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# **The Impact of the COVID-19 Pandemic on the Growing Importance of Cybersecurity of Data Transfer on the Internet**

**Abstract:** Information technologies, ICT and Industry 4.0 are developing particularly fast in the fourth technological revolution. During the COVID-19 pandemic, there has been an increase in the scale of digitisation and internationalisation of remote communication processes and various aspects of economic activity. Digitisation of the economy is currently taking place simultaneously in many areas of economic processes and the functioning of many economic entities and public, financial and other institutions. Many companies, enterprises and public institutions that previously operated mostly or solely offline during the pandemic have switched to remote, electronic operation via the Internet. The development of electronic banking is also increasing, including internet and mobile banking. The share of electronic, cashless payments via the Internet and payments with electronic bank cards is increasing. In addition, in recent years, the range of applications of Data Science, Big Data, and Data Analytics technologies in economics, finance and organisation management, including enterprises, financial and public institutions, has been increasing. Therefore, the importance of implementing analytical instruments for advanced processing of large Data Science data sets in enterprises, financial and public institutions is also growing, including the construction of Big Data Analytics platforms to support organisation management processes in various aspects of operations, including improvement relationship with customers. The scale of

cybercrime has also increased during the pandemic, as has the importance of improving cybersecurity techniques and instruments.

**Keywords:** *cybersecurity, data transfer security, ICT information technologies, Industry 4.0, Big Data, social media, COVID-19, digitisation, Internet*

## Cybersecurity of Data Transfer on the Internet

Globalisation and technological progress have brought new challenges to protecting, transmitting, and processing data, including classified information. The development of techniques for sharing information via the Internet is primarily determined by many amenities for beneficiaries, customers and people using information services offered by companies and financial and public institutions (Lakomy, 2015, p. 35; Marszałek-Kawa, 2019). On the other hand, for entities that provide electronic information via the Internet, there is a possibility of a significant reduction in transaction costs of financial operations and electronic data transfer (Hołyst & Pomykała, 2011). However, there are also negative aspects to electronic data transfer on the Internet (Gwoździewicz & Prokopowicz 2019, pp. 27–28). However, the development of information technologies operating on the Internet is also associated with the risk of loss or theft of information by unauthorised entities (Gołębiowska, 2017, p. 27; 2013, p. 27). The process of sharing information via the Internet also generates many threats related to crimes of identity theft (Machowski, 2016), electronic interception of classified data by hackers and embezzlement of funds in electronic banking systems (Grzywak & Widenka, 2015, p. 62). In order to reduce the risk of data loss and other threats to the electronic transfer of classified data, individual entities, including public sector institutions, develop security systems for the remote provision of information and transactions carried out via the Internet (Wróbel, 2014, p. 57). Improving techniques to ensure a certain level of security of Internet data transfer is constantly being continued. The procedures for the safe processing, storage and sharing of information are constantly being improved. In the context of the development of ICT, the importance of improving techniques for the secure transfer of classified data on the Internet is growing, including, in particular, personal data (Gołębiowska, 2010, pp. 175–182; Gałach et al., 2015, p. 320; Marszałek-Kawa et al., 2019) and other categories of sensitive data (Gwoździewicz & Prokopowicz, 2017, pp. 66–67).

In recent years, the importance of the security of electronic data transmission and processing, including classified information, has been growing. The development of techniques for sharing information via the Internet is associated with many facilities for beneficiaries, clients and people using information services of public sector institutions (Gwoździewicz & Prokopowicz, 2016). For entities that provide electronic information via the Internet, there is a possibility of a significant reduction in transaction costs of financial operations and electronic data transfer. On the other hand, the process of sharing information via the

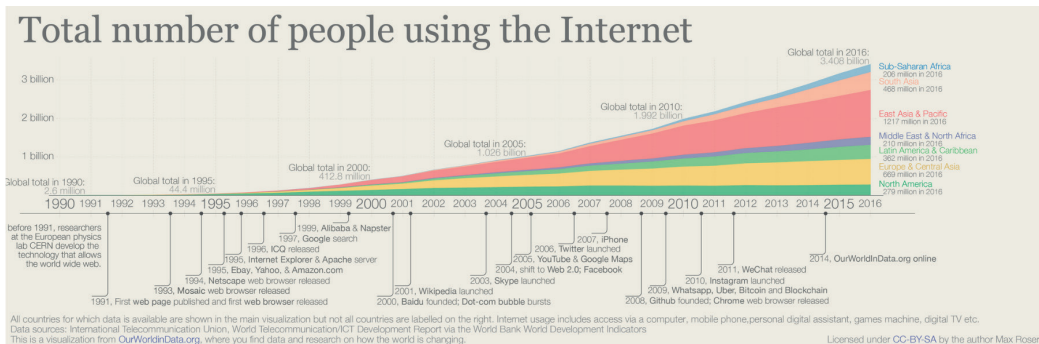


Chart 1. Internet users by world region  
 Source: *Internet Users by World Region* (2022).

Internet (Gołębiowska et al., 2021b, pp. 251–275; Gołębiowska & Prokopowicz, 2021a, pp. 135–154; 2021b, pp. 129–154; Dutko & Karciarz, 2011, p. 35) generates many threats related to crimes of identity theft, interception of classified data by hackers and embezzlement of funds in electronic banking systems (Prokopowicz, 2009, p. 63).

