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POST-PANDEMIC REALITY AND THE SECURITY OF ICT, BIG DATA, INDUSTRY 4.0, SOCIAL MEDIA PORTALS AND THE INTERNET

Abstract

In the period of the current fourth technological revolution, information technologies, ICT and Industry 4.0 are developing particularly fast. During the SARS-CoV-2 (Covid-19) coronavirus pandemic, there has been an increase in the scale of digitization and internationalization of remote communication processes and various aspects of economic activity. Digitization of the economy is currently taking place simultaneously in many areas of economic processes and in the functioning of many economic entities and public, financial and other institutions. Many companies, enterprises and public institutions that previously operated mostly or solely traditionally 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 organization 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 organization 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.

Streszczenie

W okresie obecnej czwartej rewolucji technologicznej szczególnie szybko rozwijają się technologie informacyjne ICT i Przemysł 4.0. Podczas pandemii koronawirusa SARS-CoV-2 (Covid-19) nastąpił wzrost skali digitalizacji i internetyzacji procesów komunikacji zdalnej oraz różnych aspektów działalności gospodarczej. Digitalizacja gospodarki dokonuje się obecnie jednocześnie w wielu dziedzinach procesów gospodarczych i w funkcjonowaniu wielu podmiotów gospodarczych i instytucji publicznych, finansowych i innych. Wiele firm, przedsiębiorstw i instytucji publicznych, które wcześniej funkcjonowały głównie lub wyłącznie tradycyjnie w trybie off-line podczas pandemii przeszła na działalność zdalną, prowadzoną elektronicznie poprzez Internet. Zwiększa się także rozwój bankowości elektronicznej, w tym internetowej i mobilnej bankowości. Zwiększa się udział płatności dokonywanych elektronicznie, bezgotówkowo poprzez Internet oraz podczas płatności z udziałem elektronicznych kart bankowych. Poza tym w ostatnich latach zwiększa się zakres zastosowań technologii Data Science, Big Data, Data Analytics w ekonomii, finansach i zarządzaniu organizacjami, w tym przedsiębiorstwami, instytucjami finansowymi i publicznymi. W związku z tym rośnie także znaczenie implementacji instrumentów analitycznych zaawansowanego przetwarzania dużych zbiorów danych Data Science w przedsiębiorstwach, instytucjach finansowych i publicznych, w tym między innymi budowy platform Big Data Analytics dla wspomagania procesów zarządzania organizacją w różnych aspektach działalności, w tym także w zakresie poprawy relacji z klientami. W rzeczywistości postpandemicznej wzrosła także skala cyberprzestępczości oraz znaczenie doskonalenia technik i instrumentów cyberbezpieczeństwa.

Keywords: *ICT information technologies, Industry 4.0, Big Data, social media, pandemic, coronavirus, Covid-19, digitization, cybersecurity, data transfer security, Internet.*

Słowa kluczowe: *technologie informacyjne ICT, Przemysł 4.0, Big Data, media społecznościowe, pandemia, koronawirus, Covid-19, digitalizacja, cyberbezpieczeństwo, bezpieczeństwo transferu danych, Internet.*

The development of Big Data technology applications and the security of data transfer in the Internet

One of the noticeable consequences of the pandemic and lockdown was changes in the way both companies and individuals function. It turned out that almost every person activity in the real world has its virtual dimension, in the digital space. In fact, the earlier conveniences have become a necessity, and technology has become even more important, changing the spectrum of Internet and social media activity, and thus changing the structure of time spent using the Internet.

The determinant of Big Data development is not only the collection of terabytes of data obtained from the Internet resources and serviced clients, who are provided with specific financial products, information, advisory, communication and other services, e.g. that fit into the offer of social networks (Dutko, Karciarz, 2011, p.42). The function of effective use of Big Data technology is the issue of the quality of isolating the necessary, appropriately processed information from information databases (Matosek, Prokopowicz 2017, pp. 224-225). According to this concept, Big Data grows out of data warehouses developed since the 1990s, in which the current development of the collected information and its analysis based on velocriteria queries began to be used. For several years, corporations and financial institutions have combined these technological solutions with remote access via the Internet and verification of market data contained in the resources of the global network (Gołębiowska, Prokopowicz, 2021, pp. 137-138). Currently, entities that base their activities on building a portfolio of products sold or services provided to a large group of recipients are interested in using Big Data in the field of identification, characterization and analysis of customer profiles (see Gołębiowska, 2017, pp. 43-55; Gołębiowska, 2017, p. 199; Trejderowski, 2013, p. 27; Mórawski 2015, p. 51).

The precise definition of the cross-section of the dominant customer profiles and their ongoing update based on the ongoing analysis of the market environment and the available Internet resources will increasingly determine the market success of a given company and will become one of the factors in

the competitive struggle. Financial institutions are among those entities that have already noticed the great marketing and strategic potential of Big Data technological solutions (Mayer-Schonberger, 2015, p. 62).

Technological solutions based on Big Data constitute a new category of information source (Prokopowicz, 2017, pp. 121-122), the multi-criteria analysis of which can potentially significantly improve and increase the efficiency of corporate management based on making more accurate decisions relating to both strategy and more current, operational issues (Gołębiowska, 2010, pp. 175-182; Złoch, 2013, p. 58). A positive aspect of the implementation and development of solutions based on Big Data is also the possibility of a significant reduction in the scale of information asymmetry in the field of marketing activities aimed at existing and new customers of banks. Marketing asymmetry of information is often a source of annoying situations on the part of bank customers who receive phone calls and e-mails several times a year with offers of new financial services. This applies both to offers presented by a bank with which the beneficiary of these advertisements has been cooperating for years, as well as offers from other companies and financial institutions with which no cooperation was previously concluded. The problem is exacerbated because specialized marketing companies build databases of potential customers for various products and services and then resell these databases to various companies and financial institutions (Sarnowski, Prokopowicz, 2015, pp. 147-148). For existing bank customers, the most annoying situations are those during which they repeatedly receive telephone and e-mail offers of further loans and insurance. The implementation of technological solutions based on Big Data in the bank would allow for a more precise diagnosis of customer needs and prevent a situation in which a loyal customer is offered completely unnecessary financial services several times (Gołębiowska, Jakubczak, Prokopowicz, Jakubczak, 2021b, pp. 251-275; Gołębiowska. Prokopowicz, 2021a, pp. 135-154; Gołębiowska, Prokopowicz, 2021b, pp. 129-154; Dutko, Karciarz, 2011, p. 35; Warren, Marz, 2016, p. 147). In order to significantly reduce this marketing asymmetry of information and eliminate such irritating situations, it is necessary to implement the so-called multichannel in the field of communication channels of customer access to services and the development of solutions based on Big Data (Ostańska, 2019).

