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Technology Watch is the Elettricità Futura initiative to monitor global technology trends having the power sector at their heart. In our quarterly newsletter you will find an article with our analysis on a specific technology trend and technology news from all over the world selected by Elettricità Futura.

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The Insight

How Digitalisation is shaping the power sector

Author:

What is Digitalisation?

Digitalisation describes the growing application of Information and Communication Technologies (ICT) across the economy, including energy systems. Digitalisation is becoming more and more pervasive of our everyday life and can be thought of as the increasing interaction and convergence between the digital and physical worlds. The digital world has three fundamental elements [1]:

- **Data:** digital information
- **Analytics:** the use of data to produce useful information and insights, normally through data elaboration and manipulation
- **Connectivity:** exchange of data between humans, devices and machines (including machine-to-machine), through digital communications networks.

The trend toward greater digitalisation is enabled by advances in all three of these areas: increasing volumes of data thanks to the declining costs of sensors and data storage, rapid progress in advanced analytics and computing capabilities, and greater connectivity with faster and cheaper data transmission [1].

Digitalisation in the power sector

Digital technologies have been helping to improve and shaping energy systems for decades. The energy sector has often been an early adopter of large Information Technology (IT) systems. In the 1970s, power utilities were digital pioneers, using IT to facilitate management and operation of the grid [1]. Electricity markets across the world, are managed in real time over vast geographical areas serving large numbers of customers using digital tools, including Artificial Intelligence.

The industrial sector has used process controls and automation for decades, particularly in heavy industry, to maximise quality and yields while minimising energy use. Intelligent transport systems are using digital technologies in all modes of transport to improve safety and efficiency: digitalisation is for instance a key enabler for autonomous cars and vehicles.

Furthermore, the pace of digitalisation in energy is increasing. Investment in digital technologies by energy companies has risen sharply over the last few years. For example, global investment in digital electricity infrastructure and software has grown by over 20% annually since 2014, reaching USD 47 billion in 2016, according to IEA [1].

A recent report published by DNV GL [2], based on a global survey of 1,919 energy industry professionals, alongside in-depth interviews with market leaders and insight from business experts, highlighted that:

- **41%** of respondents have digitalisation as a core part of their public-facing strategy;
- **87%** say digitalisation is part of their company's strategy;
- **20%** feel more advanced than the rest of the industry.

Key areas linked with digitalisation and digital transformation for companies are investments and skills. The report [2] highlighted that 71% of respondents are investing in digital skills training, 69% in cybersecurity and 66% are investing in digital workflow automation. The same survey concluded that for 41% of respondents consider that the "lack of a 'digital mindset' is a top barrier to digitalisation" and 39% think that "say a lack of digital skills is a barrier to digitalisation", underlining how important the human and skills factors are.

In the study conducted by Elettricità Futura in 2020 [3] among key electricity retailers in Italy, it emerged that 43% of responding companies already offer digital services to their clients and the rest are working on it (histogram 1 in figure 1) and 87% of respondents stated that they already have digital solutions to manage the relationship with their customers (histogram 2 in figure 1).

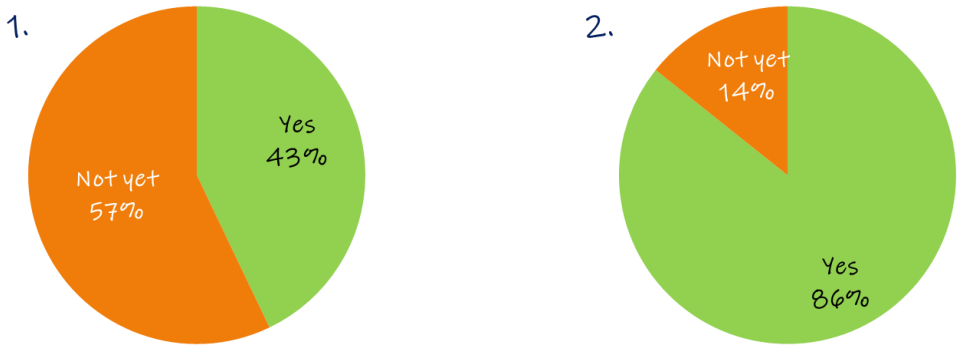

Figure 1 – Results of the Elettricità Futura's study [3] regarding electricity retail companies in Italy offering digital services to their clients (1) and having digital solutions to manage the relationship with their customer base (2)

The study also highlighted that very significant impacts are observed in improving the effectiveness of the relationship with own customers, in the management of internal processes as well as in the organisation of internal resources.