In response to these threats, individual entities, including public sector institutions, develop security systems for remote information sharing and transactions carried out via the Internet. Currently, improving techniques to ensure a certain level of security of Internet data transfer, including classified data, is being continued (Wociór, 2016, p. 48). Procedures for the safe processing, storage and sharing of information, also in the field of personal data protection on the Internet, are being improved (Matosek & Prokopowicz, 2017, pp. 221–222). In the context of this issue, the issue of the development of Big Data technology and Internet social networks in the context of the security of classified data transfer (Gołębiowska et al., 2021a, pp. 862–863) on the Internet is of particular importance.

The revolution took place in the area of knowledge and usefulness. Previously, computers were used in the military and science fields, and their capabilities were known only to specialists and only they understood their operation. Before computers became popular in society, they were purely industrial. Only since about 30 years computers have become available to ordinary human beings, and with them, the Internet has appeared. From that moment on, new technologies accompany people in everyday life in almost every activity. Their operation is becoming easier and easier. Gestures, verbal commands and intuitive interfaces have made computers, mobile devices and applications ubiquitous, existing in human consciousness and easy to use even for children. Technologies have become tools that take over some of the tasks previously performed by humans and thus expand their capabilities while allocating the saved time to other activities. Today, quick searching for information, finding a route or checking the weather anywhere in the world is instant and requires no effort. Modern computers, smartphones and software are designed to

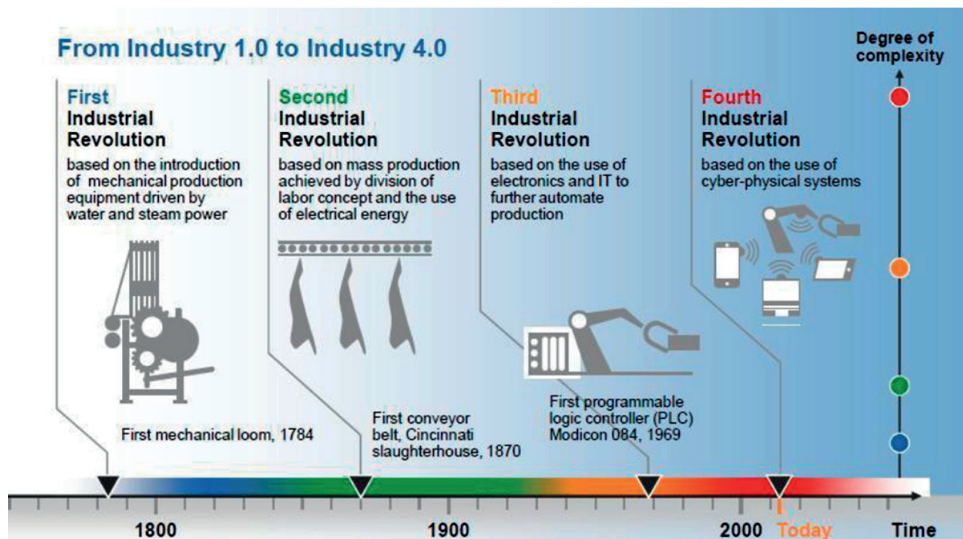
achieve full synergy between a human being and a device (Kamińska-Czubała, 2013, pp. 145–148).

K. Krzysztofek and M. Szczepański (2007, p. 36) defined the information society as a society “(...) in which information is intensively used in economic, social, cultural and political life; it is a society which has rich means of communication and information processing, which are the basis for creating the majority of the national income and providing a source of income for the majority of people”.

### **Increase in the Scale of Digitisation and Internetisation of Remote Communication and Economic Activity During the COVID-19 Pandemic**

In recent years, the development of digitisation of the economy has accelerated in many countries. During the pandemic, there was an increase in the scale of implementation of ICT and Industry 4.0 (Jakubczak et al., 2021, pp. 173–174) information technologies in various areas of economic activity of commercially operating companies, enterprises and public institutions (Gwoździewicz & Prokopowicz, 2019, pp. 28–29). Industry 4.0 is a set of currently developed, advanced technologies typical of the current fourth technological revolution known as Industry 4.0. (Sanders et al., 2016, pp. 811–833). Three technological revolutions have preceded the fourth technological revolution. Chronologically, they included the first technological revolution, also known as the industrial revolution of the eighteenth and nineteenth centuries, which accelerated development after the invention of the steam engine. The second technological revolution was based on inventions in electricity from the late nineteenth and early twentieth centuries. The third technological revolution from the 1960–80s was based on the development of computer science. However, the development of information processing technology in the era of the current technological revolution, referred to as Industry 4.0 (Y. Lu, 2017), is determined by the development and growth of applications of ICT information technologies, Internet technologies and advanced data processing (Matosek & Prokopowicz, 2017, pp. 224–225).

The currently taking place technological revolution, referred to as Industry 4.0, is motivated by the development of the following factors: analytical and database technologies, Big Data Analytics, Data Science, cloud computing (Szpor, 2013, p. 47), machine learning, personal and industrial Internet of Things, artificial intelligence, Business Intelligence, autonomous robots, horizontal and vertical data system integration, multi-criteria simulation models, additive manufacturing, Blockchain, cybersecurity instruments, Virtual and Augmented Reality and other advanced data mining technologies. According to some researchers, regarding the issues of technological development and technical and civilizational progress, we live only at the beginning of the Industry 4.0 era (Rojkjo, 2017). The advanced information processing technologies find more and more applications in various industries, including producing goods and providing services. There is a growing number



Graph 1. From the first technological (industrial) revolution to the current fourth technological revolution  
 Source: Rutkowska & Sulich (2020); Maj Consulting (2015).

of industries, fields of economic activity, and sectors of the national economy in which advanced information processing technologies typical of the current fourth technological revolution known as Industry 4.0 are applied (Zhou et al., 2016).

