 to \$50 in just over six months and remaining near this level since then (Fig. 2), oil company revenues have fallen considerably. With oil prices moderating in the short and medium term, it has become essential to address operating expenses, productivity and production lead time in order to maintain reasonable margins and achieve the best possible return on

⁽¹⁾ Mainly mobility, big data, the cloud, the Internet of Things and social networks

⁽²⁾ Franck Castagna and Adrien Martinez-Méré: Les grands du web et du numérique dans le domaine de l'énergie – IFPEN Panorama symposium, January 2017

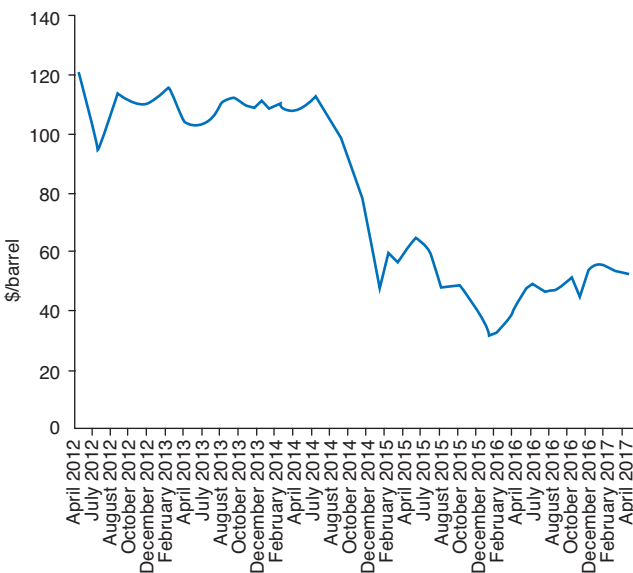
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Fig. 1 – Existing cloud-based solutions by industry



Source: Everest Group, Cloud adoption survey, 2014

Fig. 2 – Price of a barrel of oil



Source: Everest Group, Cloud adoption survey, 2014

investment³. To achieve this, groundbreaking investment in existing assets is needed, primarily through the integration and use of digital technologies.

[3] Nate Clark, Abhish Abraham and Amir Anvar: Unrealized Potential of Digital – Oil&Gas Financial Journal, 16 May 2016

Optimized asset management

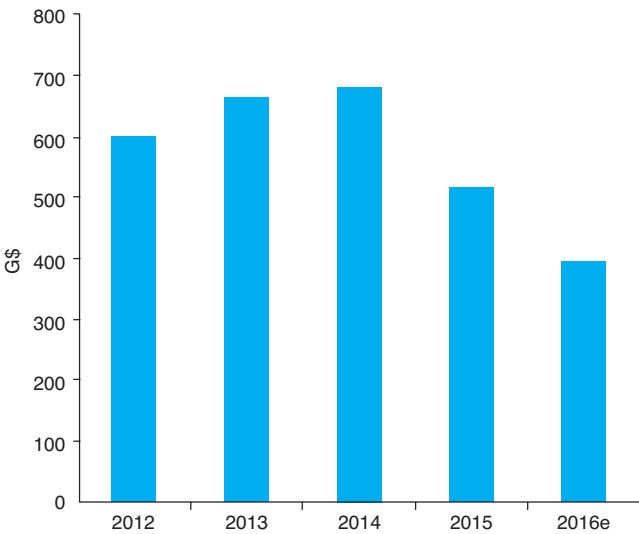
In the wake of significant reductions in exploration-production expenditures (–42% over the past two years (Fig. 3)), the number of major conventional discoveries has fallen, while such discoveries have been made in areas that are increasingly difficult to reach, in hostile environments (the Arctic, deep sea, ultra-deep, deserts, etc.). Digital transformation in oil and gas production provides companies with tools to meet these new challenges faced by the industry.

