Internet of Things and Its Use in Business Entities of the World

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Abstract. The Internet of Things digitally transforms business entities, bringing them many benefits and the opportunity to become a digital business. The main goal of the scientific article is to theoretically define the digital technology Internet of Things and to map the current state of use of the Internet of Things. Internet of Things is industry 4.0 digital technology, which is a network of interconnected devices over a wireless connection, which are made up of technological and other components used to interconnect elements in an enterprise environment and provide various services. The scientific article focuses on the theoretical definition of the term Internet of Things, its characteristics, ecosystem, technology and Technology Stack Internet of Things. The results of the work and discussion include: mapping the application and use of the Internet of Things in various sectors, then in selected business entities, evaluating the use and defining your own definition of the Internet of Things. The examined business entities include: ABB, Airbus, Amazon, Boeing, ESI, Bosch, Caterpillar, Cisco, Intel, SAP, Siemens, Shell, Tesla.

Keywords: Digital technologies, Internet of Things, Industry 4.0, Business

JEL classification: *M15, M20*

1 Introduction

The COVID-19 pandemic is currently having a global impact on business and the economy by changing their way. Responses to COVID-19 have accelerated the adoption of digitalization, digital technologies in companies around the world, and

today digital transformation is one of the fundamental challenges for businesses. Digital technologies, which are the driving forces and the most important elements of Industry 4.0, are essential for the digitalization and digital transformation of businesses. Among the key digital technologies of Industry 4.0, in addition to Artificial Intelligence, Big Data Analytics, Cloud Computing, the Internet of Things is also included. The digital transformation based on the Internet of Things is applied to physical objects whose central point is data. The current business environment creates incentives for the direct implementation of elements of Industry 4.0 - digital technologies into business processes and business models in order to maintain competitiveness, operational efficiency, profitability and especially innovation.

2 Literature review

Internet of Things (IoT) was introduced by Kevin Ashton in his presentation in 1999 and refers to a network of devices containing various electronics, sensors and other elements that allow these devices to communicate and exchange data, with each device clearly identifiable in the network. Camacho-Cogollo et al. (2020) state that IoT is a major front-end of intelligent technologies and is considered a new Internet revolution. The elements that supported the emergence and existence of the Internet of Things are: the availability of broadband wireless Internet and the emergence of a necessary, ubiquitous and distributed computing environment across the planet; miniaturized sensors built into everyday objects, home security and health monitoring systems, data collection and connection and communication from sensors built into other products or people, and the last element are Collaborative Robots (Cobots) using artificial intelligence and machine learning (Özdemir & Hekim, 2018) .

The basis of the philosophy of Internet of Things according to Dhonge (2016) is a network of intelligent physical objects or things that are wirelessly interconnected, in which it is built: electronics, software, sensors and Internet connection enabling the collection and exchange of data. According to Madakam, Ramaswamy and Tripathi (2015), the Internet of Things is an open and comprehensive network of intelligent objects that are able to automatically organize, share information, data and resources, respond and act in the event of situations and changes in the environment. Nelson (2016) defines the Internet of Things (IoT) as intelligent objects that monitor, record, and compute through nested and interconnected presentations. IoT is an Internet extension that integrates mobile networks, the Internet, social networks and smart things to provide better services or applications to users (Li, 2017). Majumdar (2019) states that the Internet of Things is a network of interconnected objects ("things") for collecting and exchanging data with each other through built-in electronics, software and sensors across the Internet. According to Gillis (2020) Internet of Things is a system of interconnected computing devices, mechanical and digital machines, objects, animals or humans that are provided with unique identifiers (UIDs) and the ability to transmit data over networks without requiring interconnected human interaction. -to-human or human-to-computer. IoT refers to the Internet interconnection of several nodes integrated with sensors, actuators, electronic equipment and network connections

to facilitate the interconnection and easy transmission of data in a real-time environment (Mishra et al., 2020). Gartner (2021) defines the Internet of Things as a network of physical objects that contain built-in technology for communicating and perceiving or interacting with their internal states or external environment. Liu (2020) states that the Internet of Things is a set of sensing, communication and computing technologies for connecting physical objects such as wearable devices, vehicles and buildings, and a large amount of data is generated from interconnected "things". Data analysis plays a central role in the automated and intelligent decision-making process for managing and optimizing IoT systems. Oracle (2021) describes the Internet of Things as a network of physical objects - "things" that are equipped with sensors, software and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet. The Internet of Things refers to working on the Internet for various types of physical devices equipped with transducers, including sensors, detectors, actuators, electronic components, and links to devices and websites, to maintain association and stress-free data exchange in real time (Sharma , Bhargava & Singhal, 2020).