Implementing ICT, Internet, and Industry 4.0 information technologies in various spheres of economic activity to companies, enterprises, and institutions representing various sectors and branches of the economy has been taking place for many years. However, in the past, there have been several periods of acceleration of these processes (Prokopowicz et al., 2021, pp. 226–227). The previous period of this type was, for example, the end of the 1990s, but at that time, the dominant sources of the acceleration of the implementation of Internet technologies into business activities were slightly different from today. The current sources of the acceleration of the technologies to economic and not only economic processes, but also many spheres of human life, are related to specific activities and anti-pandemic instruments used, primarily with the recommendation to stay at home, in-home quarantine (Komorowski & Prokopowicz, 2021, pp. 89–90). Digitisation of the economy is currently taking place simultaneously in many areas of economic processes and the functioning of many economic entities and public, financial and other institutions. Due to the development of the COVID-19 pandemic, the processes of digitisation of the economy have accelerated (Golczak et al., 2021, p. 89). In many industries and sectors, increasingly more companies develop their activities via the Internet, remotely providing their services and selling their products via e-commerce. Many companies that did not do this are now switching to remote,

electronic operations via the Internet. The importance of internet marketing (Buss, 2008, p. 57) is increasing, including viral marketing, Real-Time marketing carried out on social media portals. The development of electronic banking is also increasing, including internet and mobile banking. The share of electronic, cashless payments via the Internet (Dmowski & Prokopowicz, 2010, pp. 332–333) and payments with electronic bank cards is increasing (Grzywacz, 2016, p. 71). More and more citizens do not use cash when paying in stores but make contactless payments. In some countries, the limits for all contactless payments made with bank cards have increased. Therefore, the COVID-19 will increase the share of payments made electronically in the context of all payments made in domestic economies. The cashless system has been in place since the 1990s, but in the past, it was only a specific part of the total payments, financial system, etc., and it gradually increased and underwent successive stages of the technological revolution.

However, due to the development of the COVID-19 pandemic, the development of the electronic economy, internet and mobile banking (Borcuch, 2012, p. 81), e-commerce has significantly accelerated. The dynamics of digitisation in various areas of activity of economic entities is accelerating. The changes are so dynamic that it is difficult to predict what the scale of digitisation of the economy will be, not only in a few years but even in just one year (Grzegorek et al., 2020, pp. 95–96; Gołębiowska & Zientarski, 2017, pp. 31–43). It is also associated with many puzzles regarding the development of the COVID-19 pandemic in the coming months and possibly years. There are still many questions to which we currently do not know the answers regarding effective medical therapies for treating COVID-19 disease, the development and ending of the pandemic in the months and years to come, and the impact of this virus on people's daily lives in the coming years, etc. All these factors may change in the future also the business models and development strategies used by enterprises. The changes are so dynamic that it is difficult to predict the scale of the economy's digitisation, not only in a few years but even in a year. The issue is so much developing that unconventional analytical instruments are already being tried to forecast specific development processes of specific issues related to the development of the COVID-19 pandemic in the future and the impact of this pandemic on economic processes. An example is the ongoing attempts in some research centres to use Big Data Analytics analytical platforms for the mentioned forecasting (Prokopowicz & Gołębiowska, 2021, pp. 325–326).

During the first wave of the pandemic, there was great uncertainty and a high level of fear and insecurity. Also, the level of risk in the context of economic processes was exceptionally high in March and April 2020. The estimated investment and credit risk level in the financial markets was also exceptionally high at that time. There was a recession in the economy, a stock market crash, a decline in economic activity, the closure of companies and service plants, an increase in unemployment, etc. longer shelf life. The scale of the pandemic development rate during the first pandemic wave was also relatively large. However, although the number of new coronavirus infections in many countries during the second, third, and fourth wave of the pandemic was much higher than during the first wave of the



pandemic, the level of uncertainty and concern caused by the pandemic was much lower. In subsequent waves of the pandemic, the impact of the health crisis on other aspects of people's lives, social processes, etc., was much lower. The impact of the pandemic and the changes caused by the general social awareness of citizens regarding the issue of a healthy lifestyle, pro-environmental philosophy of life, etc., were also the greatest in 2020, i.e., in the year of various crises caused by the pandemic (Komorowski & Prokopowicz, 2021, pp. 92–93).

At the same time, in 2021, the world has already emerged from the economic recession caused by the pandemic, programmes to vaccinate citizens against coronavirus were carried out, and research aimed at creating a drug for coronavirus taken in the form of tablets was carried out, there was an increase in the digitisation and internetisation of economic processes, the scale of fears and uncertainties dropped significantly. From mid-2020, the formula of remote work in corporations, e-learning in education, telemedicine advice provided remotely via telephone or the Internet, purchases made in online stores, payments and settlements carried out online, and the development of mobile banking (Domańska-Szaruga, 2013, p. 73), Internet marketing, remote communication via social media portals, remote handling of official matters, remote use of cultural services (e.g. online offers of libraries, museums, cinemas, theatres, etc.). Accordingly, the pandemic has affected many aspects of people's lives.

