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USE AND APPLICATION OF THE INTERNET OF THINGS IN THE DIGITAL TRANSFORMATION OF ENTERPRISES

A b s t r a c t: The Internet of Things is of great interest not only in the world of information technology, but also in business environments. The implementation of this solution leads to a significant change, and sometimes even to the displacement of previously established business models. Digital transformation is a challenge for some businesses. On the other hand, the implementation of the Internet of Things becomes necessary for companies to develop, have a competitive advantage and respond to customer needs. Thus, this thesis presents the use and application of the Internet of Things in the digital transformation of enterprises. Moreover, the aim of the work is to characterize digital transformation and the Internet of Things. The desk research method allowed for a theoretical overview of the researched issues and the literature on the above-mentioned concepts. In addition, considerations of the work will focus on answers to the following questions: What are the best innovative solutions in digital transformation? What are the benefits of using the Internet of Things by entrepreneurs? Moreover, what are the essential elements that will help determine at what stage of digital maturity the companies are?

K e y w o r d s: Internet of Things, digital transformation, digitalisation.

J E L C o d e: L21, L26.

INTRODUCTION

The development of broadly understood globalization, as well as the dynamic progress of innovative technologies, have resulted in rapid changes taking place in business environments [E. Fleisch, M. Weinberger, F. Wortmann, 2014, p. 165]. Innovation is an essential factor in any company's ability to compete effectively. Hence, enterprises should strive for a high level of innovation [W. Glabiszewski, M. Zastempowski, 2017, p. 58]. The innovativeness of enterprises is also the ability and motivation to constantly apply and search for new ideas and inventions [D. Grego-Planer, K. Liczmańska-Kopcewicz, 2015,

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p. 165]. In order for the company to be able to ensure further development and respond to the needs of customers and employees, it is necessary to use innovative solutions. Implementations of modern technologies occur when the given innovations allow to solve the problems and challenges of the enterprise [M. Macierzyński, 2020, p. 29]. Especially since their introduction is a necessary condition for the development of the company [M. Zastempowski, 2014, pp. 27-28]. It is modern, innovative technologies that form the basis of the company's success [W. Glabiszewski, 2016, p. 9].

For many organizations around the world, there has been an evolution of the Internet of Things (IoT for short) known as the “next big thing” of information technology. Enterprises in the current business environment must react to changes resulting from the development of technology [Bejnarowicz J., 2020, p. 28]. By the rapid spread of the internet, the exchange of information can affect people in different ways, and objects facilitate the flow of information through technology. Rapid technological development is also driven by key intelligent technologies supporting IoT, i.e. big data analysis, cloud computing or mobile technologies. Moreover, IoT has influenced an integral part of everyday life, both private, public and business [Deloitte, 2016, p. 4]. Each of these technologies generates then both business and economic value, creating much greater benefits in combination with innovative technologies. [P. Rosati, T. Lynn, 2020, p. 144]

The application and use of innovative information technologies in the business context is currently leading to a significant change, and sometimes even to the displacement of specific business models and value creation under the name of digital transformation [M. Röglinger, N. Urbac, 2016, p. 3]. It is essential that firms take advantage of this entirely new market and benefit from the increasing “networking” of things. [PwC Report, 2016, p. 4] Therefore, new business models need to be developed to create more customer offers and thus generate added value from the IoT application. [Paulus S., Puhlmann F., 2014, p. 11] Moreover, IoT significantly influences the improvement of the company's operational processes. [Report PwC, 2016, p.4] Providing advanced technologies is a difficult task. This is due to the challenges posed primarily by conditions in the competitive and technological environment [W. Glabiszewski, M. Zastempowski, 2016, p. 61].

In the face of changing consumer preferences, companies need to compete effectively to maintain their market share. [K. Liczmańska-Kopcewicz, 2018, p. 561]. Customers demand ever faster responses and personalized actions. Such a situation requires enterprises to effectively and efficiently react to dynamically changing internal situations, as well as external environments. IoT can provide companies with new business opportunities and, consequently, change the future market. [E. Fleisch, M. Weinberger, F. Wortmann, 2014, p. 165] Thus, this thesis presents the use and application of the Internet of Things in the digital transformation of enterprises. Moreover, the aim of the work is to characterize

digital transformation and the Internet of Things. The desk research method allowed for a theoretical overview of the researched issues and the literature on the above-mentioned concepts. In addition, considerations of the work will focus on answers to the following questions: What are the best innovative solutions in digital transformation? What are the benefits of using the Internet of Things by entrepreneurs? Moreover, what are the essential elements that will help determine at what stage of digital maturity the companies are?

