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THE INTERNET OF THINGS – A PHYSICAL LOGICAL AND BUSINESS MODEL

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Abstract

Background. The dynamics of changes at the beginning of the 21st century create a new dimension of the economy based on information and knowledge. The Internet of Things, hyper-connectivity, large data sets, cloud solutions, automation, and robotisation permeate more and more areas of economic existence. The boundaries between what is physical and what is digital are blurring, making the existing ways of managing business processes likely to be insufficient, of which not all entrepreneurs are aware.

Research aims. The aim of this article is to identify the markers of business transformation processes and to demonstrate the necessity of adaptation activities of enterprises to the challenges posed by the future. We will hypothesise that the process digitisation identification set in the form of a model can become an instrument supporting business management in a strategic perspective.

Methodology. In the research process, an idiographic approach was applied with the use of understandable methods that were intended to provide an opportunity to gain insight into the "essence of things". In the process of material acquisition, the analysis of available documents and literature was used, and due to the specificity of the topic, an overview of existing digital sources was made. The technique used was semantic analysis, the co-occurrence of terms and materials usefulness for this publication.

Key findings. The collected and analysed material allowed to make a general conclusion indicating the necessity of implementation of innovative technologies into the business management processes conditioning the development and functioning in the future. The requirement of adaptation to the digitisation era may result in many socio-economic benefits. A simplified model form of identifying the factors of digitisation, tools for process reorganisation and transformation areas in enterprises can be a helpful instrument of business management.

Key words: smart business solutions, information technologies, virtualisation

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INTRODUCTION

The knowledge economy ecosystem which symbolises this century is the symbiosis of technology and information. Functioning in a technologised world geared towards knowledge, digitisation, mechanisation, and robotisation requires the coexistence of people and devices. Time, space, and knowledge are gaining new importance. Today, the fate of the world is being shaped by forces and spoils of technology which only a few decades ago were no more than speculation in the minds of futurologists. Information, internetisation, computerisation, and robotics are penetrating into more and more areas of human existence. The lines between the biological and the digital are becoming blurred.

Our reality is becoming based on information technology, and it seems that nothing can resist this trend (Kruk, 2015). The level of technological advancement directly affects the implementation and diffusion of innovation, thus setting the level of competitiveness of the economy (Smart Report Industry Poland 2017, 2017). It is therefore worth taking a closer look at the symptoms of metamorphism which today's organisations and ordinary people are subjected to as a result of the injection of new technologies into the realism of events and economic and social processes at the beginning of the 21st century.

Innovative IoT technological solutions are not a fad, but rather the result of striving to survive according to the Darwinian theory of adaptation. And as Elon Musk says, "Any company that does not develop, stands still with its technology, is overtaken by competitors" (Musk, 2017). To survive you have to be in tune with the mainstream trends, processes and forward-looking events.

Digital information is the fundamental force shaping the second technological era. The Digital Yearbook report prepared by the We Are Social website indicates that in 2016 there were around 3.42bn people with Internet access – nearly 46% of the entire world population, with the trend increasing. Current traffic leads to an increase of 30GB of data volume on the Internet in a second. The rate at which information is generated will continue to increase, with the Internet doubling its capacity at least every two years. The above data clearly shows that business analytical processes related to data and information on the Internet face new, unprecedented challenges.

Companies and providers of innovative solutions are catching up in terms of digital transformation using the so-called "Third Platform". This set of technical and technological solutions covers collection and processing of data in the cloud, mobile technologies, and analysis of big data repositories and social media in business. Trillions of connected devices with huge computing power transmit data and the information it contains, causing reality to bend.

A lot of time has passed since IBM's Deep Blue defeated the chess master Garry Kasparov. Artificial intelligence algorithms enabled Google's DeepMind to defeat the Go champion, and the bot Libratus defeated four poker players. The robots autonomously compile data, search for potential dependencies and provide their own solutions. People are gradually being replaced by robots. Devices communicate with each other, cooperate with each other, assist or replace humans in repetitive activities. In accordance with M. Weiser's (Weiser, 1991) "good servant" principle, smart objects should always be ready to perform their assigned tasks and functions providing maximum utility with minimum absorption of human attention.

The presented article focuses on the complex and interdisciplinary field of new economy created by information, knowledge, and modern technologies including but not limited to the Internet of Things, hyper-connectivity, Big Data, Artificial Intelligence, and Cloud Based Solutions. This results in a small number of books and research in this field especially when it comes to the application of these technologies in management and economic sciences. The available literature is either focused on technical and technological aspects of IoT (Guinard, & Trifa, 2016; McEwen, & Cassimally, 2013; Hanes, & Salgueiro, 2017; Buyya, & Dastjerdi, 2016) or IoT practical applications (Miller, 2015; Szpor, 2015; Kranz, 2016). There are also authors who focus on Big Data, data strategy and data mining aspects of IoT (Cukier, & Mayer-Schonberger, 2017; Marr, 2017) or human-machine relation and robotisation (Kurzweil, 2006; Brynjolfsson, & McAfee, 2016; Ford, 2015). What is characteristic in the basic literature review is the fact that all significant papers are dated to 2014 and beyond which confirms the assumption that the analysed field is new and should be further examined in scientific terms.