### ***Communication Changed in the Digital Society***

Recently, modern ICT technologies have dynamically developed, which has left a considerable mark on interpersonal communication. Such an important aspect of life did not remain indifferent to the development of the Internet and mobile technologies. One can say more – it contributed to this development and a driving force. In the era of such intensive economic development, the need for efficient interpersonal communication has become the basis for creating new technologies, trends and communication standards. The ubiquitous Internet, whose origins were related to ensuring the continuity of operational activities for the American army, quickly found recognition among the academic community, where the need to store and share information turned into the need for its dynamic exchange. It resulted in the emergence of e-mail and then the prototypes of Internet messengers (it is called: Instant Messenger – which shows the idea behind the solution, it means sending instant messages).

Recent years have brought the greatest social changes based on the technological boom. An interesting aspect is the development of communication itself, which from the one-to-one model which has dominated for centuries, as exemplified by traditional mail, has developed into a one-to-many or many-to-many model – an example of an e-mail sent to many recipients, the Internet blogs covering the area of communication of a person with many recipients or social networks which can be addressed by each of the models. Extending the spectrum of available options, their ease of use and the creation of a specific trend

for modern communication have resulted in their extensive adaptation, which ultimately resulted in enormous changes in this area of the functioning of society and, as shown by recent years, this trend seems to be constantly developing. The example of the most widespread medium of modern communication – e-mail – has caused profound changes in the way people relate. Many research results confirm that people, to a large extent, prefer to rely on this type of medium than face-to-face meetings or telephone contact (Such-Pyrgiel, 2019, pp. 149–150; Such-Pyrgiel et al., 2021, pp. 14–15).

According to research by the Radicati Group, e-mail remains the most common form of communication on the Internet, with around 3.8 billion e-mail users in the world in 2018, which is more than half of the world's population. This number is expected to increase to around 4.2 billion users by 2020. It is worth emphasising that the number of e-mail accounts is growing faster than the number of people using e-mail, which is caused by the consumer trend, where a large percentage of people have a larger number of accounts and differentiate them depending on the way of use (account for purchases, account for family and friends, etc.). According to the above study, the average number of accounts per user is 1.75 in 2018, which will increase to 1.86 in 2020. It should also be remembered that an e-mail account is commonly required to register for other services or Internet portals. In professional life, electronic communication has been the leader for years, and according to the latest research, this trend will not change in the next four years. However, in this area, the influence of new tools and communication channels is also becoming more visible – the main determinant of success here is efficiency, agility and flexibility of work. The group work tools which enable teams of different sizes, geographically and culturally dispersed, to collaborate are an example of a new approach. Such applications as Microsoft Teams or Slack allow to share documents, communicate via built-in messengers, maintain an entire history of cooperation regardless of personal changes in the team and, very importantly, access the service from anywhere in the world due to the use of cloud computing (Such-Pyrgiel, 2019, pp. 150–151).

Recently, there has been considerable progress not only at the level of interpersonal communication but also in the sphere of human-machine communication. There is the possibility of voice communication with the phone, which, based on speech recognition, can respond to our commands and perform the assigned activity, or – introduced more and more often – the control of multimedia systems in the car using gestures and ending with the use of goggles for augmented reality, where all methods of cooperation are combined. Thus, we can significantly improve the efficiency of field workers. All these changes are aimed at the easier and more effective operation of devices and their better adaptation to our needs.

Certainly, the social networks and their worldwide impact on communication are the interesting phenomena for the last dozens of years. One of the most popular social networking sites, where registered users can create networks and groups and share news and photos – Facebook, founded in 2004 by Mark Zuckerberg – was originally intended to serve students. The initial success at Harvard University, where 2/3 of students registered after the



first two weeks, encouraged the creators to further develop and expand into more universities and then to the mass market. Currently, the website is used by approximately 2.27 billion monthly users, and, tellingly, the majority of users are young people. The example of Facebook clearly shows how products in the modern world can evolve, from a social networking site to a marketing and sales platform, where the monetisation of the idea is very clear and readable. There is still much controversy surrounding the company's activity. The principle of social activity and the psychological foundations on which its mechanism is based was a raised aspect of this controversy. As Sean Parker, one of the company's first CEOs, says: Creating a social network, including Facebook, required an answer to the question: How to get the user to devote as much attention to the site as possible. We concluded that we need to provide the user with a dopamine hit every once in a while so that someone would like a comment, photo, or post. And this will prompt him or her to post more content, which will result in even more comments and likes. It is a social feedback loop, and it is taking advantage of the vulnerability of human psychology. Investors understood this principle, and the creator, Mark, used it consciously (Bołtuć, 2018, pp. 309–339).

When considering the dynamics of changes in communication in the modern world, it is worth looking at the development of major social networks – Facebook is only one of the dominant ones. The enormous share of young people between 18 and 29 has resulted in the verification of the approach to the subject and the emergence of new forms of sharing information with friends. Examples of Snapchat or Instagram show how important it is for young people to share moments and emotions related to their everyday life and the mood they are in now – hence the development of portals that focus on sharing photos and videos. What is also interesting, Snapchat is designed to be more dynamic and spectacular. The content we publish disappears from the site after 10 seconds or 24 hours in the case of the My Story option. It gives young people a sense of greater privacy but also a certain type of impunity, especially since the content can be passed on to selected people and not, as in the case of FB, to all friends (Such-Pyrgiel, 2019, pp. 152–153).