1. DIGITAL TRANSFORMATION

The common opinion is that terms such as digitization and digital transformation are being heard more and more often. Nevertheless, the concepts are used interchangeably, which is not appropriate as they are two different approaches. Digitization is a collective term for “computerization, informatization and networking”, which is a multidisciplinary area of consideration. Digital transformation is measured with the degree of social acceptance of innovative tools enabling technology implementation [Networked Digital, 2014]. Whereas digital transformation “is the entire process of transforming an analogue resource into a digital one, consisting of preparation, formatting, description and sharing” [Industry Service, Archives, 2013]. Digital transformation is a strategic change of processes in organizations [P. Rosati, T. Lynn, 2020, p. 144].

The digital transformation process is different for each company. In such a situation, it is difficult to define a definition that covers every point of view. Digital transformation is generally accepted as “the integration of digital technology in all areas of business leading to fundamental changes in the way companies operate and deliver values to customers”. This influences changes in many aspects, requires frequent experimentation, as well as departing from long-term business processes on which enterprises were created, for the needs of new practices that are still clarified and defined. Greg Vedinio describes the term in this way: “Digital transformation bridges the gap between what customers already expect and what analogue companies actually deliver.” The author points out how companies are going through the digital transformation [The enterprisers project, 2020].

Therefore, the essence of digital transformation is the use of technology to build new business models, processes, software or systems that will bring benefits to the enterprise, such as: revenue growth, competitive advantage, as well as increasing productivity and efficiency. Then digital transformation starts with the relationship between people, business and objects [Cisco Report, p. 4]. Companies are undergoing digital transformation at different speeds, which means they achieve different levels of success. In some cases, organizations make many changes. Then the rest of them are still only engaged in basic activities, without

undergoing significant modifications, and also without taking up any challenges. Besides, IoT implementation means organizational problems or other challenges that prevent them from successfully transforming. The best companies, the so-called “Digitati combine digital activity with strong leadership to transform technology into transformation.” It is a kind of determinant of a company’s digital maturity. The digital transformation has contributed to companies varying in terms of digital maturity. Organizations that are more mature and implement innovative solutions achieve better results than those based on current business models. Business development requires managers to have a vision of how to transform a business into a digital world [G. Westerman, D. Bonnet, A. McAfee, 2014].

Digital transformation is a continuous process connecting the real world with the virtual. It becomes a driving force for the development of innovation and contributes to changes taking place in the economy. It is often disruptive in nature, which contributes to the emergence of radically new values for consumers or changing systems of power on the market [J. Pieriegud, 2016, p. 11]. Changes take place in different types of organizations. Nevertheless, they identify with the common features of digital transformation. These include:

- creating new relationships with customers and suppliers,
- transformation of business models,
- stimulating innovation of employees.

Achieving the above features is possible if the company has a solid foundation in connection with the results achieved and uses the technological potential [Cisco Report, p. 4]. There are many innovative solutions on the market that enable the digital transformation of the company. KPMG presented the results of a survey on the best innovations in the technology industry. It includes responses from over 740 technology industry leaders from 12 countries. The study identifies technologies that are seen as having the greatest potential for the above companies in the next three years. Table 1 below presents the top 10 transformative technologies in 2019.

Table 1. Top 10 Business Transformation innovations of 2019

1	Internet of Things (IoT)
2	Robotic proces automation (RPA, e.g. software bots)
3	Artificial intelligence, cognitive computing, machine learning
4	Blockchain
4	Robotics and automation
6	Augmented reality
7	Virtual reality
8	Social networking, collaboration technologies

9	Biotech, digital health, genetics
10	On Demand marketplace platforms

Source: [KPMG report, 2019, p.1.]

The Internet of Things turned out to be the most innovative solution among the respondents. This demonstrates the great potential of this technology that can be used to drive business transformation. Successive implementations of Robotic process automation (RPA), including bots, artificial intelligence, and blockchain are also significant innovations used for transformation technology industry leaders [KPMG Report, 2019, p.1]. Although technology itself does not provide transformation. According to many experts, transformation is first of all, the involvement of people. Managers and employees must cooperate in a systematic way so that the company can achieve certain benefits [P. Wtulich, 2016].