In this way, enhanced oversight of facilities and equipment through the installation of digital solutions — primarily sensors — is one of the drivers that operators can use to improve operating procedures at existing fields, maintain profitable production and address HSE risks (health, safety, environment). Thanks to the collection of extensive data on equipment performance, operators are now able to create a “digital double”, a virtual model of the facility as a whole. They can develop diagnostics for various pieces of equipment, predict failures and anticipate breakdowns. In addition to reducing the cost of maintenance operations, production stoppages are also shortened due to greater responsiveness by the operational teams.

Pushed even further, the idea of such a “digital double” may allow predictions of what may happen at the facility in various scenarios which include higher and lower

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Fig. 3 – Investment in exploration-production



Sources: IFPEN according to Barclays, DTI, NPD, DEA, annual reports of companies and governments

probability events (failure on an operations platform, natural disaster, etc.) so that engineers can respond as effectively as possible.

However, the implementation of digital solutions comes with numerous security and financial restraints (costs related to production stoppages, etc.). In addition, tools designed to predict if not minimize the risk of disaster (monitoring equipment condition, systems to anticipate faults, outages) presume the existence of connectivity which may be difficult to achieve in remote locations (far offshore, desert areas, etc.).

Increasing responsiveness

In addition to optimized management and the cost savings it provides, increased oversight of equipment and facilities also has an impact on personnel management. Thanks to a continual link between production sites and the office, all teams have immediate access to information. Remote support enables faster, more tailored decision making. The size of on-site teams can be reduced, limiting transport costs to complex areas (platforms, etc.), and lowering exposure to HSE risks.

The essence of these ideas is summarized in the CWE concept (Collaborative Work Environment). According to Frans Van den Berg⁴, such an approach could result in savings between \$5 and \$10 million per year and per asset. In addition, there are countless ways to improve on this concept as technology evolves. The Internet of Things will play an increasingly important role in the industry. Industrial mobility is characterized by reliance on robotic technology

[4] Frans Van den Berg: *The digital oilfield, collaborative working at global scale* – SPE Distinguished Lecturer, February 2016

(robots, drones, etc.), cameras, tablets and other smart-phones that can withstand conditions in the field (explosions, dust, climate, etc.), which offer applications needed for work in the oil fields (data on wells, oilfield dashboard updated in real time, video communication, maintenance history, etc.).

Finally, automating the activity itself *via* end-to-end connection of the value chain is becoming possible, in an effort to balance production and the various downstream phases based on future demand⁵. Depending on expected variation in future demand, operators could anticipate retail sales levels and limit the impact on stocks, and therefore on price. Furthermore, such predictions could be made at source to optimize investments and more effectively manage operating costs.

Skills development

There is no doubt that digitalization will expand and will involve broad fundamental changes to the way the oil and gas industry works. Companies that successfully implement big data solutions based on sensors and new technologies, and perform detailed analyses based on this data to manage their assets, will be best able to meet their economic performance objectives.

Beyond the savings they provide and the new challenges they can address, digital technologies are a way to drive change in the energy business and provide new sources of revenue. For energy companies, it is a question of adding value by exceeding expectations⁶.

Finally, at a time when the oil and gas industry is experiencing “major disruptions to its workforce”⁷ with the impending retirement of a generation of petroleum engineers, the industry must pursue a strategy to capitalize its knowledge and businesses. To the extent possible, codification and automation of routine analysis and decision making processes, through digitalization and the latest artificial intelligence technologies, can be useful tools for reaching this objective (Fig. 4).

Performance of oil and gas companies faced with the dawn of digitalization

Beyond its operational contribution to working methods, digital technology offers the potential for major revolution in the oil and gas industry. Regardless of future changes

