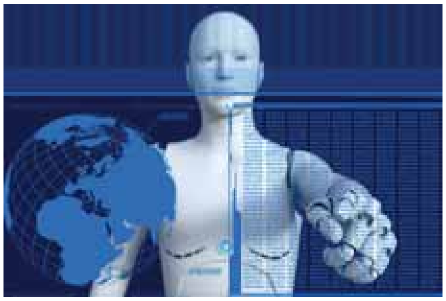
Chapter 8. Fast-evolving technologies in e-government: Government Platforms, Artificial Intelligence and People



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8.1. Introduction

As public institutions focus on the implementation of Agenda 2030 with the core principles of leaving no one behind and eradicating poverty, frontier technologies are creating both opportunities and risks for future governance.

The fourth industrial revolution and convergence of innovative technologies, such as big data, Internet of Things (IoT), cloud and super-computing, geo-spatial data and broadband, artificial intelligence (AI), and deep machine learning, are promoting a dramatic shift towards more data and machine-driven societies, while development challenges and social inequality continue to increase. So-called disruptive technologies, including predictive analytics, are creating unforeseen opportunities in many government sectors, including health, security, water management, environment, among others. The rapidity with which these new technologies are evolving, combined with the knowledge that governments already possess, present a historic opportunity for sustainable development.

However, the pace and evolution of technological innovation can surpass the speed with which governments can absorb changes and reap their rewards. In the past decade, there have been ground-breaking technological advances, such as the economy app, blockchain, and facial recognition via simple smart phones, to name a few. Apart from the need for governments to catch up is the need to ensure that the new data tools are not concentrated in the hands of a few but are equitably distributed. A sufficient balance which serves the needs of many for the greater good is required. Thus, the process of integrating the new data tools could benefit from constant review and an incremental approach.

The accelerated speed of innovation and the integration of technology into all devices and all sectors are equally disrupting the public sector. Models governing the design and consumption of public services are evolving. Beyond digital transformation, governments themselves are increasingly called upon to evolve as well. Indeed, the degree to which technology is disrupting society on the one hand and supporting it on the other is unknown. The use of these fast-evolving technologies in e-government also raises the question whether and to what extent they are being used by members of society to generate the greatest impact. The interface between government and society reinforces the widely held belief that the use of new technologies by governments can support the realization of society's broader goals.

This chapter examines several fast-evolving technologies, the e-government application of which, can be instrumental in promoting good governance principles and achieving the sustainable development goals. It also ponders present and future challenges and hypothesizes that the success of e-governance lay in leveraging and balancing the extraordinary new platforms with society's needs.

8.2. Harnessing fast evolving technologies

There is a case to be made that fast-evolving technologies have already transformed the traditional ways in which governments operate and deliver services. In the context of e-government, this chapter focuses on digital technologies, excluding but not discounting innovations in the fields of energy, biology, health and other domains. Some of the major digital technology trends fuelling innovation and growth in both the private and public sectors are mainly related to digital, analytics, cloud, core modernization, and the changing role of information and communications technologies overall. Social and mobile technologies, open data initiatives, and Internet of Things (IoT) also play an important role in transforming government efforts. Constituent engagement also drives transformation, both in service delivery and operational efficiency.

Several rapidly advancing technologies have great potential, both for the ICTs industry as well as for governments around the world, include:

- Data, intelligent apps and analytics
- Artificial Intelligence and Robotic Process Automation
- Intelligent "things", cyber-physical integration and edge computing
- Virtual and augmented reality
- High Performance- and Quantum Computing
- Blockchain and Distributed Ledger Technologies

A combination of the fruition of long-term research and development are among the forces driving these technologies. Artificial Intelligence, for example, has been around since the 1950s, but its use today by businesses and individuals has increased exponentially. That is due in part to the growing processing power of hardware, increasing data availability, and the needs and expectations of society. Often, the technologies themselves are not new. Rather it is the convergence of developments in hardware, software and data availability that offer new potentials.

8.2.1. Data, intelligent apps and analytics

The public sector has the challenge of processing vast amounts of unstructured data, responding to inquiries, and making knowledge accessible. Through automated capabilities, so-called dark analytics, or the analysis of data that is not in common use, can allocate, store, secure, and retrieve vital data on demand, from such sources as documents, e-mails, tickets, videos, and tweets. Algorithms, following a form recognition protocol, can read machine print and hand print, and use contextual logic databases for automated validation. This can reveal trends, population movements, user preferences, demographics, transportation details, and more. User trends can then be analyzed to improve customer service. Decision-making in such areas as migration can be made more transparent and targeted, and have profound impacts.

Intelligent apps and platforms are already being used to make correspondence and customer service of public institutions quicker and more effective, as well as less costly. They also support the process of digital payments and help manage information flows and reporting. Moreover, applying analytics frees human resources and reduces costs by speeding up data capture, recognition, and retrieval. This increased capacity allows greater focus on improving the "customer journey".

Data analytics can be the link between public and private institutions. Open public data can be used to fuel private sector innovations, but likewise, private sector data can support new and better public services. Technological developments and information sharing between governments and private stakeholders can benefit such vital areas as national security, health care, social and financial services, transportation, and public safety. Together with artificial intelligence and automated processes, data science are key drivers in technology-induced transformation.

8.2.2. Artificial Intelligence and Robotic Process Automation

Artificial Intelligence constitutes a range of specific technologies through which "intelligent machines are gaining the ability to learn, improve and make calculated decisions in ways that enable them to perform tasks previously thought to rely solely on human experience, creativity, and ingenuity".[1] Artificial Intelligence is the ability of a computer or a computer-enabled robotic system to process information and produce outcomes in a manner similar to the thought process of human beings in learning, decision-making and problem-solving. Artificial Intelligence has been rapidly advancing and will provide benefits through enhancing citizen engagement, automating workloads, and increasing workplace productivity. It will thus significantly impact businesses, societies and the daily lives of their members.