Twitter is another example of the communication revolution – a social networking site for microblogging, which means publishing short text messages under its own nickname (see Twitter Revolution). Messages can be up to 280 characters (previously 140 characters per message). Often picture or video is added. Other service users can read our message – tweet, like, comment or forward it. Politicians and journalists especially like this form of communication. It is significant since the messages are very dynamic and short in content – it looks like a sign of our times, where strong, clear information is most readily received. It is not without reason that in the last 15 years, social networks, especially Twitter, have been used to organise social protests, facilitating coordination and organisation for demonstrators while at the same time ensuring the spread of ideas and information to the world public.

Artificial intelligence and machine learning could not exist without large data sets called Big Data. These large and varied datasets can be described in terms of data management challenges that, due to the growing volume, speed and variety of data, cannot be solved

using traditional databases. While there are many definitions of big data, most include the concept of the so-called “three Vs”: high volume – a large amount of data, wide variety – high diversity, includes data from many sources and formats (e.g., social media interactions, e-commerce transactions, commerce and online transactions, financial transactions, etc.) and high velocity – high speed of data processing which must be analysed quickly and in the shortest possible time. After some time, the model was supplemented with two additional components – the value of the data we can obtain from them for the end-user and verification of the data (veracity). According to Gartner, Big Data is high-volume, high-velocity or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation (Harvard Business Review, 2019).

Marion Barraud for HBR says: The term Big Data is ubiquitous. Thanks to the ecosystems of information flowing in broadband networks, companies compete with each other for the largest, most valuable data sets. And companies of all varieties – old and new, industrial and digital, big and small – are coming into play (Microsoft, 2019).

Large amounts of data from various sources such as social media, sales data, historical weather data, and various government systems registries can correlate and extract valuable outputs such as sales predictions, customer sentiment analysis and more.

Big Data has been defined in various ways in recent years. In the classic definition, i.e., according to Douglas Laney, since 2001, Big Data means a massive amount of data that is collected rapidly. Currently, this definition has been significantly expanded with further components symbolising new features of the characteristics of this issue of advanced technology of collecting and processing large data sets. According to this new approach to defining, Big Data databases are built according to the 4V formula, i.e., volume, variety, velocity and value. The volume stands for a volume symbolising a large amount of collected data. Variety, i.e., diversity, i.e., different types of information and quantitative data. Velocity means speed because the data collected in Big Data is characterised by high volatility and dynamics of data modification. Value is a concept symbolising the analyses and verifications carried out and evaluations based on data sets collected in Big Data.

The current technological solutions of Big Data are not only large databases, data warehouses allowing for multifaceted analyses of vast sets of quantitative data made for the needs of reports submitted periodically to management staff. Currently, emerging trends in the development of technology based on Big Data dataset platforms allow to perform multi-threaded calculations and provide results of analyses, usually in real-time, and the analyses carried out on substantial data sets allow for comprehensive, multifaceted risk assessments at the level of the entire entity, i.e., in the company formula – comprehensive risk. This type of analysis provides the management boards of banks with information on the bank's exposure to a specific risk category and the required level of collateral for given parameters of transactions (Antkiewicz, 2008, p. 47). Thanks to Big Data technology operating in integration with cloud computing platforms, financial institutions already

could carry out complex risk analyses in real-time, taking into account many criteria and obtaining precise results according to the multifaceted parameters. In addition, the results of the analyses may also include the verification of the company's or bank's current exposure to various risk categories, including liquidity, profitability, credit risk in connection with the issue of financial instruments valuation, research on customer behaviour and seasonal and cyclical changes in demand for individual financial products (Libuda, 2016, p. 95).

One of the authors of this article Małgorzata Such-Pyrgiel, a Polish sociologist, studied Polish experts specialising in digital transformation. One of the research problems was to show whether and to what extent the development of new technologies contributes to the spread of new types of threats. The greatest threats included: the theft of personal data, the development of new forms of cybercrime using artificial intelligence algorithms, the loss of privacy and the breakdown of family ties through individual leisure activities of family members. Subsequently, also: addiction to digital technologies and entertainment available on the Internet, alienation of people, lack of appropriate legislation, mediation of contacts via social networks, new forms of communication, the prevalence of face-to-face communication, intergenerational deepening resulting from different patterns and the degree of use of digital technology, as well as digital exclusion of people without appropriate competences (Such-Pyrgiel, 2019, pp. 255–271).

## **Conclusion**

The development of the COVID-19 pandemic significantly contributed to the acceleration of the development and application of ICT information technologies and technologies of the current fourth technological revolution known as Industry 4.0. We are already observing and participating in accelerating the digitisation of processes, which is the result of, for example, many people staying in-home quarantine, etc. Therefore, in many branches and sectors of the economy, there is already an increase in the use of certain Industry 4.0 technologies, i.e., analytical and database technologies, Big Data Analytics, Data Science, cloud computing, machine learning, personal and industrial Internet of Things, artificial intelligence, Business Intelligence, autonomous robots, horizontal and vertical data system integration, multi-criteria simulation models, additive manufacturing, Blockchain, cybersecurity instruments, Virtual and Augmented Reality and other advanced data mining technologies (Grzegorek et al., 2020, pp. 95–96; Prokopowicz, 2017, pp. 115–139). Among other things, there is an increase in the use of ICT and Industry 4.0 information technologies in medical therapies, communication, logistics, new Internet media, life science, ecology, and predictive analytics, which may also be indirectly, partially determined by the development of the COVID-19 pandemic. In the past, in the development of human civilisation, various crises appeared, including local, national, international and global crises in geographical and social terms, pandemic, economic, financial, political and other crises appeared in terms of the specificity of the problems. It often happened that emerging crises motivated people to create