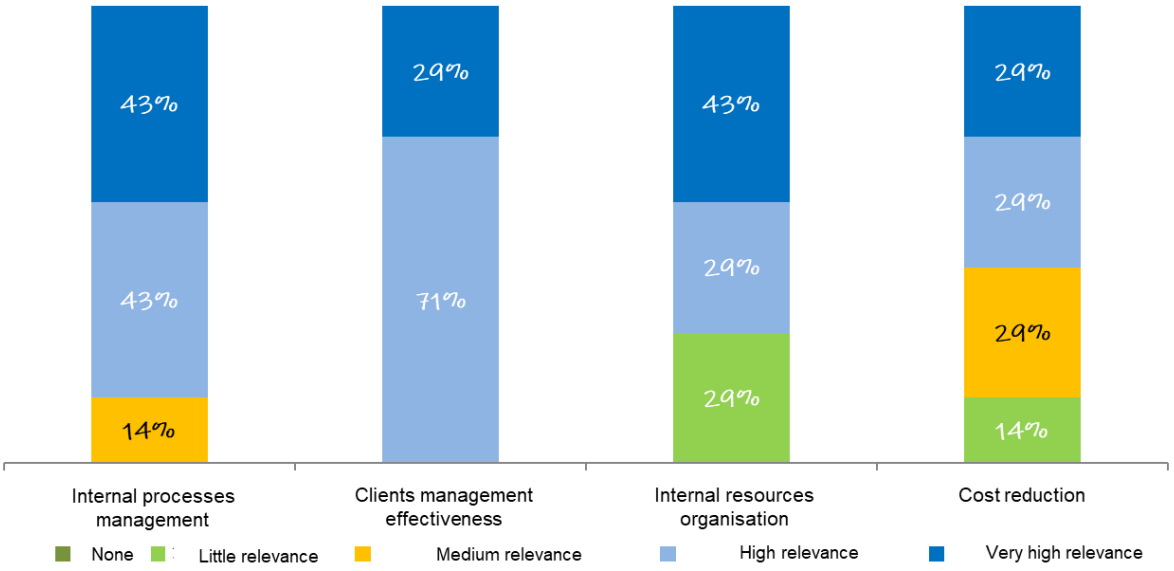

Figure 2 – Results of the Elettricità Futura's study [3] regarding electricity retail companies in Italy, assessing the impact of digitalisation in various areas

Example of digitalisation technologies

Digital technologies are at the heart and basis of many of the emerging technologies that are shaping the power sector, as a non-exhaustive list:

- Artificial Intelligence
- **Data science applications**
- Wearable technologies
- Robotics and autonomous systems
- **Internet of Things**
- Smart sensing
- Advanced and digital manufacturing e.g. 3D printing
- **Augmented and virtual reality**
- ICT evolutions, such as blockchain

Some concrete examples from the above list are included hereafter.

Data science is an inter-disciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from many structural and unstructured data. Data science is related to data mining and big data. Data science is a "concept to unify statistics, data analysis, machine learning and their related methods" in order to "understand and analyse actual phenomena" with data. It employs techniques and theories drawn from many fields within the context of mathematics, statistics, computer science, and information science [4].

With regards to the power sector, data science and analytics has a vast range of applications. Some examples, described by DNV GL are [5]:

- Forecasting activities like predicting changes in power flow, making long-term investment decisions, and modelling consumer behaviour all rely on the availability of both good data and data analytics. Also, data analytics provides better insights into asset management, resource planning and dispatch for renewables, and demand forecasting
- For operations as well as operations of power generation, reporting is becoming more automated, and so too will data analysis. This will allow operators to anticipate risks and respond faster to changes, for example, making it easier to balance renewables and manage risks.
- Settlement is already data intensive. Here, data analytics will help speed up and automate the process of allocating metering data to the responsible market parties and allocating payments. This will be crucial to deal with the increasing volumes of data from smart meters. Moreover, data analytics will be driving new business opportunities, such as smart contracts, energy management across organisational boundaries and will support high frequency energy trading.