The confluence of significant technological developments in hardware, software and data has fuelled the development of Artificial Intelligence, positioning it to have a major impact on society for the coming decades. The speed of improvements in processing power has continued apace. Graphics processing units, which are specialized hardware that can run specialized algorithms, play a key role in Artificial Intelligence. New software has been developed that can leverage this processing power by leading to faster and better learning. Data – the crucial ingredient for Artificial Intelligence – is also increasingly available, fuelling the learning process of computers. This can significantly benefit the public sector, for example, in automating decision-making of routine tasks, forecasting climate change, answering questions from citizens and managing transport flows. Another change is access to large cloud computing platforms such as AWS, Google, and Microsoft, among others, and the advent of quantum computing, which is a vastly different approach.

8.2.3. Intelligent "things", Cyber-Physical Integration and Edge Computing

Intelligent things are an evolution of the Internet of Things (IoT) whereby physical objects with sensors are connected to a network, and can function almost autonomously by using artificial intelligence. By linking software and IT/cyber) with electric and mechanical or physical parts, data can be monitored and analysed over a communication network. Often, sensors simply gather data that is processed centrally in the cloud. That information is subsequently sent to the location where it is needed. With Edge Computing, data is processed at the point of collection or at the "edge" instead of inon a central server. This reduces latency and the amount of data that must be moved. With an increasing number of IoT devices, a mix of on-site and cloud processing will be needed. The idea itself is not new. To take a simple example to visualise this, windshield wipers on cars get their information from sensors in the vehicle. The car does not need to send rainfall data to a cloud to get back the information on which action is needed. The data is directly analysed and action is immediately taken. This concept is now being applied to more complex situations and implemented in a network of private and government infrastructures. Using this form of computing, autonomous driving, smart homes, and smart grids are made possible.

In public institutions, hybrid combinations of Cloud and Edge Computing can serve as platforms where sensors are combined to support customer relationship management, enterprise resource planning and supply chain systems.[2] For example, equipping roads and snowploughs with sensors, combined with data from weather and driving apps and tweets, improves snow removal, cuts costs by 10 per cent and frees up human and government resources.[3]

8.2.4. Virtual and Augmented Reality

Virtual Reality (VR) enables users to immerse themselves in a digital world. Augmented Reality (AR) shows the world in real time enriched with digital images, and digital and physical objects interact. With augmented and virtual reality and intelligent things, information is added to the space around the user. This helps the user in processing critical information, visualizing scenarios, improving the quality and speed of decision-making, and communicating with others. Examples of application of augmented reality in the public sector can include public infrastructure management and spatial planning, public safety services (such as firefighting), transportation management and tourism.

The World Economic Forum in 2017 stressed the potential: "AR serves as the visual portal to data across the public and private sectors"[4]. In health care, tele-health formats can be supported by virtual examinations that can improve customer satisfaction and result in treatment success. In the area of defence, AR can help soldiers to see and hear under all conditions. Commanders can communicate more efficiently and make more educated decisions, based on first-hand information and their assessment of the situation. With virtual reality tours of buildings and surroundings, wheelchair access can be checked and planned, benefitting persons with disabilities and their caregivers. With hands-free AR devices, maintenance workers can see exactly which action to perform next with guidance from technical experts and supervisors. Augmented Reality also can be effective in training and education, such as by highlighting cultural artefacts or ecological phenomena while providing information about their appropriate use.

Virtual and Augmented Reality technologies are being used increasingly by governments to streamline processes and improve constituent experience. Some of the early adopters were the military, law enforcement and national security agencies. These technologies deliver context, immersion and have the potential to retool training environments, redefine the role of field service workers, improve communication, and reshape public sector business processes. Technological improvements, such as the digital twin concept, which is a cloud-based virtual representation of a physical asset, also are being adopted. Such innovations have the potential to redefine markets, industries and societies.

8.2.5. High Performance- and Quantum Computing

By 2020, 25 billion connected devices will generate more than two zettabyte annual data traffic.[5] By then, High Performance Computers or "supercomputers" executing 1 trillion operations per second will be needed to cope with the massive amount of data. By aggregating computing power, large amounts of data can be processed, thereby solving complex problems in engineering, manufacturing, science and business. High Performance Computing can cut through complexity, understand patterns and detect anomalies. By processing highly complex data with accuracy, such tools are especially useful in forecasting and real-time-prediction. The potential benefits for the public sector can be vast in such areas as combating disease, forecasting and managing traffic flows, monitoring climate conditions, and allocating tax revenues. High Performance Computers can accelerate science and innovation to solve questions that were previously too complex to tackle. Given the high investment in their use, cooperation between public and private actors is beneficial.

Quantum computing, as opposed to regular computing, leverages the laws of nature to process information in a different way. It can compute for different resultsresults simultaneously, thus increasing computing power exponentially. This allows for discovery of relationships between data that otherwise would not have been possible, leading to improvements in health care, climate change monitoring and managing logistical challenges.

Both high performance computing and quantum computing can help process the vast amount of available data faster, paving the way for new insights into ways to overcome obstacles to achieving sustainable development. Combined with new algorithms in the field of Artificial Intelligence, the potential for its use in tackling the challenges of the 2030 Agenda is significant but have yet to be fully exploited by the public sector.

8.2.6. Distributed Ledger Technologies

Distributed Ledger Technologies are ways of storing information in a distributed manner across numerous actors. Instead of information being stored in one central database, it is stored in several locations among multiple actors. Blockchain is a well-known example of a form of Distributed Ledger Technology where value exchange transactions are sequentially grouped into blocks. Each block is chained to the previous one and immutably recorded across a peer-to-peer network using cryptographic trust and assurance mechanisms. Identified as a game-changing technology, Blockchain has the potential to solve such problems as those related to control over information and access, as well as security and privacy of data with a high degree of sensitivity. Given its decentralised nature, blockchain holds the potential to become the ledger for creating decentralized data management systems that ensure users full control over their data. Blockchain is already being used for, among other things, land registries, speeding up registration processes andreducing possibilities for fraud and corruption.[6] These benefits can augment the building of resilient societies in the context of achieving SDGs, by keeping track of data across various activities and actors, authenticating and guaranteeing the execution of tasks, and enabling the emergence of more transparent and accountable governments. Blockchain solutions can even facilitate cash transfers in refugee camps, identify Stateless refugees or register Global Conservation areas.[7]

Distributed Ledger Technologies benefit the public sector in certifying identities, establishing trust, exchanging assets between parties across borders, and sealing digital contracts. Payment and authentication processes can be made more convenient for citizens and can include parties that are currently outside the traditional financial system.[8] Governments in emerging markets are supporting Blockchain, hoping to create an advantage for the population and economy in ways that facilitate development and growth.[9]

The key game-changing innovation of Distributed Ledger Technology is decentralized trust and traceability of information. It allows for more efficient handling of information, and greater security, because the ledgers cannot be tampered with. The holonic architecture of Distributed Ledger Technologies also means scalability issues can be solved logically and transparently.