2.1 Internet of Things ecosystem and characteristics

The Internet of Things consists of real-world things and sensors connected to or combined with these things and connected to them via a wired and wireless network. **Characteristics** defining Internet of Things by I-Scoop (2021) are:

1. *Connectivity* - There must be connections at different levels between all the devices used in the IoT concept, hardware, sensors, electronics and control systems.
2. *Things* - Anything that can be tagged or attached is for connection. Devices may include sensors or sensing materials may be attached to the devices and items.
3. *Data* - They are an essential part of the IoT, the first step towards action and intelligence.
4. *Communication* - Devices connect to be able to communicate and then analyze the data. Communication can take place over short distances or very long distances up to very long distances. Examples are Wi-Fi, LPWA network technologies such as LoRa or NB-IoT.
5. *Intelligence* - Aspects of intelligence, such as scanning capabilities in IoT devices and intelligence obtained from big data and AI analysis.
6. *Action* - The consequence of intelligence - it can be manual action, action based on discussions about intelligent decisions in companies and automation, often the most important part.
7. *Ecosystem* - The place of the Internet of Things and its integration in terms of other technologies, communities, goals and the image in which IoT is used.

The Ecosystem IoT consists of intelligent web-connected devices that use embedded systems, such as processors, sensors, and communications hardware, to collect, send, and act on data they obtain from their environments. IoT devices share data from

sensors that they collect by connecting to an IoT gateway or other peripheral device where data is sent to the cloud for analysis or analysis locally (Techtarget, 2020). IoT sensors can use different types of connections such as RFID, Wi-Fi, Bluetooth and ZigBee, and also allow broadband connectivity using many technologies such as GSM, GPRS, 3G and LTE. IoT-enabled things will share information about the state of things and the environment with people, software systems and other devices (Zeinab & Elmustafa, 2017).

2.2 Internet of Things technology stack

Farahani et al. (2018) state that IoT has evolved from Radio Frequency Identification and Wireless Sensors Networks technologies to more advanced integration with Internet services, cloud computing, cyber-physical systems, and connections between software and hardware devices. Technologies Internet of Things according to Madakam, Ramaswamy and Tripathi (2015) are: Radio Frequency Identification (RFID), Internet Protocol (IP), Electronic Product Code (EPC), Barcode, Wireless Fidelity (Wi-Fi), Bluetooth, ZigBee, Near Filed Communication (NFC), Actuators, Wireless Sensor Networks (WSN) and Artificial Intelligence (AI).

Sharma, Bhargava & Singhal (2020) state that the IoT technology stack is a classification of many technologies used in IoT categorized into broad layers, and the number of layers integral to the IoT ecosystem may increase over time. According to the authors Sharma, Bhargava and Shinghal (2020), there are three basic layers on which it works and these are:

1. **IoT device layer** is the layer where an IoT ecosystem begins, and its accuracy has a huge significance in the performance of any smart product whose ecosystem depends on it. It interacts with the physical environment through the "things" in the IoT. The device in this layer should contain at least the following IoT-enabled things:
   1.*transducers, sensors*, or/and actuators and
   2. *device connectivity*—transmitters, receivers, and device-operating software.
2. **IoT gateway layer** is the pathway or bridge through which the transmitted data flow from the layer of "things" to the layer of operations. Edge computing/fog computing is the technology powering digital connectivity with abilities like high-grade processing and smart analytics. It is no ordinary bridge however, rather it is a smart and intelligent gateway housing technologies to aggregate connectivity for things to communicate while preprocessing their data, translating protocols, and ensuring network security.;
3. **IoT platform layer** could be called the control center of a smart system, though it obviously does much more than just that. This is where everything actually connects to create their intelligence! With cloud storage, smart analytics of big data, machine learning, high-speed messaging, and central processing this layer integrates a plethora of diverse technologies, clouds, software services, and APIs to ensure IoT interoperability device virtualization and real-time responses. It is the middleware between input and output in the IoT ecosystem..

3 Research objectives and methodology

The main goal of the scientific article is to theoretically define the digital technology Internet of Things and to map the current state of use of the Internet of Things.