Another important area of analytical processes that can be carried out on the basis of Big Data (Celiński, 2019, p. 92) technological solutions is the analysis of the market risk of business activities and threats related to fraud and theft attempts by cybercriminals, i.e. the use of Big Data in the field of so-called fraud prevention. Big Data can be helpful in diagnosing potential threats resulting from attempts to perform fraud in the field of traditional banking, such as investment and mortgage loans, examining the economic and financial situation of an unreliable borrower or improperly conducted operations by bank employees. Therefore, the share of banks that use Big Data solutions to detect frauds, such as frauds made in the field of extorting mortgage loans, payments and financial operations carried out with the use of bank cards, is growing. On the other hand, Big Data may facilitate analytical processes related to threats and risks related to electronic online banking. An example may be the analysis of card payments and the precise adjustment of the banking product offer to the developed behavioral customer profiles (Złoch, 2013, p. 59).

The essence of the fuller functionality of Big Data-based solutions is the scope and quality of the analyzes performed on the extensive data sets collected. In order to increase the effectiveness of the use of Big Data technology for the needs of customer service in deposit and credit banks, the following principles should be followed (Gołębiowska, Jakubczak, Prokopowicz, Jakubczak, 2021a, pp. 862-863; Mayer-Schonberger, 2015, pp. 114-115):

- reliable and logically structured information should be collected in Big Data databases, collecting data from external sources should be a process of selectively selecting only confirmed and reliably obtained information,
- the bank should invest in IT technology that allows for a quick analysis of the collected data, the ideal would be an analysis carried out in real time,
- the results of the analyzes of the collected data sets can be used in the management of various areas of the bank's operations, provided that they contain information also from external databases and the market environment, and not only from internal banking transaction systems (Warren, Marz, 2016, p. 231),

- gathering in one place in the form of Big Data information from many external institutional and internal databases, including banking transactional systems, translates into cost optimization of analytical and organizational processes (Lee, Sohn, 2016, p.143),
- precise, on-going verification of large sets of quantitative data may be the basis for formulating conclusions also regarding the economic and financial situation in individual sectors of the economy and in macroeconomic terms, on the other hand, a thorough real-time analysis of transfers and payments made will allow the bank to also develop microeconomic characteristics of changes in profiles of individual customer groups and carrying out appropriate modifications of the offer of financial products and services addressed to a specific customer,
- improving the process of multi-criteria analysis of large sets of information collected in Big Data should take into account key aspects of banks' business activities, such as risk management processes or methods of selling related financial products and services, i.e. cross-selling methods,
- the collected data sets in Big Data technology should be constantly tested by complex multi-criteria analytical models built with the use of mathematical and statistical knowledge developed towards artificial intelligence, which will allow for a significant reduction of operational risk related to the imperfection of traditional systems, devices and work organization in individual areas of the bank's operations (Warren, Marz, 2016, p. 183),
- in many companies and institutions, a significant part of the data reflecting the historical perspective of the economic and financial situation of a given entity is still collected only in paper form and stored in archival cabinets, therefore access to this data and carrying out analytical processes on these data is significantly difficult therefore, in such situations, it is advisable to digitize the documents collected only in paper form and to include these "new" information on electronic platforms into databases built in Big Data technology (Gołębiowska, Jakubczak, Prokopowicz, Jakubczak, 2021a, pp. 862-863; Lee, Sohn, 2016, p. 145).

The last of these principles is still valid and applies to many companies and institutions operating in various sectors of the economy. In 2013, Coleman Parkes Research, commissioned by Ricoh Europe, conducted research on the potential possibilities of improving management processes by digitizing historical information on the activities of individual companies and institutions contained in paper documents and including this digitized data in Big Data-based databases. The research showed that 3/4 of European corporations digitize paper documents, assuming that this would generate savings of 5-20% of annual revenues. Managers in these companies believe that digitization of paper documents will significantly shorten analytical processes and improve decision-making processes.

Therefore, most of the surveyed entities, since the aforementioned research, have digitized information previously contained only in paper documents or are currently in the process of fully digitizing data that can still be used in organizational management processes. More and more companies notice the positive aspects of the full digitization of information regarding the current operation of a given entity and its implementation into databases built on the basis of Big Data (Prokopowicz, Gołębiowska, Matosek, 2021, pp. 226-227; Mayer-Schonberger, 2015, p. 59). These trends are also confirmed by the growing capital expenditures of companies regarding various aspects of electronic data collection, transfer and processing. In recent years, the investment priority in corporations has been Business Intelligence solutions and mobile solutions for data transfer and sharing.

In view of the above, in the last few decades, significant progress has been made in electronic data transmission systems, which was determined by the development of information and telecommunications technology. Customers of services and products offered by various enterprises, public and financial institutions more and more often contact these entities remotely via the Internet (Gwoździewicz, Prokopowicz, 2019, pp. 29-30). This is the main, but not the only, determinant of the digital revolution taking place in information societies today. In addition, the determinants of this development include: the development of ICT devices enabling mobile access to the global Internet network and the successively expanded offer of financial institutions (Świderska, 2013, p. 95) in the field of online electronic banking (Prokopowicz,

2009, p. 63). These processes are one of the key factors of the ongoing economic globalization (Jakubczak, Gołębiowska, Prokopowicz, 2021, p.173-174; Bukowski, 2010, p. 114).