The advantages of Blockchain over traditional centralized databases are that it can offer resilience in cases where central databases are difficult to secure. It also distributes management of the ledger, increasing trust in it by not centralizing its management in the hands of more actors. This does however require a large peer-to-peer network to resist manipulation of the blockchain. Having only a small number of nodes can increase the likelihood of the blockchain being compromised. To increase the size of the peer-to-peer network also means that there should also be an incentive to do so. In commercial applications such as cryptocurrencies, those incentives are financial. For public services, alternative incentives should be devised. Advances in computing also present a possible risk to the cryptography, technology that Blockchain currently relies on. It is thus crucial to consider security in any application. Additionally, while decentralizing data offers many advantages, it also creates an increasingly complex network that must communicate and validate information constantly, resulting in an exponential increase in energy consumption.

Blockchain has potential public sector application for record management, identity management, voting, taxes and remittances, and even Blockchain-enabled regulatory reporting. A proof of concept was developed, for example, in Ireland.[10] Blockchain can equally be used to better manage development aid by enhancing security and transparency, as well as making international payments more accessible and easier to monitor. In that regard, multiple pilot projects have been launched, such as by the World Food Programme in Jordan,[11] and in connection with banking services for refugees in Indonesia.[12]

UNECE's United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT), which has played a fundamentally important role in the development, promotion and implementation of trade facilitation, is following the Blockchain developments closely and working to help governments understand and use their potential. (See Box. 8.1)

Box 8.1. United Nations Economic Commission for Europe (UNECE) : whitepapers on Blockchain

UNECE

UNECE's United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) is developing two white papers to address the following questions: What is the impact on existing UN/CEFACT electronic business standards and what gaps could be usefully addressed by new UN/CEFACT specifications? What opportunities do these technologies present for improving e-business, trade facilitation and the international supply chain? The second whitepaper on the opportunities for trade facilitation and e-commerce will be available for comment this autumn. How could blockchain technology be used to facilitate trade? What do government decision-makers who deal with information technology need to be aware of? And how could UNECE contribute to the development of this technology as a trade facilitation tool? The international supply chain can be characterised as a set of three flows - of goods, funds and data. Goods flow from exporter to importer in return for funds that flow in the reverse direction. The flow of goods and funds is supported by a bidirectional flow of data such as invoices, shipping notices, bills of lading, certificates of origin and import/export declarations lodged with regulatory authorities. At the same time, an essential requirement for each of these flows is trust. Where there is no trust at all, there will be no flow of goods, funds and related data. Establishing the minimum level of trustworthiness for carrying out trade can be done in a number of ways. Reducing the delays and costs created by the use of trust services has been one of the focuses of trade facilitation which seeks to increase the transparency and efficiency of international trade processes. At the same time, business, legal and other constraints have limited the ability of trade facilitation measures to reduce the costs and delays created by trust services. Today, "blockchain", or Digital Ledger Technology (DLT), has the potential to provide the trustworthiness that traders need, at a much lower cost and using fewer trust guarantors."

Source: UNECE

8.3. Deep Dive into a cluster of new technology revolving around data

Data is becoming critical to many government organizations and will fuel the development of new e-government services.[13] Digital data is defined as "a reinterpretable representation of information in a formalised manner, suitable for communication, interpretation or processing", which is authored by people or generated by machines/sensors, often as a by-product.[14] See table 8.1 for further definitions.

Data is useless if it is not processed and analysed, delivering insights, which are leveraged for better decision-making and the development new products and services.[15,16]

Table 8.1. Definitions

- Algorithms are a set of step-based instructions to solve mathematical problems that are used to query and analyse data. The Algorithm Economy is an emerging concept describing the increasing amount of data analytics performed by economic operators, aimed at tailoring their services and products.
- APIs or Application Programming Interfaces are interfaces for technology products that allow software components to communicate. The Internet of Things has substantially unleashed the volume of machine-to-machine communication.
- Big Data has been coined to describe the exponential growth and availability of data, both structured and unstructured and is defined by 3 V's: Volume, Velocity and Variety.[17]
- Data science is the study of the generalised extraction of knowledge from data by employing machine learning, predictive and prescriptive methodologies, thereby creating direct value on an experimental and ad-hoc basis.
- IoT is the use of interconnected sensors and controls that help gather and analyse data about the environment, the objects that exist within it and the people that act within it, to improve understanding and automate previously manual processes.
- Open Data is information that is open in terms of access, redistribution, reuse, absence of technological restriction, attribution, integrity, no discrimination.[18]
- Open Government Data is data produced or commissioned by public bodies or government-controlled entities, which is then made accessible, and can be used feely, reused and redistributed by anyone.[19]

8.3.1. Integrating government services – public service as a platform

Taking advantage of the data economy and the data that governments already possess can allow for a much greater integration of services. Such digital transformation is based on a data infrastructure which can either be centralized or decentralized, and rely on two fundamental components. The first concerns the re-use of data already collected from the citizens; the second revolves around the use of Application Programming Interfaces (API) as a core component of the public-sector data infrastructure.

One-time provision of data: Governments making better use of data

With digital technology, public administrations can easily retrieve data and limit the number of user requests the data may address. Citizens in turn have the right to modify and/or delete the data and be informed as to how and where the data is being used, in line with data protection regulation.

In the Europe Union, a number of initiatives have been launched around the "Once Only Principle", which aims to streamline the use of authentic data sources and foster machine-to- machine communication across the different IT systems of various public bodies. That approach is expected to generate a total net savings of approximately 5 billion euros per year[20] across the Union. Additional benefits[21] include: (i) ensuring better control of data as the data is only provided once, which reduces errors and discrepancies; (ii) helping public administrations work faster, more transparently and more efficiently, thereby saving costs; (iii) reducing fraud through the use of consistent and authoritative information; and (iv) making evidence-based decisions through the use of complete and consistent information.