Today's Internet is the Internet of people. It is people who use devices to initiate the communication process and communicate. The IoT will reverse this perspective. And though people will be participants in the communication process, the Internet will serve machines. Connecting computers, machines, and sensors with the aid of software enabling communication to be initiated will result in the creation of a cohesive system able to operate without human involvement – a system operating according to its own intelligence. A system which is more than the sum of the interconnected units. The synergy of the system's components, or rather of how the devices work, how they collect, analyse, and use the data, qualifies them as smart (Kolasińska-Morawska, & Brzozowska, 2017). In many ways the IoT is an evolution of early M2M (Machine-to-Machine) networks as a new functional model.

IOT DIGITAL FOOTPRINT, ANALYTICS, AND DATA MODELS

The electronic economy, also known as the e-economy, the digital economy, or the economy of bits is "a method of doing business using modern information technology and computer networks, it is part of the merging and combining of IT and telecommunications technology, and knowledge" (Żurak-Owczarek, 2013). Against this background, "industry 4.0", "distribution 4.0", and integrated supply chains are determined by new technologies. The most common include robotics, smart factories, business intelligence, cyber-physical systems, embedded systems, machine-to-machine communication, smart logistics, RFID*/AIDC, the Internet of everything, and man-machine interface in a variety of applications (Pfohl, 2016).

The Gartner research institute estimates that by 2020 the IoT will include around 26 billion devices**. A rival company Allied Business Intelligence (ABI) claims that this figure will exceed 30 billion. Technological Tycoon Cisco claims that there will be 50 billion of these devices in that time frame. According to Nelson Research, meanwhile, this will be 100 billion; Intel talks of 200 billion, and Intel Data Corporation

* RFID – radiofrequency identification technology using special tags with encoded information about a given product (Kolasińska-Morawska, 2011).

** The Coca Cola vending machine functioning at Carnegie Mellon University since 1982 is considered the first intelligent network device. It was equipped with sensors and connected to the Internet. This allowed it to pass on information about numbers of drinks and their temperature.

(IDC) of 212 billion (Miller, 2016). According to the report by IDC (International Data Corporation) Worldwide Semiannual Internet of Things Spending Guide the world Internet of Things market will grow year on year by around 16.7%. The world Internet of Things market will reach a value of $1.5 trillion in 2020,* and in 2024 this sum will hover around the $3tn mark (Domaradzki, 2016). In Poland, expenditure has been growing on average at a rate of 20.8% year-on-year. Investments in IoT** in Poland in *2014 reached $US2bn. It is expected that they will rise to $3.7 billion in 2018 to reach $5.4 billion in 2020.**** Not all segments of the Polish IoT market will develop as quickly. In 2018, the vehicle monitoring market will have the greatest value ($344m), along with the smart grid ($227m) and manufacturing ($183m).**** However, the household appliances market will grow fastest by 2018, by 46%, there will also be rapid expansion of the market for automotive solutions (an increase of 39%) and of solutions used to create personalised promotions based on such things as beacons (36%). In mid-2016, there were 2.23 million active SIM cards in Poland used to communicate with machines (M2M – *Machine-to-Machine*), representing a 45% increase from the end of 2013 (Kaczmarek, 2017).

In this context, the Internet of Things (IoT) is not so much interdependent components in the form of devices that collect and transmit data and network infrastructure, it is IT systems aggregating data and methods, techniques, and analytical procedures to enable smooth processing of the material received. In the process of implementation of the IoT in an organisation, business analytics is *de facto* the most important aspect shaping the system's value. Faced with the necessity to process increasing amounts of data, Data Science is becoming the DNA of an organisation. Analysis and inference skills attest to the effectiveness and efficiency of the system.

Big Data operations can be used in combination with predictive analysis and elements of artificial intelligence. The resulting material is used for highly complex projects that require dynamic adaptation of a means of action or course of business processes to the changes observed in the company's environment. The Internet of Things becomes

* The IDC Report, 2017.

** The estimates included the value of the entire IoT ecosystem, including sensors, counters, software, IT and telecoms services, IT infrastructure, and of course end devices.

*** The IDC Report, 2017.

**** Smart power networks.

interesting wherever it is possible to accurately translate information about the infrastructure and data collected from external sources into specified business values. It usually leads to financial effects, monetisation, and general efficiency.