The reconstruction of the financial market in Poland in the 1990s was an important factor in the effective development of the market economy in Poland. The development of internet electronic banking determines the need to constantly refine the regulations shaping the security of electronic data transfer and personal data protection (Gołębiowska, Zientarski, 2017a, pp. 31-43; Gołębiowska, 2017, pp. 11 – 29; Gołębiowska, Zientarski, 2017b, p. 170; Prokopowicz, A. Gołębiowska, 2021, pp. 325-326; Gałaj-Emiliańczyk, 2016, p. 38). In the situation of a rapidly growing number of internet electronic banking users, the issue of improving the functioning of IT systems in terms of security of transactions, risk-taking analysis and incurring costs for creating system solutions to maintain a high level of security and protect classified data is growing in importance. The issue of improving system security solutions is particularly important in the situation of frequently appearing hacker attacks on online electronic banking systems (Czarny, Śledziewska, 2013, p. 73).

Moreover, as a result of the increase in transnational capital flows and trade, the share of financial transactions settled electronically is also growing. Moreover, due to the fact that Poland is a member of the European Union (Prokopowicz, 2012, pp. 25-26), Polish regulations concerning the security of electronic data transfer and protection of classified information are adjusted to the normative EU standards. This process is also included in the improvement of external legal regulations and is associated with the currently progressing globalization of financial systems (Kosiński, 2015, p. 141).

Covering topics related to the use of new technologies with jurisdiction is a huge challenge legislation for all countries and international organizations. It is particularly important to pass a new law in the following days:

- Criminal law – it is necessary to determine the issue of liability criminal activity for crimes committed by artificial intelligence licence (if a problem can be classified in this way at all);
- Civil law – it is necessary to determine the issue of liability liability for damage caused by artificial intelligence;

- Intellectual property law – it should be determined whether artificial intelligence can be an author under copyright law, and if not who?
- Protection of personal data – what needs to be determined data can be collected, analyzed and processed by artificial intelligence (Polityka Insight 2018, cited after Such-Pyrgiel 2019:186).

Legislation is important because of the possibility of a situation posing a threat to society as a result of intensive and unsustainable technological development. It's also about the producers devices with elements of artificial intelligence produced them in a way responsible – an example is the EU security framework in the form of machinery directive, radio equipment directive, the General Product Safety Directive (European Commission 2018), but is it enough?

Determinants of the development of online social media portals

In line with the above, the progressing economic globalization and, consequently, the increasing ties between the Polish economy and the world mean that the improvement of national legal regulations regarding the maintenance of a certain level of security of information systems and the protection of classified data takes place, among others, as a process of adapting Polish legislation to the regulations of the European Union . On the other hand, it is not a factor ensuring full adjustment of legal norms to the dynamically developing electronic banking offer of financial institutions and services provided by Internet companies. Currently, it is assumed that the applicable legal regulations provide only the most elementary level of protection of classified data during the implementation of certain commercial orders and financial transactions, however, they may be insufficient in view of the constant progress of ICT technology used by Internet service providers, especially companies that usually offer cost-free use of portals, social media (Lakomy, 2015, p. 73).
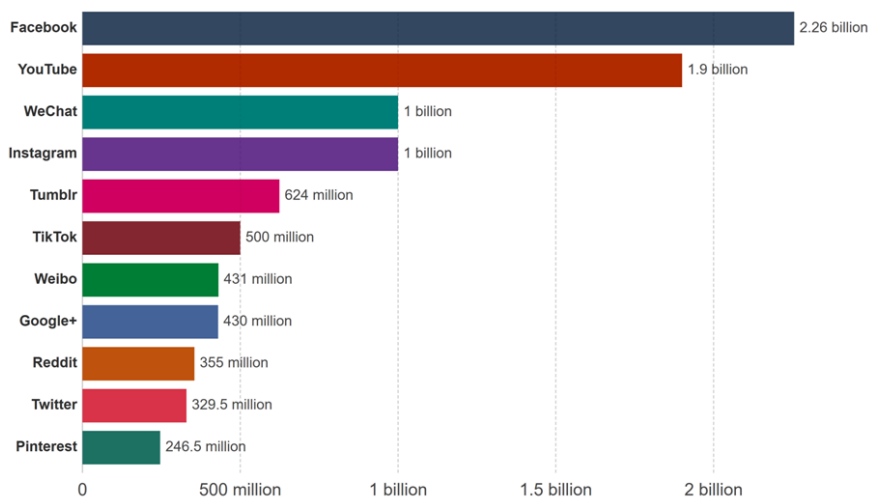
As a society, we need to be aware that we are increasingly exposed to monitoring, surveillance of our behavior, phone calls, e-mails, text messages and other

forms of communication. On the one hand, this is to prevent the spread of terrorism, but on the other hand, state intervention and constant surveillance of citizens seem to limit the principle of liberty and freedom and lead to a loss of privacy that is slowly becoming scarce goods (Sienkiewicz 2006). Perhaps even more worryingly, most communication flows through and private companies' infrastructure and applications have access to almost unlimited data of their users. An example here may be social networking sites, applications or cloud technologies where we put all our data (facebook, snapchat, tweeter, etc.).

In the context of the ongoing digitization of companies, offices and institutions, it is now assumed that, in line with the needs of most Internet users, personal data protection is the area of human existence that should be provided by entities operating on the Internet (Matosek, Prokopowicz, Gołębiowska, 2021, pp. 223-224). Pursuant to the provisions of the Constitution, the protection of personal data is one of the elementary rights of every citizen, and therefore also of the Internet user. The incessant technological progress and in the field of Internet companies' offer of services has resulted in a gradual partial obsolescence of the provisions of this law on the part of Internet users (Gałach, Jędruszczak, Nowakowski, 2013, p. 121). This is because either Internet users are not fully aware of the avatars built in data warehouses of Internet companies, or new ICT technologies no longer allow full privacy of citizens operating in information societies.