Use of Application Programming Interfaces, and their ability to securely connect applications across government and support the development of new services

Moving towards API-based information systems can improve the efficiency of business operations by providing stronger integration between the organizational value chain and partners such as suppliers and national public administrations. APIs are the connecting links between applications, systems, databases and devices.[22] Accessing data already collected by public administrations allows the use of an internal API to improve public services. Based on their access rights, public administrations can retrieve the data they need, such as an address, a profession, or a social security number.[23]

Several countries, such as Estonia and Finland, along with New South Wales in Australia are using APIs to strengthen government platforms and turn governments into fully integrated one-stop-shops.[24] In Singapore, the Land Authority saved $11.5 million in application costs for 70 government agencies through geospatial data-sharing through the GeoSpace's APIs and Web services. Machine-to-machine access among data-enabled agencies make it possible to adjust applications 30 per cent faster and cut storage costs by 60 per cent. It also eliminates data duplication.[25] There are several instances of non-government API use as well. The De Waag Society in the Netherlands, for example, uses API for smart cities and the preservation of cultural heritage data. Setting up public or so-called open APIs can also stimulate businesses and civil society to develop new services that address areas that may not fall under the direct competence of the government. Box 8.1 further explores Government as an API.

Box 8.2. Government as an API

Estonia created X-Road,[26] an application network for exchanging data among agency systems so that all government services are effectively available in one spot. In addition to offering querying mechanisms across multiple databases and supporting the secure exchange of documents, X-Road seamlessly integrates different government portals and applications.

The private sector can also connect with X-Road to make queries and benefit from access to a secure data exchange layer.[27]

X-Road has made it possible to bring 99 per cent of public services online. On average, 500 million queries per year are made annually using X-Road. Indeed, its use has been estimated to save as many as 800 years of working time. The solution has been equally successful in its roll-out to Finland, Azerbaijan, Namibia, as well as the Faroe Islands. Furthermore, cross-border digital data exchanges have been set up between Estonia and Finland, making X-Road the first cross-border data exchange platform.

Source: https://e-estonia.com/solutions/interoperability-services/x-road/

8.3.2. Insights for decision-making and intelligence at the point of action

Data analysis can bring unprecedented insight. Governments are able to take advantage of the data revolution by making use of insights gained through data analytics as well as formulating their response at the point and time of action.[28] As shown in the *2018 United Nations E-Government Survey* as well as in other international benchmarks and indicators, governments have been increasing their efforts to publish open data.[29] This reinforces the drive to align with good governance principles, and underlines the economic and societal benefits governments can expect from open data. Going beyond data publishing, governments are starting to understand the benefits of re-using their own data more efficiently and effectively. As highlighted in the report on Open Data Maturity in Europe 2017, 19 European countries are now using open data in their decision-making. Successes range from better urban planning, thanks to the systematic use of geospatial data in Denmark, to efficiency in public procurement spending in Slovenia. These examples are not limited only to Europe. The use of open data assisted in the formulation of solutions to eliminate or reduce air pollution in Mexico City, for which it received an award at the Data for Climate Action Challenge (D4CA)[30] Australia has been exploring ways to improve data sharing for more efficient research[31] and has renewed its commitment to open data by signing the Open Data Charter in April 2017.[32]

8.3.3. Insights and Data-Driven decision-making in the public sector

Although evidence-based policy-making is not a novel concept, the growth in the volume of data sources as well as in analytics tools, present an opportunity to deliver better informed policy-making. It also has the potential to accelerate data collection, thereby reducing the time spent on policy cycles and iterations. Analyses performed on the data collected can equally be refined.

Algorithms are another useful tool, as they drive digital innovation and redefine the approach to technologies, leadership and execution.[33] Algorithms can determine information flows and influence public-interest decisions, which, until recently, were handled exclusively by human beings. Data analytics also witnessed a shift from sample focus groups to exhaustive analysis or 'real' demand which is increasingly recognised as limiting the bias of statistics and forecast inaccuracy. Taking advantage of Big Data in the public sector also implies expanding the data pool of public-sector information and statistics to include new data sources stemming from the digital economy. These sources include mobile data, Internet of Things, and social media, among others. Finally, data held by private entities such as in the health and financial sectors, as well as eCommerce platforms could also aid policy-making.

Data-driven decision making can be applied in different areas of the public sector. For example, in Latvia, insolvency data is used to plan policies or support operations in both the public and private sector[34]. In the health sector in France, as part of the implementation of the national deployment of telemedicine strategy, the French Ministry of Health has been implementing a data-driven approach to manage acute stroke.[35] It combines data on the distribution of population using census data and the distribution of geographical location of health facilities in the area. Box 8.2. on the Global Pulse Initiative, 2009, underlines how data has been used bu the UN in the context of the SDGs.

To provide a practical illustration for the above, typical applications of data-driven insight for the public sector can advance the following goals, among others:

- SDG 3 on ensuring lives and promoting well-being by developing health-care systems which detect epidemics in their early stages, compile diagnostics, analyse prescription drug use and improve access to medications at the right time and in the right place. This has been witnessed successfully during the ebola outbreak. Further research is currently conducted on monitoring the spread of mosquitoe borne disease.

- SDG 8 on decent work and economic growth by adopting a more prospective vision of the employment market based on the use of professional social networks and job boards. The idea is to enhance Machine Learning engine tools so as to match job offers with job applications.