Figure 3 - Picture of control room for the power sector [5]

The Internet of things (IoT) is a system of interrelated computing devices, mechanical and digital machines provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction [6].

The definition of the Internet of things has evolved due to the convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of Things. In the consumer market, IoT technology is strongly linked with the concept of "smart home", covering devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more

common ecosystems, and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers [7].

IoT has a wide variety of applications in the power sector and a selection of them is summarised in Figure 4. IoT is an enabler for greater automation in the power sector and this might reduce the need and interaction of personnel, hence helping in case social distancing measures are taken.

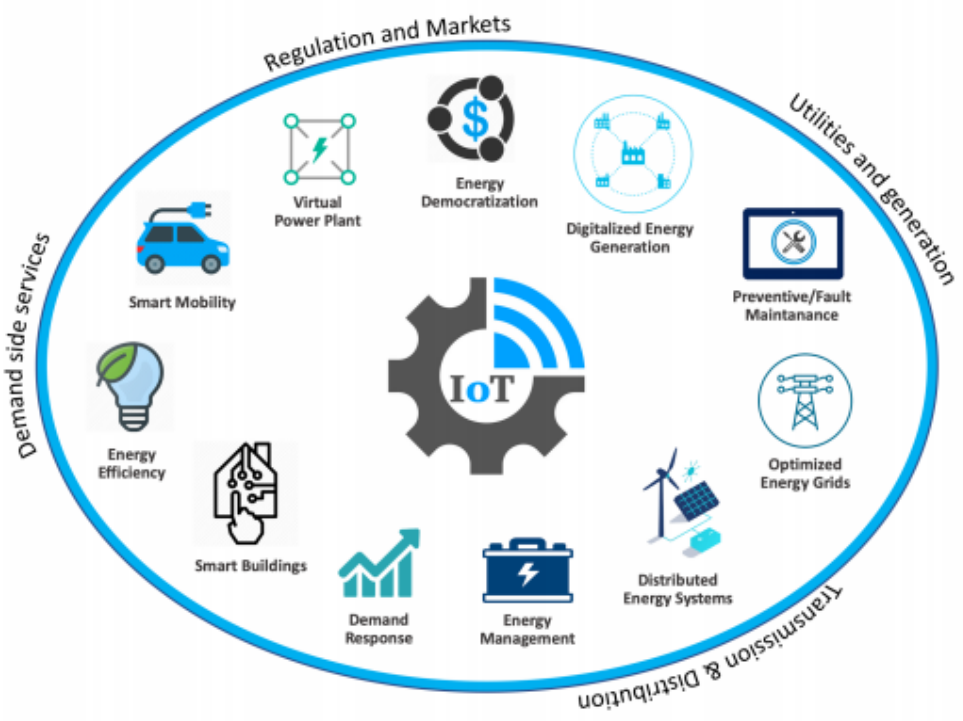

Figure 4 - Possible applications of Internet of Things for the power sector [7]

Augmented reality (AR) is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory and olfactory. AR can be defined as a system that fulfils three basic features: a combination of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects [8]. Virtual reality (VR) is a simulated experience that can be similar to or completely different from the real world. Applications of virtual reality can include entertainment (e.g. video games) and educational purposes (e.g. medical or military training). Other, distinct types of VR style technology include augmented reality and mixed reality [9]. Smart goggles and glasses are among the key technology building blocks enabling AR and VR.

AR and VR can find several applications in the power sector, such as the use of smart glasses to inspect components and plants and connecting in real time with digital tools (e.g. manuals, digital twins, etc…) and with colleagues located remotely [10], [11]. This can also be useful in the current context with restriction for travels and social distancing due to the COVID-19 emergency.

Figure 17 - Rendering of application of augmented and virtual reality tools to inspect power plant machinery [10]

References:

[1] IEA, “Digitalization & Energy”, 2017

[2] DNV GL, “Digitalization and the Future of Energy”, 2019

[3] Elettricità Futura, “Ritratto del fornitore di energia elettrica” (“Portrait of the electricity retailer in Italy”), 2020

[4] General definition of Data Science on Wikipedia, “https://en.wikipedia.org/wiki/Data_science”

[5] DNV GL, “Data analytics in the electricity sector” (https://www.dnvgl.com/publications/data-analytics-in-the-electricity-sector-131778), 2018