The essence of the IoT lies in the business context. The extraction of non-trivial information, hidden in the available data, takes on critical importance. The idea is to collect massive amounts of data from various sources, to be able to quickly extract information from it that will enable the appropriate action to be taken. This is where the greatest difficulty lies today. Advanced algorithms are based on prediction, artificial intelligence, where historical data is used to teach and train models. It is vital to have the know-how in complex business data analytics allowing the right approach to be chosen. The Siri Voice Assistant,* Cortana,** and Google Now*** are just some examples of solutions in the area of AI.

A special place in the artificial intelligence solutions in the field of business data analytics is held by a solution called Einstein Analytics**** from the giant American company Salesforce. It is a system of online Business Intelligence built into the CRM platform solution provided by Salesforce, making this the most innovative and effective customer relationship management system. The Einstein Analytics system uses all possible sources of internal (from the platform) and external data. These include data on system users' activities, sales figures, data from external ERP systems, information from email communication, calendars, social data streams, as well as IoT signals. All of this serves the development of accurate predictive models. And since the Salesforce platform has millions of users entering business data on a daily basis, it is a unique opportunity to provide the best models for the processes of sales, services, marketing, distribution, and maintenance.

With the advanced algorithms used in Einstein Analytics, which have their roots in the processes of machine learning, predictive analytics, natural language processing, and intelligent detection of links between data sets, these innovations automatically match models for virtually every customer. What is more, these models learn independently and operate adaptively, so that without human intervention they can tune

* A voice assistant introduced by Apple in 2011 for iPhone 4S.

** Voice assistant created by Microsoft.

*** The Google Inc. Smart Assistant provides information to the user.

**** The Business Intelligence solution by Salesforce uses artificial intelligence algorithms.

themselves and react intelligently to any interactions and additional data from outside the system. The latest data analytics solutions applied in Einstein Analytics mean that the system will automatically detect information which is important from a business point of view, for example, help to predict future behaviours (of people, processes, and devices), proactively recommend the best action, and even automate these actions significantly improving efficiency. This type of activity often involves a knowledge base accumulated automatically in the system, which has its source in external bases and systems, as well as, and perhaps above all, data collected on the basis of user activity and from external devices (such as devices and IoT sensors). Each user of the system can leverage the power of BI technologies that are supported in the Einstein Analytics by artificial intelligence algorithms to provide more personalised and predictable results.

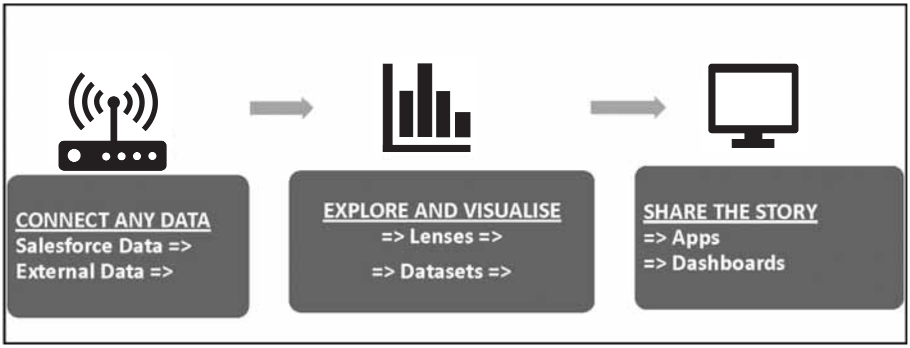

Figure 1. The flow of data and information in the Einstein Analytics system

Source: own research based on https://trailhead.salesforce.com/trails/wave_analytics

The specific area of application for Einstein Analytics is the Internet of Things. The "IoT Cloud Einstein" application contains a collection of hierarchically assigned virtual devices that collect and keep data from connected IoT devices and sensors. Then, with the use of algorithms and models based on artificial intelligence methods, the system can recommend the optimal steps associated with general marketing, sales, or service processes based on the analysis of the data collected in real time from devices and automated optimisation of IoT rules. The new IoT cloud, built on the basis of the Einstein Analytics system, exploits the power of the Internet of Things and converts all the data generated by the users, customers, partners, and IoT devices and sensors into the actions optimised and relevant from a business point of view.

Another example of advanced business analytics are the tools and systems provided by the German company SAP. Data collected should, after all, refer to specific business processes. SAP, with many years of experience in supporting business processes, has a comprehensive approach to this issue. SAP systems collect and collate data for a specific purpose, and enrich existing processes with new elements to create new business models based on the emerging potential of IoT data.