innovative solutions that were to help solve problems generated by a specific crisis. Crises and their resolution often created much inspiration for the creation of new technological solutions, determined the continuation of technical progress and, indirectly, also specific changes in many other areas of civilisation development (Gołębiowska & Prokopowicz, 2021, pp. 142–143; Matosek & Prokopowicz, 2017, pp. 225–226; Gwoździewicz & Prokopowicz, 2019, pp. 33–34). The progress by which humanity is gathering, storing and using available information is enormous, and our focus on getting the most value out of its analysis is worth emphasising. According to Małgorzata Such-Pyrgiel (2019, pp. 309–310), this trend allows us to conclude that society is becoming digital, not just information or network. In addition, the technology itself is becoming faster, better, more mobile, intelligent, and valuable. Thus, it can increasingly be used to solve many social, economic, domestic, and ecological problems and challenges, as well as issues in safety, security, and many others.

## References

- Antkiewicz, S. (2008). *Innowacje finansowe*. Warszawa.
- Bołtuć, P. (2018). Siła edukacji cyfrowej. In L. Zacher (Ed.), *Potencjały i relacje sił w cyfrowym społeczeństwie wiedzy*. Poltext.
- Borcuch, A. (2012). *Bankowość elektroniczna w Polsce*. Warszawa.
- Bukowski, S. (Ed.) (2010). *Globalizacja i integracja regionalna a wzrost gospodarczy*. Warszawa.
- Buss, A. (2008). *Internet Marketing*. Longman Pearson Education.
- Dmowski, A., & Prokopowicz, D. (2010). *Rynki finansowe*. Centrum Doradztwa i Informacji Difin.
- Domańska-Szaruga, B. (2013). Common banking supervision within the financial safety net. In *The Economic Security of Business Transactions. Management in business*. Oxford.
- Dutko, M., & Karciarz, M. (2011). *Informacja w Internecie*. Warszawa.
- Gacki, G. (2006, September 7). *Przestępczość internetowa*. Gospodarka.pl. Poradnik Internetu dla Twojej Firmy.
- Gałach, A., Hoc, S., Jędruszczak, A., & Kowalik, P. et al. (2015). *Ochrona danych osobowych i informacji niejawnych w sektorze publicznym*. Warszawa.
- Gałach, A., Jędruszczak, A., & Nowakowski, B. (2013). *Ochrona danych osobowych, informacji niejawnych i systemów teleinformatycznych w sektorze publicznym*. Warszawa.
- Golczak, K., Golinowski, K., Kamycki, J., Lewandowski, K. J., Pająk, K., Płaczek, J., Prokopowicz, D., & Wesołowski, Z. (2021). Prognoza globalnego kryzysu finansowo-gospodarczego zdeteminowanego przez pandemię koronawirusa w obszarze gospodarczym, społecznym, politycznym i geopolitycznym. Prognoza kryzysu w obszarze gospodarczym. In P. Soroka, A. Skrabacz, P. Wilczyński, K. Golczak, R. Kołodziejczyk, K. Pająk, & A. Mitrega (Eds.), *Raport zawierający diagnozę i prognozę globalnego kryzysu finansowo-gospodarczego zdeteminowanego przez pandemię koronawirusa w obszarze gospodarczym, społecznym, politycznym i geopolitycznym* (pp. 87–120). Dom Wydawniczy Elipsa.
- Gołębiowska, A. (2010). Kształtowanie się instytucji danych osobowych w Unii Europejskiej. *Ekonomiczno-Informatyczny Kwartalnik Teoretyczny*, 24, 175–182.
- Gołębiowska, A. (2017). Implementacja dyrektywy Parlamentu Europejskiego i Rady w sprawie ponownego