2. INTERNET OF THINGS

The concept of the Internet of Things was launched in 1999 by Kevin Ashton, co-founder of the Auto-ID Centre at the Massachusetts Institute of Technology (MIT). At that time, during his presentation, he used the term “Internet of Things” as the title of his presentation. Back then, the Internet was a popular trend and it made sense to use such a phrase, however it did not gain so much attention [K. L. Lueth, 2014]. This originally involved the use of object identification via RFID technology ¹[Michałowski B., 2018, p. 10]. Although the concept of the Internet of Things is commonly used in society, and the number of publications and research is systematically growing, there is no unambiguous, consistent definition describing the phenomenon. [J. Wielki, 2016, p. 209]. According to Garent, the Internet of Things (IoT) “is a network of physical objects that contain embedded technology to communicate and understand or interact with their internal states or the external environment” [Gartner Glossary, 2020]. Simply put, it is a concept of connecting any device with an on / off switch to the Internet. This includes innovative devices ranging from coffee machines, headphones, lamps, mobile devices to machine components, e.g. aircraft jet engines or medical equipment. [J. Morgan, 2014]. All these devices communicate and share information based on specific protocols to achieve intelligent reorganization, positioning, security, tracking and control [K. K. Patel, M. S. Patel, 2016, p. 6122]. The number of devices using IoT technologies is systematically growing. According to a Gartner report, by 2021, it might grow up to 25 billion devices connected to the Internet [G. Omale, 2018].

¹ RFID is “the general term used to describe the technology that enables the automatic identification of an object using radio waves.” [B. Krupanek, R. Bogacz, 2018, p. 1].

The goal of the Internet of Things is to facilitate “things” connected using networks and technology [K. K. Patel, M. S. Patel, 2016, p. 6122]. Thus, IoT relies on a network of sensors connected to communication devices providing data that can be analysed and used to initiate automatic actions [Fast Lane Consulting and Education, Inc., 2016]. In addition, IoT has an even wider reach as it also covers connections that go beyond the industrial context, such as mobile devices [R. Desai, 2016].

Increasingly, the term Internet of Things is used interchangeably with the term Internet of Everything (IoE). It stands for “a network of people, data, processes and things connected to the Internet” [Lc elektronik, 2019]. Consequently, IoT is one of the four components of IoE. This means that the Internet of Everything covers a much broader scope than the very concept of the Internet of Things [Fast Lane Consulting and Education, Inc., 2016]. In addition, along with the dynamic development and more and more often used IoT, related concepts can be distinguished among many industries. Industrial Internet of Thing (IIoT) or Internet of Service (IoS), Industrial Internet of Things (IIoT) is a field related to how “machines are connected and optimized” [Report of the Institute of Innovative Economy 2019, p. 18]. And the Internet of Services (IoS) allows you to meet the needs of customers in the delivery of services to gain greater flexibility, thanks to the rapid response to changes and product requirements [J. M. V. Cedeño, J. Papinniemi, L. Hannola, I. Donoghue, 2018, p. 60]. Nevertheless, IoT has a much broader scope as it covers both IIoT and IoS [R. Desai, 2016].

The Internet of Things heralds a new era in the digital evolution of enterprises [K. Manhart, 2018, p. 94]. With the implementation of IoT, many new concepts are created among enterprises, commonly used by initiators of innovative solutions. These concepts include intelligent data-based services, the so-called “Smart Service”. This allows for flexible connection, “intelligent” acquisition, as well as analysis of the obtained data. Smart Services are available through digital online platforms where different providers and users meet. This affects a variety of combination options for everyone involved [B. Steimel, I. Steinhaus, 2017, p. 4]. Moreover, marketing managers learn which intelligent products, the so-called “Smart Products” are actually used. This situation enables better targeting of the product to customer segments. Smart Service can reduce costs by using automated processes, such as monitoring or maintenance of “items”. However, in this case, it is necessary to ensure IoT security and data protection. IoT changes many industries and areas. The so-called Smart Industry is emerging that optimize and automate network machines [B. Steimel, I. Steinhaus, 2017, 16-23].

The growing importance of innovative solutions means that consumers require entrepreneurs to use more modern technologies, including IoT solutions. Which makes entrepreneurs try to meet their expectations. What is more, there are much more benefits for which enterprises decide to implement IoT.

The following Chart 1 shows the benefits for which entrepreneurs decide to use IoT, according to a survey conducted by the consulting company Bain.