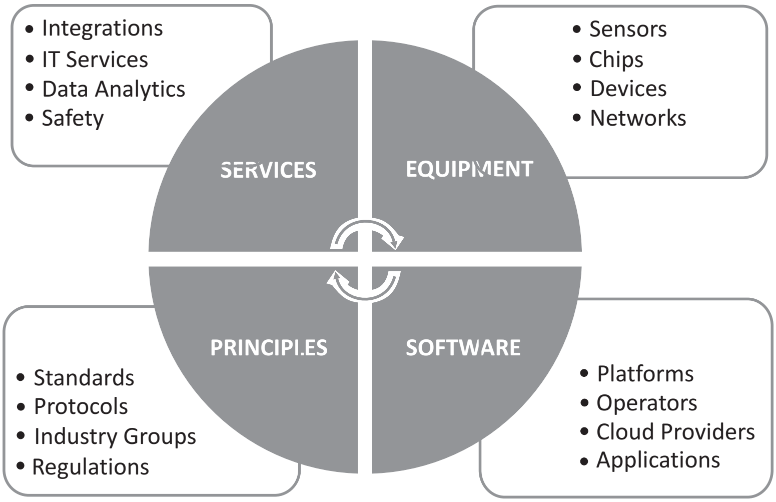

Figure 2. Integrated components of the Internet of Things

Source: Own research based on CompTia Report 2016, www.comptia.org

The SAP S/4HANA is a modern solution built from scratch and dedicated to the needs of today's digital business. The foundation built with the use of a modern ERP system must have a platform around it enabling IoT data to be collected, processed and appropriately integrated. In SAP's offer, this role is filled by SAP's Leonardo platform, which connects the world of things with the world of processes. In addition, as well as technical capabilities it also provides a constantly upgraded directory dedicated to specialised applications. The most important component, however, is SAP S/4HANA, which is the foundation of all digital SAP solutions and is what absolutely differentiates them.

Besides being a technological component, SAP S/4HANA may be a catalyst for the digital transformation of enterprises.

Automation is the so-called last mile that combines the fact of possessing and processing data with its effective, operational use in the business process.

TECHNOLOGY IN THE MANAGEMENT OF IOT DATA STREAMS

Information and information technologies are currently at the centre of development, they are one of the most important factors in the development of civilization, if not the most important (Dąbrowska, Janoś-Kresło, & Wódkowski, 2009). The Internet, by penetrating almost every area of 21st century human life, is causing qualitative changes in everyday reality. Until recently, a user who wished to find data about a product had to check all the information on a desktop computer, save or print out the information gathered and then decide whether to make a purchase. Currently, thanks to the use of mobile devices such as smartphones, the user has access to information about a product, always and everywhere, for example by scanning barcodes found on the products or in advertisements. This provides access to information about it, as well as a quick comparison of prices in different shops, and a review of the opinions and ratings giving by other users.

From the technological point of view, the key factors powering the development of the digital economy are the Internet of Things (IoT), the Internet of Everything (IoE), hyper connectivity, applications and services based on Cloud Computing, Big Data Analytics (BDA), Big-Data-as-a-Service (BDaaS), automation and robotisation, multi-channel and omni-channel models for distribution of products and services.* In turn, the communication layer contains the following standards and protocols for data transmission and automatic identification: WiFi, Bluetooth, GSM, 3 g, LTE, WiMaX, IPv4, IPv6, MQTT, DDS, EDI, RFID, and NFC. It is these wireless data transmission technologies and portable devices and solutions which have a significant influence and basically determine the dynamic development of the IoT, and which are responsible for the snowballing of the amount of exchangeable data

* In more detail: Pieriegut, 2016.

whether between humans, between machines, or between humans and machines. This is happening because it is this wirelessness and mobility that frees devices from a fixed installation point, making them useful anywhere and at any time, including on the move, which is of key significance in such fields as logistics, transport, and distribution.

The architecture of a network system, which the IoT undoubtedly is, must guarantee the possibility to connect physical objects with the virtual world. At the design stage of the architecture of the Internet of Things several integral components must be taken into account, including the network infrastructure, processes, business models and security. Attention should also be paid to the scalability and interoperability between devices, and to their heterogeneity. Many researchers, in order to protect the network, have proposed the use of three to six layers. The models are based on TCP/IP protocols. The network of the Internet of Things consists of six hierarchical layers: code, perception, network, intermediate, application, and business.

The code layer ensures the identification of objects. In this layer, each object is assigned a unique identifier that allows the device to be recognized. The next layer adds physical meaning to each object. It consists of various types of sensors that pick up programmed states or events. Examples of these types of sensors are RFID tags, infrared sensors, temperature, humidity, speed, position, and height sensors. This layer collects information from devices fitted with sensors and converts it into digital signals which are then transmitted to the network layer in order to continue operating and transformation. The next network layer is responsible for the transmission of digital signals from the perception layer to the intermediate layer by means of different standards of data transmission, mainly on the Internet. The most popular data transmission standards used in the IoT are currently WiFi, Bluetooth, ZigBee, GSM, 3G, and WiMaX, and protocols worth mentioning are IPv4, IPv6, MQTT, and DDS. The intermediate layer processes information received from sensory devices (sensors) giving them the form of messages. This includes technologies for cloud computing, which provides direct access to the database and the stored information. This is followed by the automatic processing of the data obtained in order to acquire the desired information, also called in the literature intelligent data processing. The application layer implements all the possible aspects of the Internet of Things. It expresses the need to apply the Internet of Things in a given field. This is a software utility for devices applied for a specific purpose, for example supporting household needs (smart home), transportation, production, or distribution, including trade (e-commerce). The application layer is being developed to support and specify the activities of the Internet of Things. The final layer is the business layer. This manages the applications and services of the Internet of Things. It is also responsible for all activity on your network and the entirety known as the business model. From a business point of view, this is where added value is created for the system's users, and it enables appropriate business models to be constructed depending on the usage requirements.