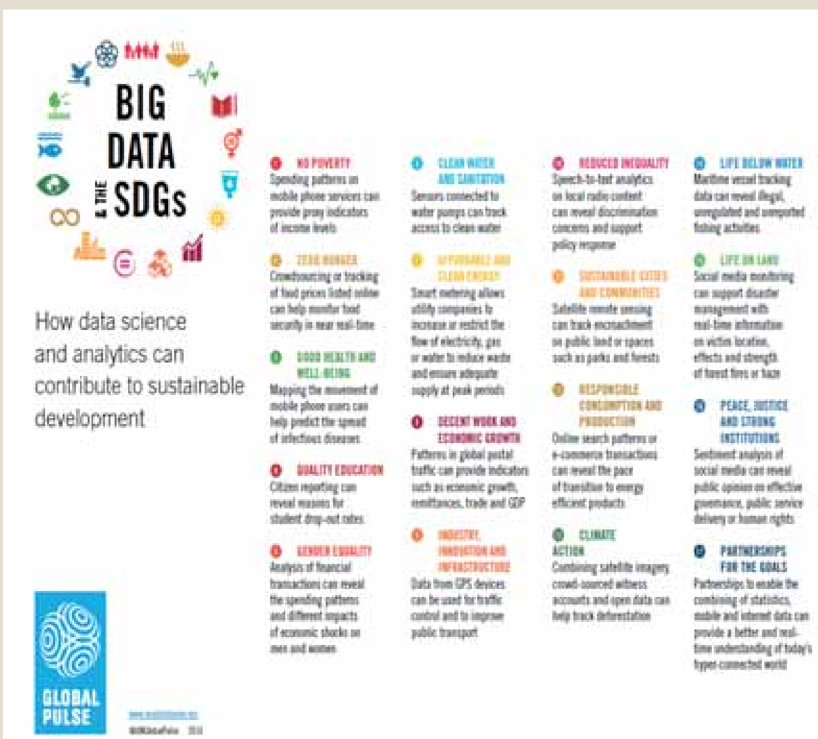
- SDG 14 on the conservation and sustainable use of oceans by such projects as Life Below Water & Resource management. One example is the Global Fishing Watch[36] prototype, developed by Oceana, Google and Skytruth, which combines data gleaned from scanning behavioural patterns of vessels, in order to identify which are potential fishing vessels and which are not.

- SDG 16 on peace, justice and strong institutions by offering enhanced analyses in support of security, combatting crime, and fraud prevention. Data mining techniques, for instance, can drive the analysis of large amounts of text and evidence to support the structuring of evidence in court cases.

The challenges in implementing data-driven and insights-based policy-making are further developed in section 8.5.

Box 8.3. Global Pulse Initiative, 2009[37]

Global Pulse is a flagship initiative of the United Nations Secretary-General on big data. Its vision is a future in which big data is harnessed safely and responsibly as a public good. Its mission is to accelerate discovery, development and scaled adoption of big data innovation for sustainable development and humanitarian action. The initiative was established based on a recognition that digital data offers the opportunity to gain a better understanding of changes in human well-being, and to get real-time feedback on how well policy responses are working. To this end, Global Pulse is working to promote awareness of the opportunities Big Data presents for sustainable development and humanitarian action, forge public-private data sharing partnerships, generate high-impact analytical tools and approaches through its network of Pulse Labs, and drive broad adoption of useful innovations across the UN System.



Source: http://unglobalpulse.org/

8.3.4. Insights at the time and point of action: streamlining the use of real-time data

Sensors monitoring traffic, air pollution, energy consumption, among other things, combined with increasing mobile data, are making real-time data available. The benefit of real-time data is its ability to prompt action at very specific locations, as described in Chapter 3. Real-time data, for instance, was used to find housing solutions for victims of natural disasters, such as in the aftermath of the earthquake in Emilia Romagna, Italy.[38] Rapid mobile phone-based surveys were deployed by the Red Cross to complement traditional communication methods, which shaped the response during the critical first days of the Ebola outbreaks in Sierra Leone, Benin, Guinea and Cote d'Ivoire.[39]

The United Nations Food and Agriculture Organisation (FAO) has developed a Water Productivity Open-access portal, known as WaPOR, which uses real-time satellite data to monitor water productivity. That real-time data allows farmers to optimise the use of water in their irrigation systems, rendering a more reliable crop yield.[40] Also notable is the use of real-time data in Slovenia to protect vineyards from pests. Singapore has announced its intention to make port management more efficient with the use of drones capable of capturing real-time data, data analytics as well as mobile applications.[41] These are just a few of the examples of real-time satellite data use.

Box 8.4. Streamlining the use of Earth Observation

The use of Earth Observation data and Geographic Information Systems (GIS) has already been underlined in the *2016 United Nations E-Government Survey* as a promising technology for improving service delivery. With an increase in the availability of satellite data worldwide, thanks to NASA's Earth Observing system[42] and the European multi-stakeholder Copernicus programme,[43] data, and the insights gleaned from it, can be delivered more rapidly. Indeed, the different applications of satellite data, be it GPS or Earth Observation data, have a specific shelf value. Satellite revisit times have proven critical in providing supporting data in the context of wildfires in the United States,[44] Australia and Italy,[45] Initiatives are growing across the globe addressing multiple environmental issues. The Satellite-based Wetland Observation Service (SWOS), for example, makes use of Earth Observation data, which enables large-scale dynamic monitoring of the evolution of the wetlands in Europe, Africa and Asia[46]. Farming by satellite is another advantage of Earth Observation data, which can assist in monitoring crops such as rice.[47] In June 2018, to drive innovation leveraging Earth Observation data, the EU has launched the Data Infrastructure Access Services (DIAS) providing access to data, cloud services as well as data tools and professional support services.[48]

Source: http://swos-service.eu/

Data use is expected to grow exponentially in the next decade and offer the ability to systematically analyze and act in real time to solve more challenging business problems, enhance competitive advantage and lead to more informed decisions in today's tightly connected world.

8.4. Deep dive into a cluster of new technology revolving around AI and Robotics

The term "Artificial Intelligence", or AI, has been around for nearly 60 years, but it is only recently that AI appears to be on the brink of revolutionizing industries as diverse as health care, law, journalism, aerospace, and manufacturing, with the potential to profoundly affect how people live, work, and play.

AI can be mono- or multi-layered, performing simple automated tasks to highly advanced automation. While robotic process automation enables machines to do repetitive and rules-based work, AI enables robots to do judgment-based processing, such as thinking and learning (machine intelligence) and even making decisions (synthetic, computer-based AI).[49] Robots can appear in the shape of cyber-physical systems, imitating humans. These systems perform tangible work linked to the physical world, such as supporting the elderly, treating patients, and even harvesting fields and manufacturing cars.[50] Robots can also appear formless like virtual assistance on websites, apps, and platforms. By automating responses to matters that arise most frequently, employees can focus on more complex inquiries. The benefits lay in greater capacity, efficiency, service quality, and accuracy. A recent policy inat the European Union level is further illustrated inwithin Box 8.4. Europe rolls out an integrated approach to Artificial Intelligence.