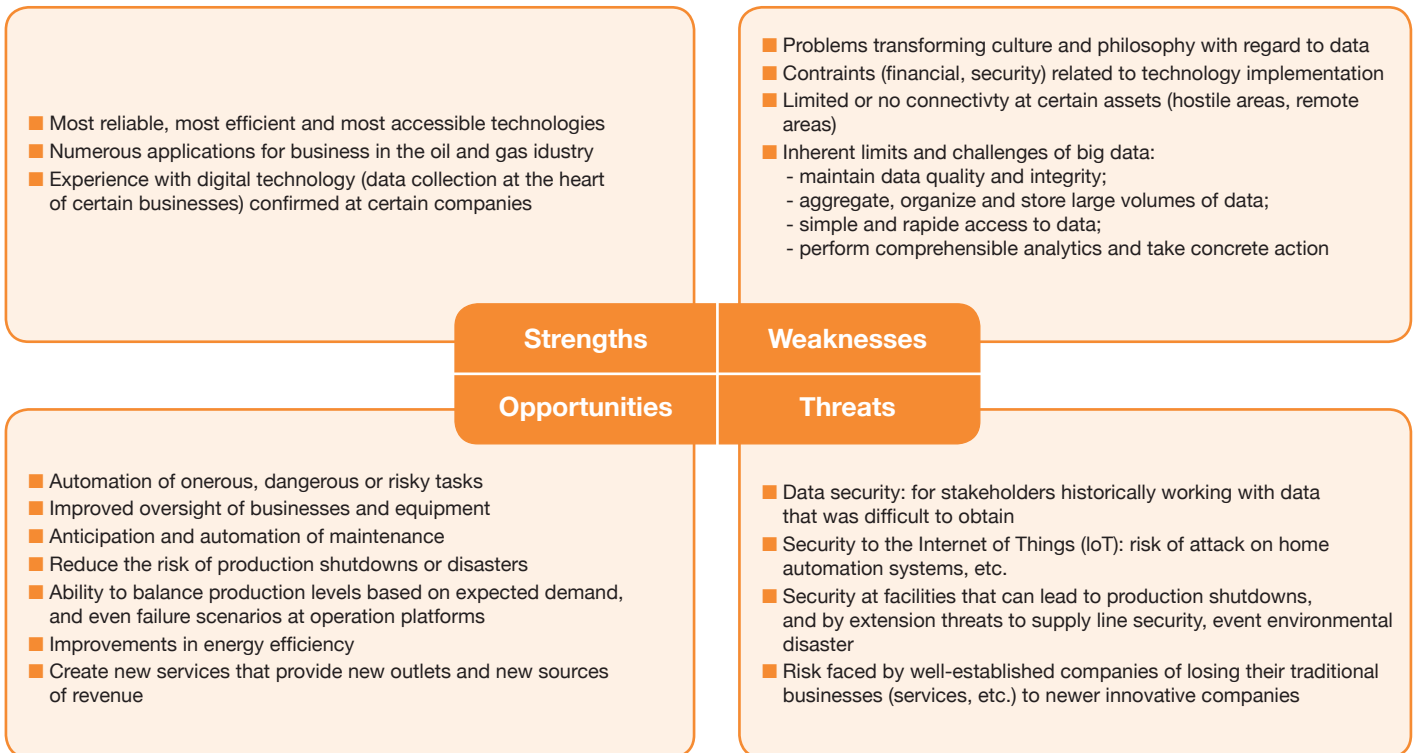
[5] Stefano Martinotti, Jim Nolten and Jens Arne Steinsbø: *Digitizing oil and gas production* – Mc Kinsey, August 2014

[6] Thierry Mileo: *La révolution numérique dans l’industrie: quels impacts dans le secteur de l’énergie* – IFPEN Panorama symposium, Paris, 24 January 2017

[7] Stefano Martinotti, Jim Nolten and Jens Arne Steinsbø: *Digitizing oil and gas production* – Mc Kinsey, August 2014

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Fig. 4 – SWOT analysis of digital technology in the energy sector



Source: IFPEN

in oil prices, data technology is penetrating the industry, which seems to have grasped that its progress is inevitable.

In addition to concrete implications, what impact will digitalization have on the industry's historical players? Will their philosophy on data, historically a highly-prized asset, evolve sufficiently so they can delegate analysis to outside companies? Or on the contrary, will their philosophy remain unchanged, driving them to process everything internally? In this case, it is worthwhile to ask whether and how they will adapt to changes at certain companies, such as equipment manufacturers and suppliers, whose offerings are enriched by new services focused on data.