The sources of data for the processing of scientific articles were domestic and foreign professional literature in the form of: books, scientific articles and studies, surveys of technological and statistical companies, press releases of business entities, etc.

In the scientific article, we used the analysis to analyze the current state of the issues discussed in foreign and domestic literature; we used the comparison when comparing the definitions of IoT and also when comparing the ways of using IoT in specific companies and we used induction in the formulation of the conclusion.

The subject of research is digital technology Industry 4.0 Internet of Things, where we theoretically defined it in the literature review, in the results we mapped the current state of IoT use in business entities through studies and examples of applications in selected companies. The object of the investigation was selected business entities according to the IoTONE ranking, namely: ABB, Airbus, Amazon, Boeing, ESI, Bosch, Caterpillar, Cisco, Intel, SAP, Siemens, Shell and Tesla.

4 Results

In the results of the scientific article, we decided to map and examine statistical analyzes related to the Internet of Things and to examine the specific use of IoT in selected business entities.

4.1 Statistical data about Internet of Things

According to Statista (2021), the total Internet of Things (IoT) market reached approximately US $ 388 billion in 2019 and is set to increase to more than one trillion US dollars in 2030. The market is dominated by the consumer sector and is expected to generate $ 476 billion in sales by 2030. In the following Fig. 1 shows Statista's (2021) expenditures on the Internet of Things of various industries by vertical around the world in 2015 and their forecast for 2020. As we can see, the most expenditures in 2015 - 10 billion of US dollars had industries: Discree manufacturing, Transportation and logistics and the least expenses were incurred by the Insurance industry (2 billion of US dollars). The forecast for 2020 was favorable in all sectors and each sector expected an increase. Expected average spending in 2020 increased by 303%, representing an average increase of 16.82 billion of U. S. dollars to 22.36 billion of U. S. dollars. The largest percentage increase of 500% was expected by the Retail sector (from 2 billion of US dollars to 12 billion of US dollars), an increase of 471% was expected by the

Utilities sector (40 billion US dollars, which represented an increase of 33 billion of US dollars) and further B2C by 400% from 5 billlions of US dollars to 25% dollars. The Insurance industry expected an increase in spending of only 150% compared to other industries and represented the smallest spending in 2020. Total expenditures from the 2017 forecast for 2020 were to be 246 billion of US dollars, the 2020 forecast from the Statist states that expenditures on Internet of Things technology are expected to be at the level of 749 billion of US dollars, which represented an increase of 204 %.

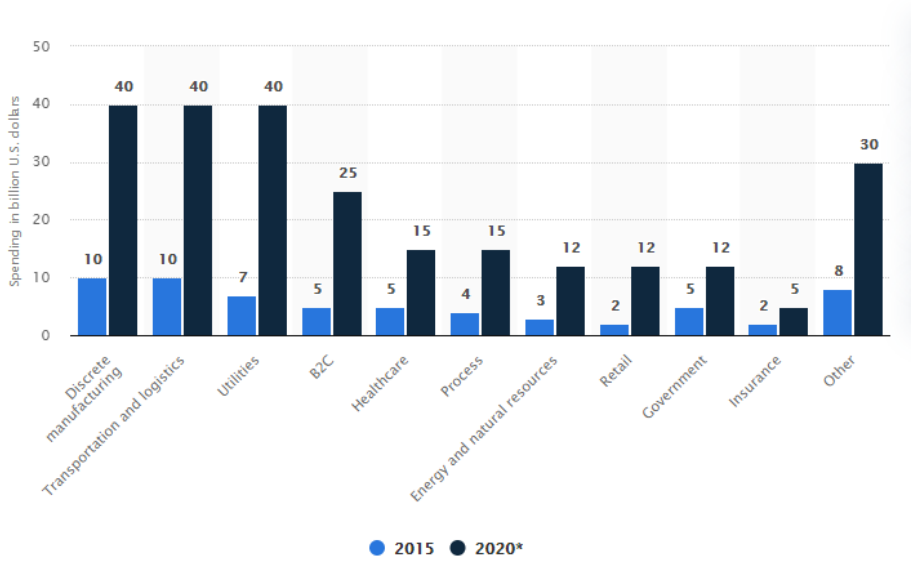

Fig. 1. Spending on Internet of Things Worldwide by Vertical in 2015 and 2020 (in billions of U. S. dollars)

In 2019, there were 7.74 billion of Internet of Things connected devices worldwide, and Statista (2020) further states that the number of Internet of Things devices should be at 8.74 billion in 2020 and triple by 2030. to the level of 25.4 billion of Internet of Things devices. Furthermore, according to forecasts of Internet of Things devices, 40% will be used in businesses. In 2019, there were 7.74 billion of Internet of Things connected devices worldwide, and Statista (2020) further states that the number of Internet of Things devices should be at 8.74 billion in 2020 and triple by 2030. to the level of 25.4 billion of Internet of Things devices. Furthermore, according to forecasts of Internet of Things devices, 40% will be used in businesses.