The above-mentioned Internet technology companies such as Google, Facebook, Twitter, Instagram, YouTube collect new data on the users of their social networks every day, constantly expand the existing avatars in terms of information, i.e. electronic equivalents of individual citizens – Internet users. How and when these data will be used (apart from the fact that the advertising activities of these companies are already conducted), unfortunately, Internet users do not know. Citizens cannot know this, since even these very companies – internet concerns that own social networking sites also do not know what the purpose of this constantly expanded information, collected in data warehouses, will be used in 10 years.

Chart 2. Number of people Rusing social media platforms in 2018. Estimates correspond to monthly active users (MAUs). Facebbok, for example, measures MAUs as users that have logged in during the past 30 days.

Platform	Users
Facebook	2.26 billion
YouTube	1.9 billion
WeChat	1 billion
Instagram	1 billion
Tumblr	624 million
TikTok	500 million
Weibo	431 million
Google+	430 million
Reddit	355 million
Twitter	329.5 million
Pinterest	246.5 million

Source: *Monthly active users*, Internet portal "OurWorldinData", 25.06.2021, in: M. Roser, H. Ritchie (2017) "Technology Progress", Published online at OurWorldIn-Data.org (https://ourworldindata.org/technological-progress), for: Statista and The Next Web 2019. (Statista: https://www.statista.com; and TNW: https://thenextweb.com/tech/2019/06/11/most-popular-social-media-networks-year-animated).

New Internet media, including primarily social media portals, are developing dynamically thanks to their specificity that allows the participation of users of these portals in the process of co-creating viral marketing (Sarnowski, Prokopowicz, 2015, pp. 141-142). This is a feature that distinguishes social media portals from other types of media. Because without incurring high financial expenditures, a citizen can conduct activities of promoting certain content, promoting himself or herself or certain products, services, his activity and / or its effects. Thanks to this formula, the socialization of marketing activities, social media portals developed so quickly. However, on the other hand, despite the constantly developed systems of control of content entered by citizens, despite the involvement of modern Industry 4.0 technologies

(Grzegorek, Prokopowicz, Gwoździewicz, 2021, pp. 114-115) in the developed systems of verification of entered comments, posts, entries, banners, etc., these systems are still imperfect, since in the content posted on popular media portals social networks (i.e. Facebook, Instagram, TikTok, Tweeter, etc.) there is a lot of untrustworthy information, fake news, information not confirmed by scientific research, not verified by users of these websites, who often click "Share", "Like" etc. without reflection. for specific comments, post banners, videos, etc. without proper verification of their content. Therefore, in recent years, social media portals have been used to influence public opinion, to shape general social awareness by various organizations, including informal organizations, acting unethically and unreliably in terms of information policy (Matosek, Prokopowicz, 2017, pp. 226-227).

The impact of Internet advertising today is usually greater than consumers realize. In recent years, new internet marketing instruments have also been developed, mainly used on social media portals and also used by companies operating in the e-commerce sector. Especially now, due to the acceleration of digitization of the economy caused by the SARS-CoV-2 (Covid-19) coronavirus pandemic (Komorowski, Prokopowicz, 2021, pp. 95-96). Currently, in many industries and sectors, more and more companies are expanding their activities via the Internet, remotely providing their services and selling their products via e-commerce (Golczak, Golinowski, Kamycki, Lewandowski, Pająk, Płaczek, Prokopowicz, Wesołowski , 2021, pp. 94-95). Many companies that previously did not do this are now switching to remote, electronic operations via the Internet. There are also Internet technology companies and fintechs that offer information services on the Internet to support marketing management, including planning advertising campaigns for products sold over the Internet (Gwoździewicz, Prokopowicz, 2019, pp. 31-32). For this purpose, sentiment analyzes are used to survey the opinions of Internet users in the field of dominant awareness, recognition, brand image, mission, and offers of specific companies. Sentiment analysis is carried out on large data sets downloaded from various websites, including millions of pages of social media portals, collected in Big Data systems (Mayer-Schonberger, 2015, p. 64). The analytical data collected in this way is very helpful in the process of planning advertising campaigns carried out in new media, including social

media portals. These campaigns advertise, inter alia, products and services sold via the Internet, which are more and more often also or mainly available in online stores. Large amounts of information collected from comments, entries, posts from social media portals are processed in Big Data database systems in order to determine, for example, consumer awareness of the offer of products and services of specific companies (Prokopowicz, Gwoździewicz, 2017, pp. 90-91). This type of information is of great importance for the planning of advertising campaigns informing about the mission, idea, product offer, usability features of the company's offer. This type of data may be important for the purposes of forecasting the changing preferences of consumers towards the offer of specific companies. The techniques of collecting analytical data in the Internet can be supported by the use of 5G technology. One of the areas in which the possibilities of using market data analytical technologies are growing, including data downloaded from web portals, is the marketing of enterprises and institutions.

In recent years, the development of marketing has been determined by the development of Industry 4.0 technology and the development of open innovations on the Internet (Grzegorek, Prokopowicz, Goździewicz, 2021, pp. 117-118). Open innovations developed on the Internet concern, among others, free information and marketing services. The issue of the possibility of publishing specific content, texts, banners, comments, etc. on the Internet and obtaining information free of charge, are the key determinants of the development of information services on the Internet (Ostańska, 2019). On the other hand, the largest internet technology corporations earn their income mainly from paid marketing services. The Internet environment is, therefore, a kind of a mix of free and paid information and marketing services, which are developed simultaneously, simultaneously and in a mutually interconnected manner by various Internet companies (Matosek, Prokopowicz, 2017, pp. 227-228). Currently, research is conducted on the analysis of the development of open innovations in the field of free information services, which are the main factor in the business success of the largest Internet technology companies, which include such concerns as Google and social media portals such as Facebook, Instagram, YouTube, Tweeter, LinkedIn and others.