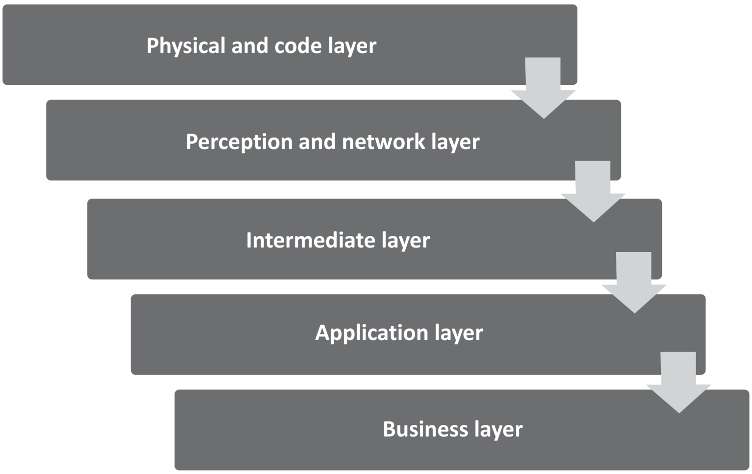

Figure 3. Architecture of the Internet of Things

Source: own research based on Faroog, 2015, Six-Layered Architecture of IoT and review on the Internet of Things.

The concept of the Internet of Things can also be represented graphically. The interaction between the layers is shown, and the whole includes cloud computing, where most of the processes take place, particularly business processes and interaction with the environment. The scalability and flexibility of cloud computing services are also worth mentioning (Mateos, & Rosenberg, 2011). It enables support for a sufficiently large amount of data and users, according to the expected requirements. The final recipient is someone who can also process the data or receive ready, processed information on a subject that interests him. So in technological terms, the Internet of Things consists of material and virtual resources.

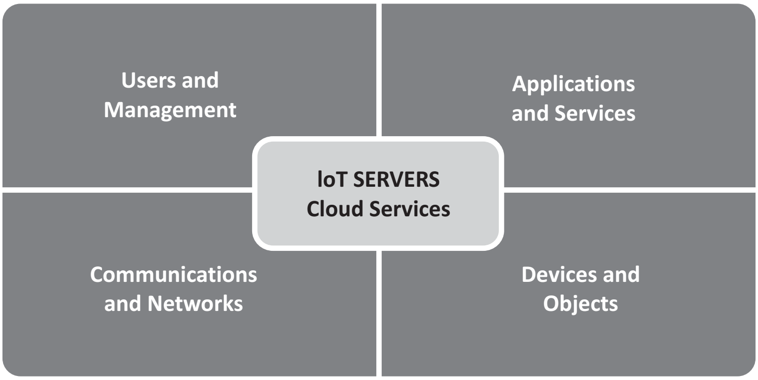

Figure 4. Simplified model of the Internet of Things

Source: own research based on Maciejewski, & Morawski, 2016, p. 147.

Elements of the infrastructure include sensors (e.g. visual, sound, position, and temperature), actuators and devices (servers, computers, and mobile devices), and virtual resources include communication (wireless and wired, infrared), memory (database, DHT decentralised distributed systems), identification (picture, video codes, biometric readings, information from RFID tags, and barcodes), location (GSM signals, GPS) and processes (service network sensors and network support). The most common technological uses of the Internet of Things include RFID automatic identification technology, which uses radio waves to transmit data, and the electronic power supply of the system which labels an object for the reader to identify it. It is possible to read (using radio waves) or write data from the RFID. This system consists of radio wave identifiers (RF tags) containing information about the object, readers which send and receive the radio signal, and control software (Januszewski, 2012). Other wireless technologies and protocols used in the IoT are cloud computing, wireless networks, Bluetooth, the IEEE 802.15.4 standard, ZigBee networks, and 6LoWPAN standards.

The architecture of the Internet of Things is based on three key assumptions – objects able to communicate, receive or transmit information, communication networks as intermediaries in the communication and transmission of data, IT systems, and solutions that process or collect data and transmit the information to the device. Each stage involves verification and analysis processes, i.e., constant business analytics.