- wykorzystywania informacji sektora publicznego. In A. Gołębiowska & P. B. Zientarski (Eds.), *Ponowne Wykorzystywanie informacji sektora publicznego w administracji* (pp. 11–29). Kancelaria Senatu RP.
- Gołębiowska, A. (2017). Przepięstwo kradzieży tożsamości w ustawodawstwie polskim. In A. Gołębiowska, (Ed.), *Kradzież tożsamości w Internecie* (pp. 43–55). Dział Wydawnictw i Poligrafii Wyższej Szkoły Policji w Szczytnie.
- Gołębiowska, A. (Ed.). (2017). *Kradzież tożsamości w Internecie*. Dział Wydawnictw i Poligrafii Wyższej Szkoły Policji w Szczytnie.
- Gołębiowska, A., & Prokopowicz, D. (2021). Business Intelligence analytics based on the processing of large sets of information with the use of sentiment analysis and Big Data. In A. Gołębiowska, & M. Such-Pyrgiel (Eds.), *Socio-economic and legal dimensions of digital transformation. Selected contexts* (pp. 129–154). SGSP.
- Gołębiowska, A., & Prokopowicz, D. (2021). Wzrost znaczenia nowych mediów internetowych jako istotnego czynnika efektywnego rozwoju gospodarczego kraju. In M. Such-Pyrgiel & A. Gołębiowska (Eds.), *Bezpieczeństwo w dobie cyfrowej transformacji – aspekty prawne, organizacyjne i społeczne* (pp. 135–154). SGSP.
- Gołębiowska, A., & Zientarski, P. B. (2017). *Aspekty prawne ponownego wykorzystywania informacji sektora publicznego w administracji*. Kancelaria Senatu RP.
- Gołębiowska, A., Jakubczak, W., Prokopowicz, D., & Jakubczak, R. (2021a). Cybersecurity of Business Intelligence Analytics Based on the Processing of Large Sets of Information with the Use of Sentiment Analysis and Big Data. *European Research Studies Journal*, XXIV(4), 850–871.
- Gołębiowska, A., Jakubczak, W., Prokopowicz, D., & Jakubczak, R. (2021b). The Post-Pandemic Development of the Green Circular Economy and the Declarations Made During the UN Climate Change Conference (COP26) as Security Determinants. *European Research Studies Journal Volume*, XXIV(4B), 251–275.
- Grzegorek, J., Prokopowicz, D., & Goździewicz, S. (2021). Wykorzystanie platform analitycznych Big Data Analytics technologii informacyjnych ICT w analizie sentymentu dla wybranej problematyki związanej z Przemysłem 4.0. In P. J. Suwaj, S. Goździewicz, & K. Samulska (Eds.), *Bezpieczeństwo informacyjne jednostek organizacyjnych. Wybrane problem* (pp. 101–142). Wydawnictwo Naukowe Akademii im. Jakuba z Paradyża w Gorzowie Wielkopolskim.
- Grzegorek, J., Prokopowicz, D., Gwoździewicz, S. (2020). *Zastosowanie zaawansowanych narzędzi przetwarzania danych w dobie cyfryzacji*. In A. Laskowska-Rutkowska (Ed.), *Cyfryzacja w zarządzaniu* (pp. 93–128). Wydawnictwo CeDeWu.
- Grzywacz, J. (2016). *Bankowość elektroniczna w przedsiębiorstwie*. Warszawa.
- Grzywacz, A., & Widenka, G. (2015). *Bezpieczeństwo rozproszonych systemów informatycznych – Kryptografia w zastosowaniu do podpisu cyfrowego i identyfikacji użytkownika w sieci Internet*. Dąbrowa Górnicza.
- Gwoździewicz, S., & Prokopowicz, D. (2016). Prawo do ochrony informacji i danych osobowych w cyberprzestrzeni w dobie rozwoju bankowości internetowej – The Right to Protection of Information and Personal Data in the Cyberspace in the Age of the Internet Banking Development. In D. Gałuszka, G. Ptaszek, & D. Żuchowska-Skiba (Eds.), *Technologiczno-społeczne oblicza XXI wieku*. LIBRON Filip Lohner.
- Gwoździewicz, S., & Prokopowicz, D. (2017). Analiza bezpieczeństwa ochrony systemów informatycznych w kontekście globalnego cyberataku ransomware przeprowadzonego w dniu 27 czerwca 2017 r. In S. Gwoździewicz & K. Tomaszycy (Eds.), *Prawne i społeczne aspekty cyberbezpieczeństwa*. Międzynarodowy Instytut Innowacji “Nauka – Edukacja – Rozwój”.
- Gwoździewicz, S., & Prokopowicz, D. (2019). The Importance and Organization of Business Information

- Offered to Business Entities in Poland via the Global Internet Network. *International Journal of Small and Medium Enterprises and Business Sustainability*, 4(2).
- Harvard Business Review. (2016). *You don't need big data, you need right data*. <https://hbr.org/2016/11/you-dont-need-big-data-you-need-the-right-data>
- Hołyst, P., & Pomykała, J. (2011). Cyberprzestępczość, ochrona informacji i kryptologii. *Prokuratura i Prawo*, 1.
- Internet Users by World Region*. (2022, January 25). OurWorldinData. <https://ourworldindata.org/grapher/internet-users-by-world-region>
- Jakubczak, W., Gołębiowska, A., & Prokopowicz, D. (2021). The Legal and Security Aspects of ICT and Industry 4.0 Importance for Financial Industry 4.0 Development. *European Research Studies Journal*, XXIV(4B), 169–181.
- Jakubczak, W., Gołębiowska, A., Prokopowicz, D., & Jakubczak, R. (2021). The Key Security Problems Related to the Pro-Environmental Economic Transformation and the Implementation of the Principles of Sustainable Development into the Economy. *European Research Studies Journal*, XXIV(4B), 218–250.
- Kamińska-Czubała, B. (2013). *Zachowania informacyjne w życiu codziennym*. Nauka-Dydaktyka-Praktyka. Wydawnictwo SBP.
- Komorowski, P., & Prokopowicz, D. (2021). Impact of the coronavirus pandemic (Covid-19) on financial markets and the economy. *International Journal of Legal Studies*, 10(2(10)), 85–116.
- Krzysztofek, K., & Szczepański, M. (2002). *Zrozumieć rozwój od społeczeństwa tradycyjnych do informacyjnych*. Wydawnictwo Uniwersytetu Śląskiego.
- Lakomy, M. (2015). *Cyberprzestrzeń jako nowy wymiar rywalizacji i współpracy państw*. Katowice.
- Libuda, Ł. (2016). Era Big Data – zarządzanie ryzykiem z dopalaczem. *BANK. Miesięcznik Finansowy*, 6(278).
- Lu, Y. (2017). Industry 4.0: A survey on technologies, applications and open research issues. *Journal of Industrial Information Integration*. <https://doi.org/10.1016/j.jii.2017.04.005>
- Machowski, K. (2016). Hakerzy i terroryści czyli kto zagraża współczesnym bankom. *BANK. Miesięcznik Finansowy*, 6(278).
- Marszałek-Kawa, J. (Ed.) (2019). *Państwo w obliczu współczesnych wyzwań. O cyberbezpieczeństwie i innych zagrożeniach na przykładzie wybranych państw azjatyckich*. Wydawnictwo Adam Marszałek.
- Marszałek-Kawa, J., Chudziński, P., & Miśkiewicz, R. (Eds.) (2019). *Gospodarka globalna w świetle wyzwań Industry 4.0*. Wydawnictwo Adam Marszałek.
- Matosek, M., Prokopowicz, D. (2017). Importance And Security Of Information Provided By The Internet In The Context Of The Development Of Economic Entities In Poland. *International Journal of New Economics and Social Sciences*, 2(6), 219–231.
- Microsoft. (2019). *What is cloud computing*. <https://azure.microsoft.com/en-us/overview/what-is-cloud-computing>
- Monthly active users*. (2021, June 25). Technology Progress. <https://ourworldindata.org/technological-progress>
- Prokopowicz, D. (2009). Zagrożenia rozwoju i bezpieczeństwo bankowości elektronicznej. *Zeszyty Naukowe Wyższa Szkoła Zarządzania i Prawa im. Heleny Chodkowskiej w Warszawie*, XIV(1(30)).
- Prokopowicz, D. (2017). Kwestia rozwoju technologii Big Data oraz internetowych portali społecznościowych a bezpieczeństwo transferu danych niejawnych w sieci Internet. In A. Gołębiowska (Ed.), *Kradzież tożsamości w Internecie* (pp. 115–139). Dział Wydawnictw i Poligrafii Wyższej Szkoły Policji w Szczytnie.
- Prokopowicz, D., & Gołębiowska, A. (2021). Increase in the Internetization of economic processes, economic,