In view of the above, the importance of internet marketing is increasing, including viral marketing, Real-Time marketing conducted on social media portals. In the near future, internet marketing will develop particularly rapidly, including viral internet marketing used on social media portals. In the field of improving internet marketing, new information technologies, ICT and Industry 4.0 are implemented (Jakubczak, Gołębiowska, Prokopowicz, 2021, pp. 171-172). Analytics carried out on large data sets on the Big Data Analytics and Business Intelligence analytical platforms with the use of sentiment analysis is developing dynamically. Based on the analysis of sentiment, the characteristics of the opinions of Internet users are created regarding, for example, specific brands of companies, the offer of products and services of companies, the recognition of the company's mission from the point of view of potential customers, etc (Tomczak, 2019, pp. 68-69).

Data security on social media portals

Data security on social media portals is a complex and multi-faceted, ambiguous topic. Well, there are many programs, applications, worms that are used to read data, information from comments, entries, posts, etc. written by users of social media portals (Dutko, Karciarz, 2011, p. 46). The collected data of this type collected in the Big Data Analytics database and analytical systems are used to conduct sentiment analysis, researching the opinions of Internet users on various topics, including the analysis of brand recognition of companies, evaluation of the product and service offer, forecasting trends in changes in consumer preferences of certain types of products and services, etc. On the other hand, there have been more than once situations in which cybercriminals stole data on users of certain social media portals, including some categories of sensitive, personal information posted on these portals (Gacki, 2006). Therefore, technological Internet companies providing specific information services to Internet users are constantly improving their security systems, procedures for protecting the data of users of Internet portals, and improving the systems of cybercrime risk management and data transfer and sharing on the Internet (Gąsiorowski, Podsiedlik, 2015, p. 34).

Due to the fact that in the field of the offer of information services available on the Internet, technological progress is constantly being made, the process of improving the security systems of data collected on social media portals will continue and probably for many years to come. For example, on the one hand, Industry 4.0 technologies are used to improve security systems, data protection procedures for users of web portals and to improve cybercrime risk management systems (Górka, 2014, p. 48). However, cybercriminals can also benefit from the current advances in technology, so this rivalry between IT professionals on both sides of the barricade continues and will probably continue for many years to come (Domańska-Szaruga, Prokopowicz, 2016, pp. 125-126). In addition, the issue of data security, including information posted by users of social media portals on these portals, does not only apply to specific cybersecurity systems of the portals themselves (Gwoździewicz, Prokopowicz, 2016). In recent years, one of the targets of cybercriminal attacks are other applications installed, for example, on smartphones or sent e-mails with links to specific other websites through which cybercriminals gain access to the profiles of specific users of social media portals (Liderman, 2008, p. 37).

Some consumers and citizens accept a partial loss of privacy in order to benefit from the information services used, available in new online media, including, inter alia, those available on popular social media portals. Some citizens are not fully aware of the extent of the loss of privacy. Most citizens do not know how much data the providers of key information services available on the Internet on new media, including social media portals, have about them (Lakomy, 2015, p. 91). Recently, there are discussions about the possibilities of potential applications of 5G technology in the context of using the Internet to collect data on citizens, companies, institutions, etc., in order to analyze them using, inter alia, sentiment analysis, determining the opinions of Internet users on specific topics or defining the company's brand recognition, evaluation of the offer products or services by Internet users.

The development of Big Data and Data Science analytics, Data Analytics and other ICT information technologies, multi-criteria technology, advanced processing of large sets of information, Industry 4.0 technology (Libuda, 2016, p. 17) increases the efficiency of using knowledge resources, also in the field of economics, finance and organization management (Gwoździewicz,

Prokopowicz, 2019, pp. 32-33). In recent years, information technologies, ICT, Industry 4.0, etc., have been developing dynamically and are being used in knowledge-based economies (Reinhard, Jesper, Stefan, 2016). These technologies are used in scientific research and business applications in commercial enterprises and in financial and public institutions. Due to the growing importance of this issue in knowledge-based economies, an important issue is the analysis of the correlation between the development of Big Data technology and Data Science, Data Analytics, Business Intelligence and the efficiency of using knowledge resources to solve key problems in the development of business entities. In recent years, the use of 5G technology to collect data from the Internet can significantly contribute to the improvement of the analysis of the sentiment of Internet users and the possibility of extending the use of research techniques carried out on analytical platforms: Business Intelligence, Big Data Analytics, Data Science and other research techniques using ICT information technologies. , Internet and advanced data processing typical of the current, fourth technological revolution known as Industry 4.0 (Sulich, Zema, 2020, pp. 2565-2576). Most consumers of online information services (Dutko, Karciarz, 2011, p. 64) available on new online media, including social media portals, are not fully aware of the risk level of sharing information about themselves on these portals (Gołębiowska, Prokopowicz, 2021, pp. 137-138).

Time will tell whether legal regulations and ethical standards as well as security frameworks are and will be sufficient for the use of artificial intelligence in the practice of social life. The success of new technologies depends on the value it creates for people, how it enriches and facilitates our lives and society. Applications should be created in such a way that people understand them and trust them when using them (Hatalska, 2018, see more Such-Pyrgiel, 2019, pp. 209-210).

Pandemic and the development of Big Data Analytics applications and other Industry 4.0 technologies

Analysis of the increase in the importance and application of Data Science technology and Big Data Analytics in order to improve the organization management processes, risk management and in the conducted predictive analyzes. Below, I have described the arguments confirming the high level of significance of the proposed research topic. Well, in recent years, the range of applications of Data Science, Big Data, and Data Analytics technologies in economics, finance and organization management, including enterprises, financial and public institutions, has been increasing (Mayer-Schonberger, 2015, p. 67). 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 organization management processes in various aspects of operations, including improvement relationship with customers. Conducted scientific research confirms the strong correlation between the development of Big Data technology, Data Science analytics, Data Analytics and the efficiency of using knowledge resources (Libuda, 2016, p. 18).