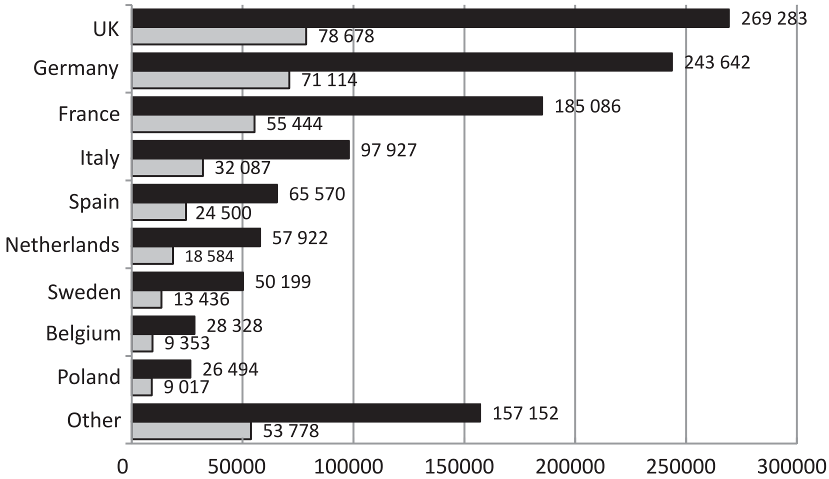

Figure 5. The market share of the IoT in 2014 and forecast for 2020 (EUR million)

Source: http://www.statista.com. Accessed July 12, 2017.

The dynamic development of the Internet of Things in terms of the role and importance of analysis is attested, apart from by statistics connected with the increasing amount of data transmitted on the Internet in due to the IoT, by forecasts of business use of this technology. These forecasts are very optimistic for Poland, which for the year 2020 retains forecast growth dynamics of the market share of IoT technology comparable to other European countries.

Technological progress has made it possible to implement statistical, optimising and simulating methods, artificial intelligence, and neuron networks in data networks (Januszewski, 2012). The application of innovative solutions does not generate additional costs, and significantly reduces previous expenses connected with IT service, among others. The application of technological facilities allows full up-to-date documentation to be kept of each element of the maintenance cycle. In line with what Elon Musk said "There will be fewer jobs and less work that man will be able to perform better than a machine. This is not something I'm dreaming. It just seems to me that at some point this will happen" (Musk, 2017).

In this context, artificial intelligence (AI) will play an increasing role in companies, allowing processes to be automated. IDC estimates that in 2019 approx. 40% of initiatives connected with digital transformation and almost all activities in the field of IoT will be supported by AI.

HUMANS IN THE NEW BUSINESS MODEL

The Internet is not only hardware and software, but also, and perhaps above all people who form humanware. "The diffusion of information, or infection with information is a feature of the modern hypermedial, digitised world. The degree of activity and involvement of members of the Internet social network is growing every day. People's daily functioning is becoming more and more dependent on the coexistence of the real and online worlds. For many people, the Internet is becoming like a «toothbrush»: essential, and in constant use to provide a feeling of freshness. One click, and information is available to the thumb" (KolasińskaMorawska, & Pytel, 2017). The millennial generation, accustomed to the availability of the digital world, is forcing entrepreneurs to change their perception of business. And these are the people who will participate in the new business models of the digital world.

The Internet of Things is mainly M2M networks which can make independent decisions, thanks to aggregated information in the form of data bases and interaction enabling mutual identification (everything is able to introduce itself), communication (everything can communicate) and collaboration (mutual action). There is also a dynamic growth in the market of services which combine digital technologies with the human body. In line with the theory of connectivism,* contemporaneity means the necessity for humans to co-exist with new technologies, which will have a permanent effect on how business is done.

Most of the Earth's population will be connected permanently to the network, e.g., by implanted transmitter/receiver devices or online equivalents in the form of avatars, and will manage their business processes in this way. This concept is known as the Fourth Platform – enhanced humans. And it is not so much that more items will be equipped with sensors, rather that people will be drawn into the network. It will become normal for information to be collected and transmitted between objects, and between intelligent objects and humans. Repetitive actions in production and storage areas will be carried out by robots, and supervision and control processes will

* Connectivism is the "theory of teaching-learning in the digital age". Assumptions of the concept given by G. Siemens in *Connectivism: A Learning Theory for the Digital Age*, http://itdl.org/Journal/Jan_05/article01.htm. Accessed August 5, 2017.

be delegated to artificial intelligence, the network of networks will become a matrix of human life. Only humans with the appropriate preparation and education will be able to function in the new socio-economic space.

THE HUMAN PRESENCE IN THE NET

Cyberspace is a better controlled, more driven, more vulnerable to influence and less democratic environment than real space (Gibson, 1984). Databases will undoubtedly become so extensive that data on every citizen's education, membership of organisations, achievements and honours, family members' names, traffic violations, and crimes committed will all be on someone's computer (McRae, 1996). There are already methods, techniques and tools for identifying every digital human based on what we have (information cards, chips, and devices to confirm identity), what we know (codes, passwords), and who we are (biometric methods, fingerprints, and retina scans). These will be optimised – which in practice means that devices will be simplified and miniaturised. Electronic IDs (Belgium) with a biometric photo and electronic signatures are just an introduction to the digital world. A more advanced form for digital man is RFiD technology that allows it to be identified. Someone with an implanted chip connected to their bank account has the possibility to make payments (e-wallet). In turn, RFiD in conjunction with a smartphone (GPS) provides information about the location of a person/object. Such a state will allow for faster uptake of customer data as well as faster access with the information about the offer to potentially interested persons.