Historical operators

Historical operators in the oil and gas industry have processed and analyzed vast amounts of data for many years.

As a legacy of its geoscientific culture, for example, Total claims a data native⁸ culture among its employees. This strong identity does not impede the group from seeking to refine its use of the raw data it gathers from its facilities and equipment. Like the data science challenge in

which hundreds of employees took part⁹, the company is working internally to promote innovation. Digital technology is also incorporated by seeking innovative solutions that are new to the market. In December 2014, Total launched a start-up incubator known as "Plant 4.0"¹⁰. To date, nine companies have been incubated, and are able to test their solutions within the group's various business lines.

On a different note, Engie decided to launch a comprehensive restructuring of its business. Led by Isabelle Kocher, who became CEO of the group in May 2016, Engie intends to become a leader of the energy transition through a focus on renewable energy and services. With this in mind, the group made a series of acquisitions in the United States, purchasing Ecova (2014), Retroficiency (2015), OpTerra (2016) and more recently, a majority interest in Green Charge Networks¹¹, companies which offer a broad range of tools and services in the field of energy efficiency.

Nevertheless, this revolution is not without challenges. The group's historical core business is being relegated to the background, with new value added being acquired elsewhere. Some see "marginalization of employees

[9] Lélia De Matharel: Offres et process internes optimisés, Total est transformé par l'IoT, Journal du Net, 11 April 2017

[10] Total: Total lance un incubateur de start-up sur le thème de "l'usine 4.0" - 18 December 2015

[11] Anaïs Moutot: Engie met le cap sur les services aux États-Unis - Les échos, 8 March 2017

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from the olden days of fossil fuels” within a company “where they no longer talk about anything but 3D Energy (D for “décarboné” in French i.e. low carbon, digital and decentralized)”¹².

From the changing relationship with data...

The examples of Total and Engie illustrate the current shift in the industry’s relationship with data, where until recently, possession and exclusivity were basic concepts that were deemed unalterable.

Initially, value added from data was gained through the action of professionals within the energy sector (engineers, technicians, etc.). New types of data, obtained through the use of sensors, is available to new players that can now provide analyses outside of a purely technical framework. We are essentially moving from a world where data analysis enabled extraction of useful technical information to improve productivity, to a world where open analysis of all types of data — not necessarily technical — leads to the development of related optimization services, whether B2B (such as production optimization) or B2C (energy optimization for end users, etc.).

... to the rise of services

If the use of new technologies improves productivity, the development of services based on newly collected data will enable some players to generate new revenue. In this context, a significant position is maintained by oil equipment and services companies, traditional purchasers of data for the benefit of operators.

For example, the service provider Schlumberger is among companies whose principal business involves data acquisition for the benefit of its partners. It is the market leader in geoscientific software that aims to process this data to extract significant information in order to shift from exploration to exploitation, then to monitor and optimize production. The company’s digitalization policy was formalized in 2015 with the signing of a collaboration agreement with IBM¹³, to develop (on Schlumberger’s Avocet platform) a set of production optimization services and very open management tools ranging from human resources, HSE, management and logistics. Recently, the infrastructure has expanded, offering high-performance computing (HPC) capacity, this time announcing collaboration with Google regarding cloud-based applications¹⁴.

[12] Jean-Michel Bezat: Engie: un plan de transition énergétique difficile à faire passer – *Le Monde*, 17 January 2017

[13] Schlumberger: Schlumberger and IBM Introduce New Service to Optimize Integrated Upstream Production Operations – 31 August

[14] Ashok Belani: Schlumberger and Google Cloud: Innovation in Seismic Data Processing – Google Cloud Next 2017 Conference, 21 March 2017

Landmark, a Halliburton subsidiary and Schlumberger’s main competitor in the software field, is also moving in this direction. Since early 2017, the company has offered its DecisionSpace 365 software in a new iEnergy Cloud environment.