IoT Analytics (2020) examined Internet of Things applications in selected businesses in various industries. As can be seen in FIG. 2, out of the total number of 1414 IoT projects, the most projects were: in the Manufacturing / Industrial sector - 22% (approx. 311 IoT projects), followed by 15% in the Transportation / Mobile sector (approx. 212 IoT projects), in the Energy sector - 14% (about 197 IoT projects). IoT Analytics (2020) examined Internet of Things applications in selected businesses in various industries. As can be seen in FIG. 2, out of the total number of 1414 IoT

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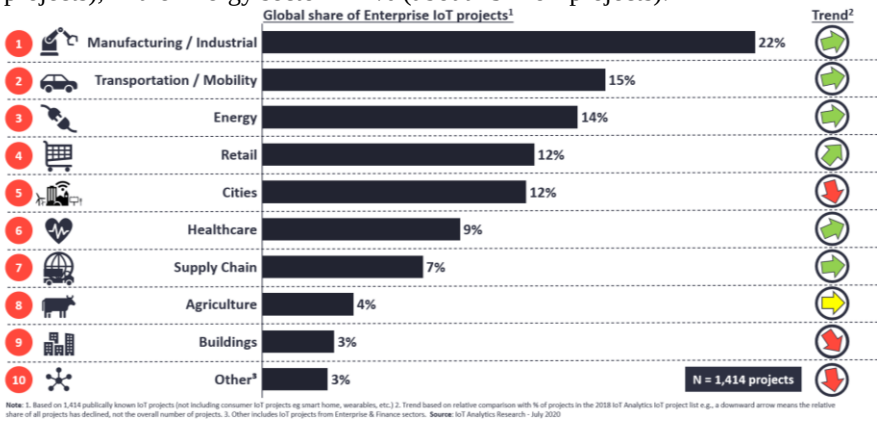

Fig. 2. Top 10 IoT Application areas 2020 by IoT Analytics

Techjury (2021) states that: by 2025, there will be more than 64 billion Internet of Things devices worldwide; the main driver of revenue for 54% of IoT's enterprise projects is cost savings; in the surveyed companies using IoT, corporate investment accounted for more than 50% of total IoT expenditure in 2020; 97% of the organizations surveyed believe that creating value from IoT data is challenging; IoT in the banking and financial services market is expected to grow to $ 2.03 billion by 2023; 58% of manufacturers say that IoT is required for the digital transformation of industrial plants, and more than 80% of executives across industries say that IoT is critical for some or all business sectors.

In 2021, IoTONE compiled a ranking of the best industrial companies in the field of the Internet of Things. The top 15 best companies include: Siemens, PTC, ABB, Intel, Schneider Electric, Honeywell, Huawei, SAP, Advantech, Bosch, Cisco, Amazon Web Service, IBM, Texas Instruments and C3 IoT.

4.2 Use and application of the Internet of Things in selected business entities

ABB is a Swiss-Swedish multinational company providing energy and automation technologies and has adopted the concept of predictive maintenance and uses IoT for: connected systems, Internet assets, ad-hoc mobile devices and simulation and security support. In specific situations, it would be used in interconnected oil and gas extraction, connected renewables, connected vessels, connected mines, connected paper mills and interconnected data centers. (ABB, 2021).

Airbus is a French airplane manufacturer, they said that “One first things the company did was to use RFID in tracking parts, and now they are moving towards IoT devices to track tools in the factory, so engineers know where their key tools are, and also so the tools can be telling them if the torque is correct for implementation, and also

look if products need maintenance. So, they are looking at a whole raft of things to not only improve products but also to reduce cost and improve production capability." (Airbus, 2021).