Customers can already also enter and experience the virtual world thanks to enhanced reality. This process is enabled by, among other things, HMD/OHMD* class glasses that make physical presence in a particular place unnecessary. The digital version suffices. And even though we are still far from the HYPER-WORLD** shown in the film *Ghost in the Shell* or that presented in *Valerian and the City*

* Oculus Rift (https://www.youtube.com/watch?v=YuIgyKLPt3s, accessed March 20, 2017) , HTC Vive, PlayStation VR, Samsung Gear, Google Daydream, Google Cardboard and Microsoft HoloLen. More on the topic: http://www.komputerswiat.pl/artykuly/redakcyjne/2016/03/realne-ceny-wirtualnej-rzeczywistosci-ile-kosztuja-gogle-vr.aspx, accessed March 20, 2017.

** https://vimeo.com/166807261, accessed March 20, 2017.

of a Thousand Planets, reviewing textures when trying out new objects, or tourism by visiting far-off lands are absolutely possible.

The multi-perspective of experiencing the world, acquisition of information, exchanging, processing, and adding information in real time are now fact. AR (augmented reality) technological solutions allow the user to be in a particular environment or to move around while having access to a greater amount of information than the surroundings would indicate.* VR (virtual reality) technology allows the user to be totally separated from reality. Thanks to Google (headset) the kinetics of the user's body can be simulated. In turn, MR (mixed reality) technology allows interaction with virtual objects by imposing an artificial image onto the actual one. Without leaving home, people can experience a variety of states and participate in various processes. Business activity in the form of educational, design, tourism and distribution services, as well as many other aspects of business can already be experienced directly in digital form. It can be assumed that there will be an explosion of various business formats according to how customer requirements evolve in future.

SYMBIOTIC INTEGRATION WITH THE WORLD OF MACHINES

The concept of virtualisation of actions is being carried over into various domains of human activity, including the business and social spheres. This is not only passive participation in the form of entries in the data bases of various institutions, on social media or tools (smartphones or glasses) enabling real-world experiences (enhanced reality), but it is increasingly an active participation manifested as a symbiotic integration with the world of machines. Transhuman cyborgisation of human beings is gradually becoming a reality. The biological body's imperfections are improved, making humans enhanced humans – cyborgs.

Actions in the field of integrating people with machines without having to use intermediaries such as keyboards, touch screens, or

* Using a phone or tablet equipped with a camera and software, the world is seen with an extra image (text, figures, objects), video and/or audio format superimposed. This means that many different internet resources can be used for reality to be more fully experienced.

a complex code key has resulted in solutions enabling communication using the mind only. Once again, what was the domain of science fiction as represented by characters from films such as Robocop and Johnny Mnemonic is becoming tangible. In the future sellers and warehouse employees will be more effective and more efficient.

The boundary between human creativity and competences of machines is constantly shifting (Brynjolfsson, & McAffe, 2015). State-of-the-art technological solutions are breaking down the existing biological limitations of human beings. We can conclude that human cyborgisation is just another step in evolution. From Homo Sapiens Sapiens to Homo Sapiens Transhumanus is but a short step. Thus the entrepreneur and the worker will perform their assigned tasks and functions in a completely different environment. It is therefore important to prepare people by educating them to function in the new, digital environment.

ADAPTING EDUCATION TO FUNCTION IN THE NEW WORLD

An essential condition for the new information society to function is the creation of opportunities for the continuous education of citizens (Sroka, & Stamka, 2005). Education anticipating the future is already using innovative technological solutions to joins the real and virtual realities. Future citizens must learn to function in this complex digital environment. The teaching process is also subject to a process of change. Education must keep up with changes in the environment to prepare future employees to function in the enterprises of the future.

Teaching as a process has undergone numerous changes from the classic work of teacher-student to the present form of e-learning,* equated with distance learning (d-learning).** In the future, technologies will have the right to exist if they enable access to knowledge in any place and time, so as to provide employees with the opportunity to continuously improve their knowledge.

* The prefix “e” has associations with easy, engaging, experimental, electric, electronic, economical, effective and executive.

** Known for over 300 years. The first correspondence course appeared in the US in 1700, and in Poland in 1776 Kraków University launched the first professional course for craftsmen to be carried out at a distance.

Solutions such as Bluetooth, WAP (Wireless Application Protocol), GPRS (General Packet Radio System), and UMTS (Universal Mobile Telecommunications System), have provided m-learning (mobile learning) a teaching formula, which means that the people participating in the educational process use cell phones, smartphones, or iPhones as communication transmitters. The coming years will be marked by Learning Management Systems (LMS) integrating the online and offline experiences of participants in the educational process in a single system.