[6] General definition of Internet of Things on Wikipedia, https://en.wikipedia.org/wiki/Internet_of_things

[7] Motlagh et al., “Internet of Things (IoT) and the Energy Sector”, MDPI Energies, 2020

[8] General definition of Augmented Reality on Wikipedia, https://en.wikipedia.org/wiki/Augmented_reality

[9] General definition of Virtual Reality on Wikipedia, https://en.wikipedia.org/wiki/Virtual_reality

[10] Turbomachinery Magazine, https://www.turbomachinerymag.com/virtual-and-augmented-reality/

[11] Application of Smart Glasses for Wind Turbine inspections, Enel Green Power, https://headapp.eu/enel-green-power-partnered-with-headapp-and-aubay-for-a-high-tech-look-at-renewable-with-smart-glas/

Note: weblinks last accessed in October 2020

Technology News Worldwide

HIGHLIGHT: **ITALIAN STRATEGY FOR ARTIFICIAL INTELLIGENCE**

The Italian Ministry of Economic Development (MiSE) has published the final document with the proposals relating to the "Italian Strategy for Artificial Intelligence", in line with the provisions at European level in the coordinated plan for AI. The group of 30 experts selected by the MiSE worked on the proposals, drafting a document submitted for public consultation in 2019 and acknowledging the comments received.
The strategy is structured in three parts: the first is dedicated to the analysis of the global, European and national Artificial Intelligence market. The second part describes the fundamental elements of the strategy, while the third examines the governance proposed for Italian AI and proposes some recommendations for the implementation, monitoring and communication of the national strategy on Artificial Intelligence. The document will be the basis for the definition of the Italian strategy within the European Coordinated Plan
Link to a Confindustria article and link to the document (in Italian)

- **#Research:** CNR-Confindustria agreement for 40 industrial PhD scholarships funded for the 37th cycle in Italy [Link (Italian)], as well as 3 million euros to co-fund industrial PhDs in the Lazio Region [Link (Italian)].

- **#Research:** the Italian Ministry of Economic Development has published the guidelines to submit applications for subsidies for the “Digital Transformation” call for SMEs with a budget of 100 Million euros. Link (in Italian)

- **#Solar:** Researchers from Linköping University have developed a molecule that absorbs energy from sunlight and stores it in chemical bonds. A possible long-term use of the molecule is to capture solar energy efficiently and store it for later consumption.
  Link

- **#Solar:** Researchers from the University of Cambridge have developed a standalone device that converts sunlight, carbon dioxide and water into a carbon-neutral fuel, without requiring any additional components or electricity.
  Link

- **#Electric Mobility:** Less than four years after the official announcement (December 2016), the American Lucid Motors has launched the Air model on the market. The car boasts a maximum range of 517 miles (830 km), surpassing any car currently on the road.
  Link

- **#Electric Mobility:** At the headquarters of the Heritage Hub within FCA's Mirafiori industrial district in Turin (Italy), FCA, Engie Eps and Terna presented a Vehicle-to-grid (V2G) electric-mobility pilot project, which will be the largest in the world once completed.
  Link

- **#Wind:** A new machine-learning algorithm developed at the University of Michigan for exploring lightweight, very stiff glass compositions can help design next-gen materials for more efficient vehicles and wind turbines. Glasses can reinforce polymers to generate composite materials that provide similar strengths as metals but with less weight.
  Link

- **#Bioenergy:** According to data recently released by the China’s Biomass Energy Industry Promotion Association (BEIPA), the country’s biomass power generation sector added 1.51 GW of new installations during the first half of this year, with accumulated installation capacity reaching 25.2 GW.
  Link

Note: weblinks last accessed in October 2020

For info and questions:
Alessio Cipullo – European Affairs and Studies
alessio.cipullo@elettricitafutura.it

Elettricità Futura is the leading Italian association representing the national electricity industry. It encompasses generators of electrical energy from Renewable Energy Sources as well as traditional sources, distributors, traders, retailers and service providers. It represents and stands up for its members' interests in Italy and in Europe, contributing to making today's electrical market more efficient, enhancing the sector and exploiting the potential of the energy transition. Elettricità Futura is member of:

ELETTRICITÀ FUTURA
imprese elettriche italiane

Piazza Alessandria, 24 - 00198 Rome. Italy
T +39 06 8537281
www.elettricitafutura.it
info@elettricitafutura.it