Amazon is American multinational conglomerate which focuses on e-commerce, cloud computing, digital streaming, and artificial intelligence. AWS IoT helps customers by providing edged based software including Amazon FreeRTOS and Amazon Greengrass that allows customers to securely connect their assets, gather data and take intelligent actions locally even when the internet connectivity is down. ... Customers only pay for what they use. (Amazon AWS, 2021)

Boeing is the biggest airplane manufacturer in the world. It was found in 1916 in USA Seatle. They have been using Artificial intelligence primarily for piloting the plane. Their subsidiary – Tapestry Solutions Inc. launched Enterprise Sensor Integration (ESI) software platform that is designed to transform supply chain operations and help businesses tap the power of the Internet of Things. Every single component Boeing 787 is attached to a wireless airplane network, providing real-time IoT data on everything from performance to required maintenance. The aircraft can produce more than a third of a terabyte of data per flight and each one makes hundreds if not thousands of flights a year. (Boeing, 2019)

ESI is based on Tapestry's field-proven technology deployed at 50 Boeing assembly plants. At Boeing, the custom technology is called the Automated Identification Technology – Information Management System (AIT-IMS). In its first year alone, AIT-IMS is said by the parent company to have saved Boeing approximately $100 million through decreased assembly time, automated asset receipt/payment, enhanced inventory management and improved quality and safety. The software harnesses the power of Big Data, boosting manufacturing efficiency, productivity and profitability. It serves as the foundation for the IoT, where internet-enabled devices are connected, intelligent and interactive. (IoT Now, 2016)

Bosch is a German company that provides solutions for mobility, housing units, industry and services. In the mobility in terms of Internet of Things their focus was in creating sharing services, simplify the search for parking spots, show eBikers where they need to go, and inform customers when they need to recharge their electric car battery. The goal is to make each ride as safe and comfortable as possible, regardless of the mode of transportation. In terms of housing units – they focused on smart home features like house maintenance, gardening or security system that was supported by IoT. In industry, they use IoT features for increasing efficiency and safety in manufacturing. (Bosch, 2021)

Caterpillar is the world's leading manufacturer of construction and mining equipment, diesel and natural gas engines, industrial gas turbines, and diesel-electric locomotives. Caterpillar has already been using IoT technology to automate its factories and has manufactured a range of heavy-duty equipment complete with IoT sensors. However, while IoT powered equipment is working hard onsite, Caterpillar is also gathering vast quantities of data from the machines. This data is then being put to work to enable predictive maintenance on the equipment. By turning data into actionable insight, Caterpillar can schedule maintenance at the appropriate time, thereby

increasing product uptime, and extending the life cycle significantly. (Fieldserviceasia, 2021).

Cisco is an American computer company that concentrates on multiple hardware and software solutions for businesses. From Industrial switches, towards industrial routers and gateways, Cisco is providing that sort of solution for many industry businesses. They also developed several software solutions that can cover the communication with hardware f.e. iox for edge applications and industrial network director. They developed Cisco Cyber Vision and discovered Cisco Edge intelligence that provide security towards businesses. Main focus was cybersecurity and data Intelligence. (Cisco, 2021)

Intel is also an computer company that focuses on microchips and integrated circuits. They are mostly known for being a company that manufactures computers, mainly processors. They also started to use Artificial intelligence f.e. to save coral reefs, they helped to create automated car factory for Audi and uses artificial intelligence to disinfect hospital surfaces due to today's Covid-19 situation. They also invested into the edge and cloud computing and Intel also provides solutions for smart cities. Like a Cisco, they also provide many hardware and software solutions for existing businesses that can increase business efficiency. (Intel, 2021)

SAP is the market leader in enterprise application software, helping companies of all sizes and in all industries run at their best: 77% of the world's transaction revenue touches an SAP system. They are mostly known for SAP ERP system that is used world widely. In terms of Internet of Things, they reimagine business processes and models with embedded IOT services. Power data-driven business applications with a large volume of sensor data that is fully managed and easy to consume. They developed a Smart Sensing Technology. Smart sensing technology helps to not just exchange this information between physical objects and enterprise applications, but also to track the associated business objects to automatically steer process steps and actions. Cloud technology enables not only the possibility to process large numbers of scanning events in parallel, but also provides a powerful decision and rules engine to "translate" insights to actions, allowing customers to leverage intelligence at almost every business process they can imagine. The smart sensing capabilities are offered as part of SAP IoT and enable customers to automatically correlate the movement of physical objects to specific process steps by scanning ID-tags such as RFID, barcode, QR code, or image recognition. (SAP, 2021)

Siemens is German multinational conglomerate focused on industrial manufacturing. The tremendous quantities of data supplied by the IoT often conceal valuable information that can't be found using simple analytical techniques like statistics. Artificial Intelligence (AI), on the other hand, is generally very successful at accomplishing this kind of task. For example, it can independently recognize patterns in measured values from production and use the information to continuously improve the manufacturing process – making artificial intelligence one of the main reasons that the IoT is booming. At the same time, the Internet of Things is driving the continuous development of AI.