Graph 2. The structure of connections and applications of the Industry 4.0 technology.
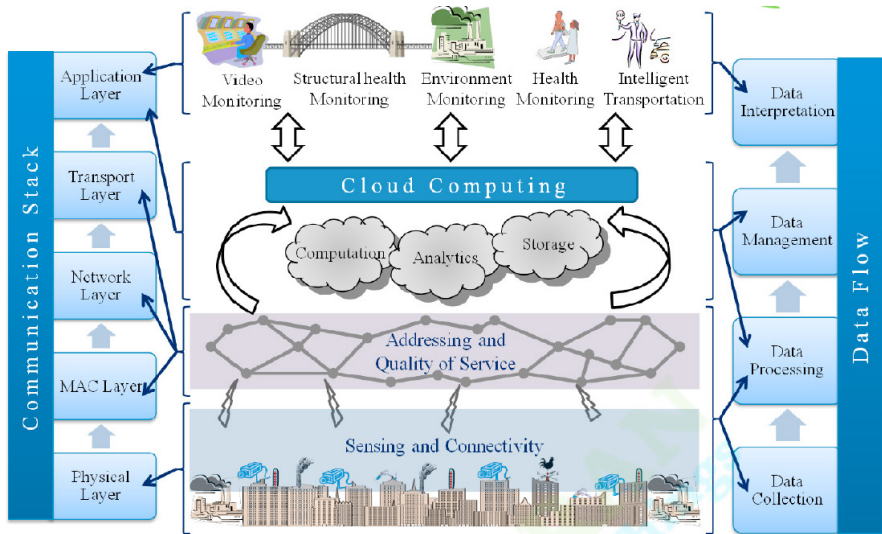
Source: Rothe R., Rutkowska M., Sulich A. (2018) *Smart cities and challenges for European integration*. (in:) Proc. 4th Int. Conf. Eur. Integr. 2018, ICEI 2018 May 17-18, 2018, Ostrava, Czech Republic. Pt. 3: 1240–1246.

The development of Big Data and Data Science analytics, Data Analytics and other ICT information technologies, multi-criteria technology, advanced processing of large sets of information, Industry 4.0 technology increases the efficiency of using knowledge resources, also in the field of economics, finance and organization management (Kolberg, Zühlke, 2015). In recent years, information technologies (Barreto, Amaral, Pereira, 2017), ICT, Industry 4.0, etc., have been developing dynamically and are being used in knowledge-based economies (Prokopowicz, Gołębiowska, 2021, pp. 317-318). The development of information processing technology in the era of the current technological revolution referred to as Industry 4.0 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 Data Science, Big Data Analytics, cloud computing, machine learning, personal and industrial Internet of Things, artificial intelligence, Business Intelligence (Tomczak, 2019, pp. 82-83), 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 Data Mining.

Graph 3. Digitization of labor markets caused by the increase in the use of Industry 4.0 technology.

Source: Fura B., Fura M. (2016) *Green jobs in the European Union – an empirical study* (in:) „Acta Universitatis Lodziensis. Folia Oeconomica", No. 2 (319), pp. 39–53.

These technologies are used in scientific research and business applications in commercial enterprises and in financial and public institutions. Due to the growing importance of this issue in knowledge-based economies, an important issue is the analysis of the correlation between the development of Big Data technology and Data Science, Data Analytics, Business Intelligence and the efficiency of using knowledge resources to solve key problems in the development of civilization (Libuda, 2016, p. 18), e.g. in terms of solving key problems in the development of enterprises, economic entities (in terms of microeconomics), analysis of changes in the factors influencing the environment of markets, branches and sectors of the economy (in terms of mesoeconomics), predictive analysis of the development of economic systems of entire countries, entire national economies (in terms of macroeconomics). Technologies Industry 4.0, including Data Science, Machine Learning, Internet of things, etc., are also used in the design and development of modern, pro-ecological agglomerations of Sustainable Smart Cities. In the context of this issue, a research

question can be formulated, for example: Is it possible to develop sustainable pro-ecological construction, taking into account the concept of smart city, green building and social and housing policy, i.e. building housing available for low-income citizens and at the same time housing that would meet the principles of environmentally sustainable economic development? (Jakubczak, Gołębiowska, Prokopowicz, Jakubczak 2021a, pp. 227-228). According to the authors of this article, such a technological and economic combination is possible. Taking into account the current technologies of ecological construction, technologies of renewable energy sources (Kuik, Branger, Quirion, 2019, pp. 475-476), the development of electromobility, etc., it is possible to combine such a technological combination with housing, socio-economic, ecological and smart city policies. Currently, it is technologically possible, but the key problem is mainly financing the development of this type of construction. Unfortunately, as usual, with the need to develop new pro-ecological technologies, the key issue is the problem of finding sources of financing.

In connection with the above, whether sustainable pro-ecological housing construction will be developed in order to solve the problems of limited access to housing for people, families with low income, it depends mainly on the financial capabilities of the state and local governments, on the state of state finances and the awareness of decision-makers in this matter, on the planned specific policy pro-social and housing, and at the same time pro-ecological (Gołębiowska, Jakubczak, Prokopowicz, Jakubczak, 2021b, pp. 263-264). In addition, predictive analytics based on intelligent, multi-faceted processing of large data sets can be helpful in forecasting subsequent climate, pandemic, economic, geological, natural and other crises. Analytics based on the use of Data Science and / or Big Data Analytics technologies (Celiński, 2019, p. 97) may be useful for forecasting the effects of the development of the SARS-CoV-2 (Covid-19) coronavirus pandemic and the impact of the interventionist anti-crisis socio-economic policy instruments, including budgetary and fiscal policies, monetary, etc. in order to reduce the scale of the economic downturn, reduce the scale of unemployment growth, decrease in income, production, consumption, investment, decrease in the economic growth rate of the country, etc. caused by the development of the aforementioned SARS-CoV-2 pandemic (Golczak, Golinowski, Kamycki, Lewandowski, Pająk, Płaczek, Prokopowicz,