Chart 1. Reasons for using the Internet of Things by entrepreneurs



Source: [Report of the Institute of Innovative Economy 2019, p. 10].

According to the survey results, the benefits for the increasing use of IoT in business include, in particular: improved product or service quality (47%), improved work efficiency (45%) and reliability of operational processes (44%) [Report of the Institute of Innovative Economy 2019, p. 10].

3. USE AND APPLICATION OF THE INTERNET OF THINGS IN THE DIGITAL TRANSFORMATION OF ENTERPRISES

Digital transformation affects the entire company. Elements such as Maturity Model, Smart Product, Smart Service or huge data sets are a part of the transformation taking place in companies. At the beginning of the digital transformation process, managers think about many aspects, trying to answer the following questions: How to properly approach digital transformation? Where is the starting point? What skills do we already possess and what do we need? What goal do we want to achieve? To answer these questions, companies must first test their digital skills. It is important to check the company's positions first. This can be done in two ways:

- test, determining the external perspective of the enterprise, as well as comparison with competitors.

- an assessment establishing an internal perspective based on the maturity model.² The values are based on detailed research of managers defined at different levels.

The digital transformation of enterprises depends on many factors, i.a the appropriate degree of digital maturity, as well as skills and resources possessed. Therefore, it is worth finding out to what extent enterprises achieve digital maturity. The following points are based on eight categories. They allow for drawing the attention of entrepreneurs to certain elements necessary to improve activities in the field of digital transformation and to determine at what stage the company is undergoing digital transformation. [B. Steimel, I. Steinhaus, 2017, 16–23]. Table 2. shows the above situation.

First, due to the increased dynamics of digital transformation, products are developed at much faster intervals. This process usually takes three months to validate the concept and six months to the final product or service. Second, they should be technology-based, e.g. intelligent products and services are constantly developed on the basis of customer requirements or knowledge of their practical application. The many factors influencing the digital transformation and the different time horizons of digital transformation prove that the level of enterprise maturity varies greatly. Moreover, there may be cases where the business model is much more digitized than the customer experience. An example is the car industry. Car manufacturing plants are widely regarded as pioneers of Industry 4.0 because they rely heavily on industrial Internet, automation, and even embedded IoT applications. Most of the car models at the moment do not offer the same solutions, such as the Tesla Model S, in which the functions can be retrofitted via the Internet. Yes, companies decide to develop modern digital strategies and innovation. However, most companies use one of two strategies. In the first place, many companies decide to re-adjust the business model, i.e. comprehensively digitizing of value creation. Then the digitization strategy is mainly based on performance criteria. The second path of digital transformation is the expansion of the platform with a proposition of values for the customer, e.g. by adding digital services to already existing basic products or supplementing one's own business model with new products. A good example of this is Claas, which has grown based on its core business, offering digital services as well as swapping its product portfolio. The third digital transformation path connects both of the two mentioned. It leads to a radical transformation of enterprises. It requires a lot of resources and attention. As a result, very few companies decide to undertake such transformations.

² The model aims to facilitate the explanation of Machine Learning principles along with the research of the Center for Digital Business developed at the University of Reutlingen. This positions each company on a scale of 0 (novice) to 100 (Master) [B. Steimel, I. Steinhaus, 2017, 16-23].

Table 2. Elements streamlining activities in the field of digital transformation of enterprises