A special role in this process is also ascribed to multimedia education, which is multi-code, multi-sensory and multilaterally activating teaching and learning for students (Kubinowski, 2003). Model 4C (or 4K* in Polish) is gaining functional support in the form of multimedia (tablets, interactive whiteboards (smart boards), laptops, smart phones, and virtual glasses). Teaching methods should stimulate students to acquire the knowledge necessary for them to function in the world of the future in order to better prepare future employees.

Only those who are able to learn constantly and use innovative devices, and above all to coexist with the machines, will find themselves in the new socio-economic field.

CONCLUSIONS AND SUMMARY

Self-communicating machines and autonomous beings are just a taste of the world of the future. In order to find their place in it, business people are already being forced to make decisions about adaptability and innovativeness. Thanks to smartphones and iPhones, the contemporary consumer is becoming smarter. The migration of customers from the real to the virtual world, the growing demand for information, emphasis on the effectiveness and efficiency of actions enforces the use of such solutions with new technologies that allow companies to develop and realise the dream of the future (Kolasińska-Morawska, & Pytel, 2017). The concept of the 3 As – "anytime", "anyplace", "anything" – is becoming a fact. Technologies that enable constant contact, from anywhere, at any time, in any way, using the device of your choice are becoming the socio-economic reality.

* Namely: communication, coordination, cooperation and construction.

As result of progressing digitalisation, automation, and robotisation – multi-channel and omni-channel models for distribution of products and services have become fact. Business management uses simplified model identifying the factors of digitisation and tools for process reorganisation and transformation in enterprises. Moreover, companies use emerging potential of IoT data to enrich existing processes with new elements to create complete new business models and deliver added value for users of the system – mainly for customers.

In conclusion, the IoT as a physical, logical, and business model compatible with the idea of the digital transformation is resulting in many economic benefits, including opportunities for a faster response to changes in environmental conditions, generation of added value ensuring more efficient use of resources, limiting the "brains" of workers, reducing costs, the development of entrepreneurship and the improvement of the competitive position. It will only be possible to achieve these benefits when the process of metamorphosis based on an analysis of the information collected and informatisation of processes constitute a permanent component of the ecosystems of the new Infosociety and Infoeconomy.

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INTERNET RZECZY – FIZYCZNY, LOGICZNY ORAZ BIZNESOWY MODEL FUNKCJONOWANIA

Abstrakt

Tło badań. Dynamika zmian początku XXI wieku kreuje nowy wymiar gospodarki opartej na informacji i wiedzy. Internet rzeczy, hiper łączność, duże zbiory danych, rozwiązania chmurowe, automatyzacja oraz robotyzacja przenikają coraz więcej obszarów gospodarczej egzystencji. Zacierają się granice między tym co fizyczne, a tym co cyfrowe sprawiając, iż dotychczasowe sposoby zarządzania procesami biznesowymi mogą być niewystarczające, z czego nie wszyscy przedsiębiorcy zdają sobie sprawę.

Cele badań. Celem tego artykułu jest identyfikacja znaczników procesów przeobrażeń biznesu oraz wykazanie niezbędności działań dostosowawczych przedsiębiorstw wobec wyzwań, jakie niesie ze sobą przyszłość. Postawimy hipotezę, że zbiór identyfikacyjny cyfryzacji procesów ujęty w formie modelu może stać się instrumentem wspomagającym zarządzanie przedsiębiorstwem w ujęciu strategicznym.

Metodologia. W procesie badawczym posłużono się podejściem idiograficznym z zastosowaniem metod rozumiejących, które w zamierzeniu miały dostarczyć możliwość wglądu w „istotę rzeczy”. W procesie pozyskiwania materiału zastosowano analizę dostępnych dokumentów i literatury oraz, ze względu na specyfikę tematu, dokonano przeglądu istniejących źródeł cyfrowych. Posłużono się techniką analizy semantycznej, współwystępowania terminów oraz przydatnością publikacyjną źródeł na rzecz materiału.

Kluczowe wnioski. Zebrany i przeanalizowany materiał pozwolił na postawienie ogólnego wniosku wskazującego na niezbędność iniekcji nowych technologii w procesy zarządzania przedsiębiorstwem warunkujących rozwój i funkcjonowanie w przyszłości. Wymóg adaptacyjności do ery cyfryzacji może skutkować wieloma korzyściami społeczno-gospodarczymi. Uproszczona modelowa postać identyfikacji czynników cyfryzacji, narzędzi reorganizacji procesów oraz obszarów przeobrażeń w przedsiębiorstwach mogą stanowić pomocny instrument zarządzania przedsiębiorstwem.

Słowa kluczowe: inteligentne rozwiązania biznesowe, technologie informacyjne, wirtualizacja