- pandemic and climate crisis as well as cybersecurity as key challenges and philosophical paradigms for the development of the 21<sup>st</sup> century civilisation. *Journal of Modern Science*, 47(2).
- Prokopowicz, D., Gołębiowska, A., & Matosek, M. (2021). Growing importance of digitalisation of remote communication processes and the internetization of economic processes and the impact of the COVID-19 pandemic on the economy. In A. Gołębiowska & M. Such-Pyrgiel (Eds.), *Socio-economic and legal dimensions of digital transformation. Selected contexts* (pp. 221–250). SGSP.
- Rojko, A. (2017). Industry 4.0 concept: Background and overview. *International Journal of Interactive Mobile Technologies*. <https://doi.org/10.3991/ijim.v11i5.7072>
- Sanders, A., Elangeswaran, C., & Wulfsberg, J. (2016). Industry 4.0 implies lean manufacturing: Research activities in industry 4.0 function as enablers for lean manufacturing. *Journal of Industrial Engineering and Management*, 9(3), 811–833.
- Sarnowski, J., & Prokopowicz, D. (2015). Zastosowanie innowacji marketingowych w przedsiębiorstwach w Polsce. In M. Sitek & T. Graca (Eds.), *Nowe wyzwania dla Europy XXI wieku w dziedzinie zarządzania i edukacji* (pp. 135–156). Wyższa Szkoła Gospodarki Euroregionalnej im. Alcide De Gasperi w Józefowie.
- Such-Pyrgiel, M. (2019). *Człowiek w dobie cyfrowej transformacji, Studium socjologiczne*. Wydawnictwo Adam Marszałek.
- Such-Pyrgiel, M. (2021). Nowe technologie edukacyjne w dobie cyfrowej transformacji – wybrane konteksty. In M. Such-Pyrgiel & A. Gołębiowska (Eds.), *Bezpieczeństwo w dobie cyfrowej transformacji – aspekty prawne, organizacyjne i społeczne*. Szkoła Główna Służby Pożarnej.
- Such-Pyrgiel, M., & Gołębiowska, A. (Eds.). (2021). *Bezpieczeństwo w dobie cyfrowej transformacji – aspekty prawne, organizacyjne i społeczne*. Szkoła Główna Służby Pożarnej.
- Szpor, G. (Ed.). (2013). *Internet Cloud computing. Przetwarzanie w chmurach*. Warszawa.
- The Next Web. (2019). <https://www.statista.com>
- TNW. (n.d.). <https://thenextweb.com/tech/2019/06/11/most-popular-social-media-networks-year-animated>
- Trejderowski, T. (2013). *Kradzież tożsamości. Terroryzm informatyczny*. Warszawa.
- Wociór, D. (2016). *Ochrona danych osobowych i informacji niejawnych z uwzględnieniem ogólnego rozporządzenia unijnego*. Warszawa.
- World Bank Science and Technology. (2017). World Development Indicators, International Telecommunication Union, World Telecommunication/ICT Development Report and database. <http://data.worldbank.org/data-catalog/world-development-indicators>
- Wróbel, P. (2014). *Komunikacja elektroniczna. Zagrożenia i ich skutki dla organizacji*. Wydawnictwo Uniwersytetu Gdańskiego.
- Zhou, K., Liu, T., & Zhou, L. (2016). Industry 4.0: Towards future industrial opportunities and challenges. *12<sup>th</sup> International Conference Fuzzy Systems Knowledge Discoveries, FSKD 2015*. <https://doi.org/10.1109/FSKD.2015.7382284>