Wesołowski, 2021, pp. 91-92). In addition, analytics based on the use of Data Science and / or Big Data Analytics technologies (Prokopowicz, 2017, pp. 125-126) can also be helpful in the processes of analyzing the possibility of implementing programs for the rapid implementation of the principles of sustainable pro-ecological development into economic processes in accordance with the green economy philosophy and financing programs for creating and implementing ecological innovations and urgent implementation the necessary environmental reforms. The aim of these pro-ecological economic enterprise programs is to reduce the level of environmental pollution and slow down the global warming process. However, this is only one of the key global problems, the solution of which may depend on the issue of the possibility of increasing the efficiency of using large resources of knowledge accumulated in Big Data databases in knowledge-based economies (Libuda, 2016. p. 18).

In view of the above, in recent years, more and more risk factors have appeared, the emission of greenhouse gases is increasing, the process of global warming is progressing faster and faster, weather anomalies and adverse effects of climate change appear more and more often, including climatic disasters (e.g. droughts of farmlands, forest fires), drying up of water reservoirs and rivers, etc.). Epidemics are emerging, the most recent of which has turned out to be the global SARS-CoV-2 (Covid-19) coronavirus pandemic. More and more threats and unfavorable phenomena, difficult to predict risk factors have appeared in recent years (Komorowski, Prokopowicz, 2021, pp. 98-99). The increase in uncertainty causes difficulties in the effective development of economic entities, the functioning of people and the development of entire national economies. Therefore, there is a growing need to improve predictive analyzes, which will help in predicting further climatic, pandemic, natural, geological disasters, etc. In the process of improving predictive analyzes, ICT information technologies and technologies typical for the current fourth technological revolution referred to as Industry 4.0 (Jakubczak, Gołębiowska, Prokopowicz, 2021, pp. 175-176). Among the Industry 4.0 technologies, the database and analytical platforms Data Science and Big Data Analytics are particularly important in the applications of analytical processes carried out with the use of large data sets and high computing power computers (Gołębiowska, W. Jakubczak, D. Prokopowicz, R. Jakubczak, 2021a,

pp. 867-868). The use of Big Data technology, Data Science analytics, Data Analytics, Business Intelligence and other ICT information technologies and advanced data processing Industry 4.0 (Rutkowska, Sulich, 2020, pp. 1237-1238) in the processes of processing knowledge resources should contribute to increasing the efficiency of processing knowledge resources in knowledge-based economies, including in the field of economics, finance, ecology, climatology, virology and other fields of science and knowledge. Therefore, in recent years, the importance of implementing analytical instruments for advanced processing of large data sets in enterprises, financial and public institutions, i.e. building Data Science and Big Data Analytics platforms to support organization management processes in various aspects of activity, has been growing in recent years, and will continue to grow in the following years, including forecasting changes in the impact of risk factors in the environment of a specific organization, business entity, institution, etc. (Matosek, Prokopowicz, Gołębiowska, 2021, pp. 231-232). In connection with the above, I propose the following research questions that may inspire you to implement important and interesting research projects: Are there any studies that verify the correlation between the development of Data Science, Big Data, Data Analytics, Business Intelligence and other ICT information technologies and advanced processing? Industry 4.0 (Grzegorek, Prokopowicz, Gwoździewicz, 2021, pp. 118-119) data and the efficiency of using knowledge resources, the use of these technologies for processing large data sets in the processes of predictive analytics conducted in the field of economics, finance, organization management, including enterprises, financial and public institutions, entire national economies and various risk factors, determinants of the environment which model the development of specific entities, economic systems, etc.?

Due to the development of electronic internet banking, including mobile banking, the increase in the scale of payments made by citizens electronically (Dmowski, Prokopowicz, 2010, pp. 335-336) with the use of bank cards and applications installed on smartphones, the space is increasing, and in fact it is the internet cyberspace in which cybercriminals can function constantly improving and creating new techniques of unauthorized access to electronic banking systems or phishing certain payments made electronically by e.g. setting up fake websites of shops, companies, public and financial institutions

(Gwoździewicz, Prokopowicz, 2017, pp. 67-68). In addition, many fake e-mails created by cybercriminals end up in e-mails. These e-mails imitate the sent out official e-mails of public institutions and enterprises, in which there is a content urging to make a specific payment for a service that will never be provided. Some e-mails of this type contain hidden spyware and malicious programs that read important personal data from computer disks, access codes to various portals and Internet profiles set up on various websites by the user of a computer, laptop, tablet or smartphone. More and more fake e-mails contain content encouraging to cooperate, signing a contract with a company that does not exist and in fact does not intend to fulfill the content of the said contract.

Through online activity, people leave their digital traces there, because of their identity consists of personal data, activity on social networks and published content. All of this matters and more or less conscious way is shared online and the person loses control of their digital identity. The greatest threat in this aspect there is leakage and interception of personal data. Effects of this kind there are crimes on both sides – companies are burdened with financial penalties for this situation, and customers are exposed to identity theft and impersonation of other people both on social networking sites and in various types of companies and institutions including electronic banking systems (Hatalska, 2018).

As it has already been emphasized in this article, various systems or even entire farms of malicious and harmful software are often used to make hacks and failures, e.g. troll farm. Breaking security codes in various types of networks may lead to attacks on unusual enterprises and industries in the future, for example, on automatic production lines food. Let's look at it this way for an example – Internet of Things (IoT) technology – allows for the aggregation and processing of large amounts of data collected from various types of sensors installed on various devices. These devices form a network. IoT technology has many advantages, but also disadvantages and threats. In enterprises, it contributes to more effective resource management, increasing profits and reducing costs, and optimizing processes deliveries and cooperation with suppliers and customers. However, an attack on IoT networks can lead to serious damage, system failures and data leakage.