Shell or Royal Dutch shell is British/Netherland company that focuses on petrol/energy business. They have been using IoT sensors to monitor offshore and

onshore oil fields. Due to this, shell managed to save over one milion dollars. The sensors are used to provide pipeline surveillance. It combined IT automation and instrumentation technologies to provide a support platform for remote field data and optimize operations. It uses analysis and data management to provide insight into field processes. It said this would lead to safer and more efficient oilfield operations. (Internet of business, 2021)

Tesla is a leader in manufacturing an electronic vehicle. The company was found in USA by Elon Musk. They use Artificial intelligence in self driving cars, they also imbed the IoT sensors inside the cars which can communicate with installed AI in the safest way possible. The power of IoT is that it provides the possibility for companies, like Tesla, to tailor services to their customers and respond in real-time to unforeseen events. And by collecting data from these devices, the companies can optimize their performance going forward. A good example of this is General Electric company, which has begun installing IoT sensors in its aircraft engines, allowing mechanics to remotely monitor the health of individual components and collect data on use, helping to not only prevent engine failure, but also to better monitor usage and wearing tear. (Forbes, 2019)

5 Discussion

There is no clear definition of the Internet of Things, and by comparing different definitions we can say that the authors agree on the main idea that: The Internet of Things is a system (Gillis, 2020) or a network of interconnected objects (Ashton, 1999; Dhonge, 2016; Madakam, Ramaswamy & Tripathi, 2015; Majumdar, 2019; Gartner, 2021; Oracle, 2021). According to the authors, objects are also referred to as devices or things that represent software, sensors, physical objects (electronic devices, buildings, vehicles, etc.) and are connected via the Internet, which allow data collection and exchange; automatically organize and share information; respond and act in the event of changes in the environment; communicate, perceive or interact with their internal states or external environment and provide better services. The authors identify several benefits from using the Internet of Things, and one of them is the ability of stakeholders to communicate quickly and effectively. By connecting components of the environment to the Internet of Things, the percentage of control over the environment is increased, the ability to respond to changes is improved, and the necessary information is immediately available to users and others.

We would like to define our own definition IoT - ***Internet of Things is a digital technology Industry 4.0, which is a network of interconnected devices via wireless connection, which are formed by technological and other components used to connect elements in the enterprise environment and provide various services***.

The Internet of Things can be used in almost all industries. From a review of statistical analyzes carried out by various companies, we found that the Internet of Things has a growing trend of use and is most used in the logistics and utilities industries. Our sample of companies used the Internet of Things to cover several business areas. They agree on increased control over the business process, better

communication between devices in the system and more efficient production. Businesses focus on providing cyber security with respect to the risks of third-party attacks. Active use of cloud solutions enables diversification of this risk. Some of the companies noted the emergence of predictive maintenance of equipment as an advantage of implementing the Internet of Things into the business. Thanks to it, companies are able to prevent possible failures in advance, which would cause greater time and material damage.

The success of IoT depends on security standardization at various levels, which provides assured interoperability, compatibility, reliability and efficiency of operations on a global scale (Li, Tryfonas & Li, 2016). IoT systems According to Majumdar (2019), they improve data collection and automation and remotely control capabilities and flexibility through intelligent devices and assistive technologies.

6 Conclusion

The Internet of Things is a growing global trend for diverse uses across society, whether in consumers, industry, services or others. Currently, it is the largest use in industry, none in the future we expect to expand into the daily life of ordinary people - the possibilities of how the concept of the Internet of Things can be applied are very many. The use of the Internet of Things by businesses is an industrial Internet of Things and is widely used, either in terms of size or industry.

The adoption of digitization and digital transformation in businesses requires a change in business models based on the analysis and identification of applicable digital technologies, the application of which varies depending on the business sector and the subject of the activities performed. The Internet of Things, along with other digital technologies, is as follows: Artificial Intelligence, Cloud Computing, Advanced Robotics, 3D Printing and Big Data analytics are great opportunities for businesses across industries due to operational efficiency, innovation, new business modem, competitiveness, better customer profitability experience and profitability.

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