Box 8.5. Europe rolls out an integrated approach to Artificial Intelligence

In April 2018, the European Union chose to pool its resources to foster innovation through the use of artificial intelligence. The Declaration[51] signed by European countries aims to ensure a sustainable vision for AI to thrive, by collectively addressing ethical and societal challenges linked to its growing and pervasive use. This states "where needed [to] review and modernise national policies to ensure that the opportunities arising from AI are seized and the emerging challenges are addressed." The European approach is based on three pillars.[52] The first foresees an increase in financial support, to reach 20 billion Euros by 2020, thereby promoting the uptake of AI in both the public and the private sector. The second pillar is based on ensuring framework conditions for socio-economic success. Actions here aim at accompanying the transition of the labour market by modernizing education and training. The third pillar addresses the development of an adequate ethical and legal framework. The first series of draft guidelines is expected by the end of 2018 and will build upon the Union's Charter of Fundamental Rights[53].

Source:http://ec.europa.eu

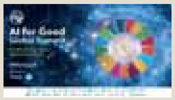
AI has the potential to bring many societal benefits. It can impact all sectors and industries, with the ability to improve mobility, mortality rates, education, hygiene, food provision and supply, and decrease emissions, crime, and human error. Robotic automation is slowly assuming repetitive tasks previously done by low-paid workers, although low-paid tasks are less likely to be replaced by expensive robots, at least, not in the short term.[54]

Still, AI is expected to displace many low-skilled workers. Robots already perform many jobs on the assembly line, and that trend is expected to increase. According to a World Economic Forum study in 2016, around 5.1 million jobs across 15 countries are expected to be lost to Artificial Intelligence over the next five years alone. A study by the United Nations Department of Economic and Social Affairs found that up to 80 per cent of all existing jobs could be at risk of being automated in the long run.[55]

Although many tasks can be automated, there are still numerous challenges to be addressed, including ethical considerations, social acceptance and economic aspects. Some decisions cannot be left entirely to machines. Human beings can consider unique circumstances when making decisions, which artificial intelligence may never be able to do. Data privacy and security concerns must also be carefully considered. In designing AI solutions, preventing external attacks, anomalies and cyber-attacks must be addressed. Ethical issues, ranging from preventing discrimination and biases to aligning AI systems with respective applications should also be considered. AI development requires the involvement of experts from multi-disciplinary fields such as computer science, social and behavioral sciences, ethics, biomedical science, psychology, economics, law and policy research. This has been the case, as illustrated in Box 8.5 during the AI for Good Global Summit.

Box 8.6. AI for Good Global Summit[56]

The AI for Good series is the leading United Nations platform for dialogue on beneficial AI. The Summit is organized by ITU in partnership with the XPRIZE Foundation, the Association for Computing Machinery (ACM) and 32 sister United Nations Agencies. The AI for Good series aims to ensure that AI accelerates progress towards the achievement of the United Nations sustainable development goals. The AI for Good Global Summit in June 2017 was the first event to launch inclusive global dialogue on the actions necessary to ensure that AI benefits humanity. The action-oriented 2018 Summit identified AI applications capable of improving the quality and sustainability of life on the planet. The Summit also formulated strategies to ensure trusted, safe and inclusive development of AI technologies and equitable access to their benefits.



Source: https://www.itu.int/en/ITU-T/AI/2018/Pages/default.aspx

8.5. Harnessing technology for societal resilience

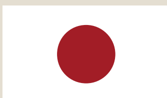
The Internet and the development of ICTs have enabled governments to reduce administrative burdens as well as reorganise their services, from design to delivery. Nonetheless, harnessing fast-evolving technologies poses a number of challenges for governments. Whereas technology is a tool, people are key in driving the development of innovative services and products. The pervasive nature of technology calls for more symmetry across the different operators and users. Ethical questions also must be addressed.

8.5.1. People and Technology driving new uses and new services

Complex emerging crises herald deep changes in how people live together on the planet. The more people are implicated in the management of these changes the better they can be catalysed to change negative behaviours. However, carrots and not sticks are required in order to productively engage populations. Europeans with their "Open Innovation 2.0[57]" and the Japanese "Ba" approach, (see Box 8.6), highlight the need for change in innovation policy in the coming decades if technology is to play a constructive role in development. That requires deep collaboration between the Information Technology community and society at large. On its own, purely technological advances devoid of context can and often do drive unsustainable material consumption and exploitation. Hence, the broader societal challenge is to create the conditions for sustainable and resilient socio-economic shifts. Increased flexibility in decision making systems will be needed to allow for different perspectives to emerge, in order to challenge the linear extrapolation of the past when seeking new solutions. This in turn requires out-of-the-box thinking and large-scale experimentation to assess impact in real world settings.

Box 8.7. Process innovation insight

Source: https://ec.europa.eu/digital-single-market/en



Source: https://ji-network.org/en/

The European approach to a modern innovation policy is based on the Open Innovation 2.0 paradigm characterised by citizen participation and prototyping approaches to socio-technical challenges in real world settings.

Similarly, the Japan Innovation Network (JIN)[58] is driven by Professor Ikujiro Nonaka's ideas on "Ba" – a place for deep interaction and wisdom sharing among stakeholders to create common value. JIN acts as an innovation accelerator, fostering both creativity and productivity.

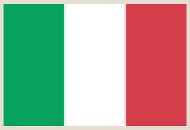
They are recognised as two descriptions of one key component in modern innovation ecosystem thinking: deep collaboration.

E-government at its core can enable better interaction within the entire society, leading to socially sustainable and acceptable solutions to complex societal issues. Key to balancing the inevitable techno-societal transformation is the creation of a safety net. "There is a need for better balance between short-term economic gain on the one side and ground-breaking research by the universities of science and technology that tackle grand societal challenges on the other."[59] In achieving societal resilience, access to high-speed Internet is key – everyone should be included in the digital economy. This point has been underscored in numerous digital for development initiatives launched by the United Nations and the European Union.