Areas of activities	Characteristics
Strategy	The most important element is establishing a digital strategy. It happens that a dilemma arises as to how these projects should be combined within the strategic goal. Without one overarching strategy, digitization may very likely fail.
Leadership	Digital transformation requires the right „owner” in the company. If he is not a manager involved in the implementation of IoT in the enterprise, it is advisable to create a position in the company (e.g. „Chief Digital Officer (CDO)”), which deals only with the change of digital technology.
Products and services	An important element is determining the right business model. Entrepreneurs often lack the ability to innovate and methodical knowledge of Smart Service design.
Operational processes	Companies have quite advanced operational processes. Moreover, they already have very efficient and even partially digitized processes. Nevertheless, there are many digital transformation processes in different areas: distribution, marketing or sales methods, where the right Interfaces are missing.
Culture	The factor driving the transformation is the corporate culture, moving towards cooperative cooperation. On the other hand, corporate culture is hard to control and reluctantly adopted by companies. Indeed, there are many medium-sized companies that are relatively open to this type of solution, but the impact of corporate culture in digitization is often underestimated.
Control	To achieve process control, a company needs three time horizons to organize a portfolio of intelligent products and services. <ul style="list-style-type: none"> • 12 months („optimize”) - this period includes all existing products and services, gradually improved and optimized to meet customer requirements, • 12 to 36 months („extension”) - these are the problems solved, related to the development of existing or the introduction of new products, and the services are also expanded, • Over 36 months („redesign”) - innovation generally requires a long term perspective. These are the issues on which the company focuses on the future and tests hypotheses. Companies should use their budget to run as many experiments as possible within a given time frame. Only in this way can they find out what innovations actually become issues of growth in order to obtain successful products and services.
Technology	In enterprises, the key issue concerns the implementation of the necessary technologies. They support the functioning of the enterprise and provide it with added value. They include, among others: Technological programming tools (software tools), Cloud-architectures, information and communication technologies (ICT) or the Internet of Things,
Client and employees	An important element for entrepreneurs is customer satisfaction with a given product or service. Moreover, business owners should use the knowledge and skills possessed by employees.

Source: [B. Steimel, I. Steinhaus, 2017, 16-23].

The business model is an important element in the digital transformation of enterprises. It is to provide a specific added value for enterprises, as well as arouse customer interest. Thus, the digital transformation of the business model means additional benefits, thanks to the use of technologies such as IoT. Another key finding of business model research is the widespread use of generic and effective business model patterns. There are three possibilities for new business models. This also applies to the relationships between Smart Product and Smart Service in companies. Three ways to build new and active IoT business models must be developed through [B. Steimel, I. Steinhaus, 2017, 16–23].:

- Providing existing products with additional IoT services - this applies to products that are already well established in the market and are likely to be functioning the same way and for some time. This variant represents the lowest level of IoT business models. One example is clothing stores that sell their clothes both in stores and online.
- Developing new products with IoT functionality - in this case, new products are developed without the need to expand existing products on the market with IoT technologies. An example is the autonomous Google car. Companies are trying to expand their activities and try to introduce Smart Product not related specifically to a given industry. Nevertheless, these innovations are ground-breaking and can be an added value for the company.
- “Product-free” smart services - Businesses can use data to offer digital services or create them completely product-free. One example is the Uber taxi app. It is a data-only service. The Uber app organizes transport for passengers in both regular and private taxis. Communication takes place via a smartphone app or on the Uber website. It is not a taxi company that has its own fleet, it does not have any cars in its assets. Uber provides services to third parties. This means that it takes on the role of an intermediary.

Digital transformation creates new markets, changes value creation, and changes market structures, as well as business models [B. Steimel, I. Steinhaus, 2017, 16–23]. Examples of this change include Facebook, Alibaba and Booking. Facebook, the most popular social media company in the world, does not create its own content. Alibaba, the world’s most valuable seller, has no inventory of its own. Booking, the world’s largest rental accommodation provider, does not own any hotels. All of these companies can be viewed as digital companies as their business models are fundamentally based on the innovative use of modern information technology. At the same time, all three companies are market leaders in their respective segments, from which they ousted established market participants in a relatively short time. Finally, they are relatively young companies. None of the examples, except for Alibaba, are more than 15 years old.

The examples above show that digitization has a strong impact on the business models of companies. It can be seen that the meaning of the client interface is evolving. Of course, the customer is important to enterprises because products and services are manufactured for them. Nevertheless, each of the above-mentioned companies has gained its success thanks to the fact that so far it has won the battle for the client interface with recognized market participants. The important thing is that digitization connects the digital and physical worlds. The digital transformation and the business models of companies that have emerged from digitization are not limited to the digital world. The examples above show that digital business models have a huge impact on individual actions and economies in the physical world. Examples of such a physical-digital fusion are cyber-physical systems and the Internet of Things. It can be seen that many opportunities and challenges related to digitization are in the business-to-consumer (B2C) environment, i.e. in relation to enterprises towards the consumer, and only then in the business-to-business (B2B) environment. In addition, many enterprises that have targeted their traditional business towards the B2B environment are increasingly considering extensions to the B2C environment [M. Röglinger, N. Urbac, 2016, s. 3].