The structure of software used by oil companies has changed little since its origins in the 1960s, based on the idea that data is rare and valuable, and that its use requires mathematical processing and complex physical and chemical relevance in order to avoid degrading the information.

It is not really suitable for ultra-fast processing of high-speed data for updates in near-real time. With the accumulation of new data, it is possible to envision a shift toward data processing that would use a more statistical approach. To achieve this, the relationship with data would continue to develop, and affected stakeholders would shift from a “data in silos” culture to “data democratization”¹⁵.

On this latter issue, suppliers of equipment (such as pumps, automation, etc.) are in an interesting position. In the field of predictive maintenance, equipment operation optimization is characterized by the growing number of sensors in use. In addition to gathering data, they can collect information beyond just the dedicated equipment. In infrastructure such as a refinery, an understanding of the asset as a whole can be deduced from analysis of “peripheral” data, based on which the supplier could offer services to its customer.

The situation at Schneider Electric is also interesting to note. Over a number of years it became a leader in electrical equipment, then in energy management; then in recent years it has evolved further with its 2014 acquisition of Invensys, a specialist in industrial software¹⁶. Since then, Schneider Electric has turned in part toward new data technologies, integrating them into its offerings¹⁷.

Lastly, General Electric (GE) has boldly committed to digital technology, creating the GE Digital business unit. This new entity, responsible for leading all of the group’s digital activities and developing and marketing the industrial web platform Predix, must lead the group’s transformation from its industrial roots to a software and services company, based on the data economy. The merger of the Oil & Gas branch with Baker Hughes at the end of 2016 falls within this framework. Communications about this transaction¹⁸ clearly demonstrates the desire to form a “new digital industrial services company encompassing the entire oil and gas value chain.”

[15] Satyam Priyadarshy: Halliburton on Big Data Challenges in Oil & Gas Industry – *KDNuggets News*

[16] Manuel Moragues: Schneider Electric finalise l’acquisition d’Invensys – *L’Usine Nouvelle*, 17 January 2014

[17] Schneider Electric: Schneider Electric: Cloud & service providers

[18] General Electric: GE and Baker Hughes agree to create new fullstream digital industrial services company gas – 31 October 2016

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This ability to create and capture new opportunities to add value demonstrates the expanding role of oil equipment and service companies within the context of fundamental change in the industry's corporate culture. With the expanded role of data in reservoir management, it will be interesting to see how the relationship between oil companies and oil equipment and service companies will develop, especially regarding mergers and acquisitions.

Conclusion

In the note that discussed digitalization of the energy sector from the viewpoint of key players in the on-line and digital technology industry, we saw that stakeholders of all kinds are still considering their options, and it was difficult to see what would stand at the heart of a new paradigm driven by the rise of data technology.

This time, after considering the perspective of stakeholders in the oil and gas industry, it appears that a turning point has been reached. The shock needed to change mindsets appears to have taken place, with all parties accepting that new data technologies will play a key role within the industry.

It is clear that oil exploration and production will continue to be protected by the massive amounts of capital required. In this context, efforts to reduce costs may shift from traditional productivity improvement, by using these new technologies in a traditional value chain. Nevertheless, energy is gradually becoming a service, and is no longer just a commodity. The development of new B2B and B2C services is the key to potential value-added gains.

But it remains difficult to determine who will become the key players in the end, with many stakeholders preparing for this change, whether visibly or internally. Will the data owners (which up to now have been the operators) successfully retain control of these services? Will suppliers to these key operators be able to further push into this market by benefitting from access to new data? Will digital technology companies, suppliers of equipment (IBM, etc.) and applications (often start-ups) serve as partners, or can they take on a leadership role?

Naturally, it's a "race" (Fig. 5) to build the capacity to offer these new services by most effectively using the data technology that is now available.

Fig. 5 – The "race" toward new services



Source: IFPEN

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