With the rise of new technologies comes the fear of unemployment, which creates anxiety and perceived insecurity.[60] Artificial Intelligence, in particular, may thwart human interaction for certain processes, as new demands and functions arise. History has indeed shown that machines can replace humans, but many experts agree that they can also create new functions for human beings, albeit, equipped with a different skill set. [61] AI will not be an exception. [62]

Artificial Intelligence and related issues - from big data to artificial vision - have been in fashion for several years. At the same time, AI algorithm and technology experiments span multiple sectors of the economy and society, from finance to medicine. Nowadays, AI techniques and the immeasurable storage and processing capacity of modern data centres make it possible to analyze signals and images collected by modern biomedical instruments. For example, in case studies on the early diagnosis of neurodegenerative diseases using non-invasive MRI to focus on the visual or automatic analysis of particular anatomical districts, such as, for example, the hippocampus in the case of Alzheimer's disease, AI can identify changes in the brains of people likely to get Alzheimer's disease almost a decade before doctors can diagnose the disease from symptoms alone. (See box 8.7.)

Box 8.8. AI and deep machine learning for early diagnosis of brain diseases



A team of researchers at the Physics Department of the Bari University in Italy and the local branch of the National Institute of Nuclear Physics has developed a novel brain connectivity model to reveal early signs of Parkinson's disease in T1-weighted Magnetic Resonance Imaging scans. The same group reported the possibility to detect Alzheimer's disease with analogous techniques just a year ago.

Parkinson's disease is the most common neurological disorder, after Alzheimer's disease, and is characterized by a long so-called prodromal or early phase lasting up to 20 years. The Italian research team lead by Prof. Bellotti has developed a novel approach using complex networks based on the publicly available Parkinson's Progressive Markers Initiative (PPMI) database, a mixed cohort including 169 healthy controls and 374 Parkinson patients. In particular, their analyses allowed the detection of the disease in subjects reported within the prodromal phase: accordingly, when tremor symptoms are yet to appear. The algorithm reported a classification accuracy of 93 per cent,% and these results were cross-validated hundreds of times to grant the statistical robustness of the results.

The physicists of the Bari Medical Physics Group[63] have developed cross-disciplinary research approaches and big data techniques with clinical purposes. The team was awarded by Harvard Medical School for the development of an accurate machine learning tool for schizophrenia diagnosis. These big data analyses, usually computational intensive, are performed thanks to the ReCaS computer facility.

Source:https://www.recas-bari.it/index.php/it/) .

Space science and technology are always at the forefront of human development as they help to break barriers. Through research and innovation, spin-offs stemming from our efforts in space impact virtually all fields of human activities. Utilizing the frontier technologies in outer space has also offered us new insights, knowledge and understanding of the functioning of our planet and its four interconnected spheres: lithosphere, hydrosphere, biosphere, and atmosphere. Space technologies have an impact on almost all aspects of development and the United Nations promote the utilization of space science and technology for sustainable economic and social development. Space is an invaluable tool that can help the UN in achieving the goals and targets of the 2030 Agenda for Sustainable Development and its 17 SDGs. Nearly 40% of the SDG indicators underpinning the goals are reliant on the use space science and technology. The SDGs provide an additional framework for the work of United Nations (See Box. 8.8) as it employs new, more holistic and tangible approaches to its traditional capacity-building role.

Box 8.9. The United Nations Office for Outer Space Affairs (UNOOSA)

UNOOSA

The United Nations Office for Outer Space Affairs (UNOOSA) is the United Nations office responsible for the promotion of international cooperation, and for leading and facilitating the promotion of peaceful uses of outer space. UNOOSA is as the main UN entity dealing with space matters and coordinates UN activities in the utilization of space-related technology for improvement of human conditions globally.

UNOOSA, as a global facilitator, plays a leading role in promoting the peaceful use of outer space and the utilization of space-related technology for sustainable economic and social development. The Office's vision is to bring the benefits of space to all humankind by strengthening the capacity of United Nations Member States to use space science technology, applications, data and services by helping to integrate space capabilities into national development programmes. UNOOSA is part of the UN secretariat with its headquarters in Vienna and two offices in Bonn and Beijing.

UNOOSA serves as the secretariat for the General Assembly's only committee dealing exclusively with international cooperation in the peaceful uses of outer space: the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). It is also responsible for implementing the Secretary-General's responsibilities under international space law and maintaining the United Nations Register of Objects Launched into Outer Space.

Through its Programme on Space Applications, UNOOSA conducts workshops, training courses, technical advisory missions and other projects worldwide as part of its capacity-building efforts as it strives to promote and facilitate the use of space for the benefit of all United Nations Member States, with a special focus on developing nations. UNOOSA has conducted over 300 capacity-building projects in countries all over the world for over 18,000 participants.

Furthermore, to address global challenges including climate change, disaster risk reduction and building more resilient societies, the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) was established in 2006 and is implemented by UNOOSA to support United Nations Member States in accessing and using satellite data for all phases of disaster management – disaster recovery, risk reduction and emergency response.

Additionally, UNOOSA serves as the secretariat of the International Committee on Global Navigation Satellite Systems (ICG) and as a permanent secretariat to the Space Mission Planning Advisory Group (SMPAG), which concentrates on asteroid impact mitigation.

Source: http://www.unoosa.org/oosa/en/aboutus/index.html.

8.5.2 Symmetry and ethics as the way forward

It is quite important for governments to understand the challenges and opportunities of the new technologies and to be aware of new public policy professions that specialize in machine learning andbut also data science ethics.

The main challenges raised by future and emerging technologies should be clarified. The first concerns data ownership, particularly who owns the data and the algorithms used to access and manage it. A second challenge concerns net neutrality64, which requires a non-discriminatory infrastructure and transparency in network management practices. The third is ethics. The question, for example, of whether one would prefer to undergo surgery by a robot or by a human surgeon raises a number of ethical concerns. Considering the broad scope of the above topics, the *2018 World Economic and Social Survey* is equally addressing a number of these challenges.