The future depends on investing in the development of the best security systems, especially since IoT technologies can equip all devices and everyday objects, including medical devices. This allows to outline further important research problems that require in-depth research and analysis in the future (com. Hatalska, 2018).

Summary

Average time spent on social media by users increased compared to the time before the outbreak of the pandemic. The reasons for the above behavior can be seen in the transfer of communication to virtual space, the introduction of restrictions related to movement, in increasing importance of technology in human life. Consequences of current behavior are, among others the problem of addiction to the constant desire to be present on the Internet and struggling with depression, social phobia, anxiety and many more. This makes it necessary to address new problems that were already noticeable before, but not on such a scale as today (digital hygiene).

The difference between security and cybersecurity is apparent, especially since life takes place in both worlds at the same time, and cybersecurity threats can have physical effects (Zagórski, 2022).

The development of the SARS-CoV-2 (Covid-19) coronavirus 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. Currently, we are already observing and participating in the process of accelerating the digitization 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. like 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, Prokopowicz, Gwoździewicz, 2020, pp. 95-96). Among other things, in the field of medical therapies, communication, logistics, new Internet media, life science, ecology, predictive analytics, there is an increase in the use of ICT and Industry 4.0 information technologies, which may also be indirectly, partially determined by the development of the SARS-CoV-2 coronavirus pandemic. In the past, in the development of human civilization, 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 a lot of inspiration for the creation of new technological solutions, determined the continuation of technical progress and, indirectly, also specific changes in many other areas of civilization development (Gołębiowska, Prokopowicz, 2021, pp. 142-143).

Technological changes related to ICT information technologies have an increasing impact on the functioning of economic entities and public institutions (Matosek, Prokopowicz, 2017, pp. 225-226). New information technologies, ICT, but also Internet technologies and Industry 4.0 are usually first implemented into specific processes of business activity and sometimes also to improve management processes, logistics, marketing, business analytics, etc. in large enterprises, corporations, financial institutions (Gwoździewicz, Prokopowicz, 2019, pp. 33-34). Some new technologies and technological standards have been developed in laboratories of large companies. However, after some time, as part of the development of a specific technology, its dissemination takes place within the life cycle of a technology, a reduction in transaction prices in the event of a technology sale transaction, certain technological solutions become more accessible to other, also smaller companies, and more and more economic entities representing the SME sector are acquiring and implements certain technologies into its economic processes. The implementation of specific information technologies, ICT, Internet and Industry 4.0, improves the economic efficiency of economic processes, which are modernized by increasing the scale of automation and work equipment in

manufacturing processes. In recent years, more and more companies from the SME sector have acquired specific ICT, Internet and Industry 4.0 information technologies in order to improve production processes, services, management processes, logistics, marketing etc. thanks to the implementation of ICT and Internet technologies, more and more companies are improving their marketing by increasing the scale of internet marketing and the provision of services by contacting customers remotely via the Internet (Sarnowski, Prokopowicz, 2015 pp. 142-143).

Due to the development of the SARS-CoV-2 pandemic causing the Covid-19 disease, the scale of implementation of ICT and Internet technologies for remote implementation via the Internet of specific processes necessary for the effective conduct of business activity is currently increasing rapidly. In addition, more and more companies, including enterprises from the SME sector, are implementing Industry 4.0 technologies, such as cloud computing, Big Data Analytics, Business Intelligence, learning machines, for the needs of improving management processes in the processes of economic and financial analyzes. In this way, enterprises increase the effectiveness of specific processes carried out as part of their business activities. Of course, the implementation of these technologies in the conducted business activity is not related only to the positive aspects. A negative factor is the increase in the operational risk of the ICT information technologies used and the risk of cybercrime and Internet data transfer (Gacki, 2006) in a situation where the range of applications of Internet technologies increases significantly. However, despite the increasing expenditure on improving cybersecurity systems, the scale of the generated increase in profitability of technologically improved economic processes is usually much greater. Therefore, the implementation processes of ICT, Internet and Industry 4.0 information technologies are constantly increasing, and in recent months, in connection with the SARS-CoV-2 coronavirus pandemic, the mentioned processes of computerization and Internetisation of specific areas of economic activity are accelerating.

Currently, the most common cyberthreat in Poland is still the so-called phishing (a criminal impersonates another person or institution in order to obtain confidential information – PAP), but in recent years, e.g. also attachments sent in SMS, the entry of which results in the takeover of the phone or

computer along with the data, and the so-called ransomware attacks, where a cybercriminal blocks access to data that is unlocked only after paying a ransom (Potejko, 2022).

In view of the ongoing digitization of companies, offices and institutions, it is now assumed that, in line with the needs of most Internet users, personal data protection is the area of human existence that should be provided by entities operating on the Internet. Pursuant to the provisions of the Constitution, the protection of personal data is one of the elementary rights of every citizen, and therefore also of the Internet user. The incessant technological progress and in the field of the services offered by Internet companies caused a partial erosion of the actual operation of this law on the part of Internet users (Gałach, Jędruszczak, Nowakowski, 2013, p. 127). This is because either Internet users are not fully aware of the avatars built in technological data warehouses of Internet companies or new ICT technologies (Dutko, Karciarz, 2011, p. 71) no longer allow for the full privacy of citizens operating in information societies. The above-mentioned Internet concerns such as Google, Facebook, Twitter, Instagram, YouTube collect new data on the users of their social networks every day, constantly expand the existing avatars in terms of information, i.e. electronic equivalents of individual citizens, Internet users. How and when these data will be used, apart from the current advertising activities of these companies, unfortunately, Internet users do not know. They cannot know it if even these very companies, internet concerns that own social networks, also do not know what they will use the constantly expanded information collected in data warehouses for in 10 years.

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