To further highlight the significance of the Internet of Things and its importance to the economy, some possible applications are outlined below. In fact, IoT technologies are widely used in many sectors. On the basis of the IIA report of the Minister of Digitization, 9 most important industries, the volume of which is favourable due to the use of IoT, should be distinguished. These include: Smart cities and buildings, industry, agriculture and environmental protection, health-care, transport, energy, finance and insurance, telecommunications, security and digitization. [Minister of Digitalisation Report 2019, p. 19]. The Internet of Things technology market is gaining in importance every year. According to the research company IDC, spending on IoT technologies in 2018 amounted to approximately 723 billion dollars. Compared to the results estimated in 2017, approx. 15% more. In 2020, the value of IoT is expected to reach \$ 1 trillion, and in 2021 – \$ 1.1 trillion [Simens, 2019, p. 8]. It is worth mentioning that most of the expenses allocated to the use of IoT on the global market are incurred on the consumer market, logistics, transport and industry. [Minister of Digitalisation Report 2019, p. 19]. Undoubtedly, the applications of the Internet of Things are not limited to a specific industry [K. K. Patel, S. M. Patel, 2016, p. 22]. Virtually every company uses IoT to a greater or lesser extent in its operations. In the consumer sector, the Adidas concept can be distinguished. It intends to expand the range with personal running shoes using 3D printers and robots. First, clients determine individual projects from a few sample elements presented on a virtual model on a computer. Then the shoes are manufactured according to the customer's preferences [B. Steimel, I. Steinhaus, 2017, p. 14]. There are many possibilities for IoT applications in the field of logistics and production used in

companies. By clearly marking things, companies can manage and control the flow of goods and the manufacturing process around the world via the Internet. For example, a logistics company can track where the delivery of goods is at any time. The pioneer in this field is RFID (radio frequency identification) technology [K. K. Patel, S. M. Patel, 2016, p. 22]. Moreover, the Internet of Things is also used in compressors. Kaeser's innovative model relies on data transfer from the compressor to SAP HANA technology for preventive maintenance. The assessment is done on smartphones or tablets by technicians who can now respond in a targeted manner [B. Steimel, I. Steinhaus, 2017, p. 38].

SUMMARY

Digital transformation is the use of digital technologies and data as levers to improve the operation of the organization. The most mature form of digitizing businesses is doing completely new "things" in new ways [PwC Report, 2020]. As a result of digital transformation, new types of organizations are created, significantly exceeding the results of their competitors, thanks to the use of solutions based on modern technologies and information processing methods. They give up the model of operation based on the use of physical resources in order to transfer the potential to the digital dimension, thus ensuring the ability to adjust it adequately to the current market needs [P. Wtulich, 2016]. From the user's perspective, IoT enables a large number of new, responsive services that should meet the users' needs and support them in their daily activities [D. Miorandi, S. Sicari, F. D. Pellegrini, I. Chlamtac, 2012, p. 1499].

However, it should be remembered that transformation is a process and an evolution, not a revolution [PwC Report, 2020]. Digital transformation is not a change through which companies can modify their business models right away. Most often, the path to digital transformation involves a series of choices and burdensome processes. Especially that digital transformation is not only an initiative of technological change, but also a metamorphosis of outdated operational processes of the enterprise. The dissonance between technology and business strategies is the biggest obstacle to the digital transformation of an enterprise [D. Gibiino, 2019]. Digitization is undertaken not only by companies that take their first steps in the world of innovative technology, but also by active participants in this market. A recent Forrester study confirms the statement that "transformation is a continuous process" [SAP, 2019, p. 7]. Enterprises with innovative solutions in their range are constantly developing to increase the company's competitive advantage and anticipate customer needs.

The growing conviction of Polish enterprises in the processes of digital transformation positively affects the expected high level of IoT implementation on the Polish market. The research carried out in the Report of the Minister of Digitiza-

tion shows that entrepreneurs trust these innovations. The respondents described the level of IoT implementation at the stage of technological advancement (rather developed). This may result from the aspirations and interest of enterprises in modern and innovative solutions. Forecasts show a high growth rate of the technology market and IoT solutions at approximately 13% year on year. This means that the Polish economy has great chances of significant absorption of this technology. Moreover, if the existing barriers and limitations were removed, e.g. in terms of regulation or development of modern communication technologies (including 5G technology), this potential would have a chance to increase significantly. [Minister of Digitization Report 2019, p. 7]. The increasing importance of the Internet of Things is used in the so-called smart cities. In connection with the above, it is worth using the IoT potential in Smart City in the continuation of research. Especially that its importance and dynamic growth rate is at the stage of a constant revolution.

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