The 2030 Agenda has introduced the concept of a data-driven governance, highlighting the challenge to "increase significantly the availability of high-quality, timely, reliable and disaggregated data by

2020". To do so, governments require systemic policies for data production, collection, management and analysis. Society will have to adapt in order to take advantage of ICTs. Today, the hierarchical structures of governments are being challenged as these new technologies equip individuals and informal networks and communities with the necessary tools to better participate in public decision-making processes, and have a societal impact at a much faster pace than ever before. This implies discussing and redefining values, which, in turn, begs the question of the nature of a coherent set of policy actions to address the challenges. Open Innovation invites policymakers to think outside the policy toolbox. Creating linkages between communities could be valuable in that regard. What would Watson[65] do? If the citizens owned their own data, what would they do? The notion of "prosumer" – producer and consumer – is rising, as can be seen by the increase in blockchain-based applications: everyone can create- and benefit from ICT use.

However, the Internet has been developing in an asymmetrical manner, with data in the hands of a limited, albeit growing, number of players as examined by the *2018 World Economic and Social Survey.* Another challenge is the nature of ICT use where users leave a digital footprint. This serves to give away their data, which is then served back to them in the form of commercial offerings which also heightens fears of ever more intrusive monitoring. The rise of AI, as examined in the previous section, also carries uncertainty in terms of work placement, skills and overall employment. Symmetry can be achieved by providing a mechanism which will reduce the gap between the data providers and the data users. The notion of a "citizen salary" is gaining some traction as a way to create a more symmetric model. The idea is to pay citizens as 'data generators' for the data they produce, which has economic value when it is in turn re-used. By being paid for data generation, citizens are rewarded for their efforts and encouraged to continue producing valuable data. The questions arises as to whether the public sector should equally purchase data from its citizens.

8.6. Conclusion

Transforming the world and realizing the sustainable development goals by 2030 will require a paradigm shift in the way societies govern themselves. It will require rethinking the role of government and the way it interacts with civil society and the private sector in managing the public affairs of a country and responding to the needs of its people. ICTs and e-government have the potential to ensure that no one is left behind in sustainable development. The 2030 Agenda specifically recognized the vital role of these two components as a catalyst for realizing its vision, and stated that "the spread of information and communications technology and global interconnectedness have great potential to accelerate human progress, bridge the digital divide, develop knowledge societies such as scientific and technological innovation among different sectors".

This chapter has considered issues facing governments in light of the widespread deployment and use of fast-evolving technologies, such as Artificial Intelligence, in e-government. The scope of the endeavour is vast and carries human rights, technical, and socio-economic challenges. These questions are not only critical to the e-government mission but represent some of the most difficult questions facing society today. Finding answers will not be easy, nor are there turn-key solutions. However, Member States can leverage their influence to lay a foundation that will bring answers within reach.

From resource allocation, predictive public utilities maintenance, to managing public hotlines, health-care chatbots and real-time verification of digital identity, governments around the world are deploying AI for both back-end and front-end public services. But AI can also actually result in more social exclusion such as through its impacts on jobs and job skills.

This will be the fastest transition on record for humankind. As seen, societies need to prepare for the impact of new technologies on the job market. In reviewing the implementation of the SDGs, the 2017 High Level Political Forum Ministerial Declaration acknowledged "the transformative and disruptive potential of new technologies, particularly advances in automation, on our labour markets, and on the jobs of the future", and recognized the need "to prepare our societies and economies for these effects". As initiated in the 1990s with the beginning of the digital revolution and reiterated in the 2017 High Level Committee on Programmes paper on future of work, technology will affect many aspects of society with unprecedented speed, scale and breadth. Policy responses must take an equally comprehensive and proactive approach to harness the challenges of technology into opportunities. This calls for a system-wide effort, building on existing initiatives, that reflects the 2030 Agenda for rights-based, normative and integrated solutions tailored to the needs of individual Member States as each strives to achieve inclusive and sustainable growth. Efforts to implement AI in government should be approached in a way that augments human capital and does not reduce jobs. With these principles in mind, the United Nations System should lead governments in handling the use of AI under the principles of 2030 Agenda.[66]

The Agenda pays particular attention to effective means of implementation, including the need for special efforts to stimulate digital transformation and to foster and share technology and policy innovation, such as through effective and meaningful deployment of AI.

Without targeted measures, the digital divide will widen with profound implications for inequality, and the principle of leaving no one behind will be challenged by the fourth industrial revolution, unless the needs of both developing and least developed countries and all segments of the population are considered. Scientific knowledge, technologies and know how spawned by the digital age will require careful management to eliminate the risks of new and wider digital divides. To have a significant social impact in using new technologies, governments should partner with the private sector in research and development, including addressing the broadband connectivity gap.

Digital transformation will not only depend on technologies, but also require a comprehensive approach that offers people accessible, fast, reliable and personalized services. The public sector in many countries is ill-prepared for this transformation. Traditional forms of regulation may not apply, and thus, a paradigm shift in strategic thinking, legislation and regulation is needed. Governments can respond by developing the necessary policy, services and regulation. This response will serve as a mission statement and endorse the role of education around core objectives. Services can be delivered to address specific needs and adapted for a defined audience, administration, business or citizen. Law-making can take the form of legally binding acts, regulation, directives, norms and standards that define the parameters of what can and cannot be done. Some governments have already started to prepare ethical and legal frameworks on AI development. It is important to embed new technologies in specific social contexts and ensure that they are properly regulated to have a positive impact on society.

However, many of these legal instruments are slow in being "brought to the market". It is therefore principles such as effectiveness, inclusiveness, accountability, trustworthy and openness that should direct the technologies and not the other way around. Similarly, functionalities should determine the technology to be used. Governments around the world will need to rethink their governance models to meet the core principles of the 2030 Agenda and to respond to demands of the people for more responsive and inclusive services. While e-government was about bringing services online, the future will be about the power of digital government in leveraging societal innovation and resilience and transforming governance to achieve the Sustainable Development Goals.

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64 Note: Over the years, policy debates and regulations on net neutrality have crystallised a few key principles, please see Internet Governance Forum (IGF) for ongoing debate on this issue.

65 Note: Watson is a deep-machine learning AI computer system capable of answering questions posed in natural language, developed in IBM's DeepQA project by a research team led by principal investigator David Ferrucci. Watson was named after IBM's first CEO, industrialist Thomas J. Watson. For details, see: https://www.ibm.com/watson/

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