Routledge Studies in Innovation, Organizations and Technology

BUSINESS MODELS AND DIGITAL TECHNOLOGY PLATFORMS

IMPLEMENTATION AND COMPLEXITIES FOR DIGITAL BUSINESS

Krzysztof Bartczak

Business Models and Digital Technology Platforms

This book examines the influence exerted by digital technology platforms (DTPs) on changes to business models. The author identifies critical factors for the successful implementation and usage of such platforms, including barriers which may be related, for example, to the absence of sufficient knowledge about DTPs or the inability to obtain a sufficient amount of financial resources.

Business Models and Digital Technology Platforms develops a comprehensive model of DTPs based on empirical research in Poland. It demonstrates how platforms influence changes in the operations of companies, their level of competitiveness, the consumer's role in the process of joint development of innovations and the consumer's experience as well as implications of the use of AI for the autonomy of DTPs.

This book offers a unique, holistic understanding of the complexities involved and showcases their role within digital business. Combining theory with practice, this book is a valuable resource for researchers and academics of business model innovation, strategic management, innovation management, digital transformation and organisational change.

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Krzysztof Bartczak

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Introduction

The main reason for choosing the topic of this monograph about digital technology platforms (DTPs) was a relatively low number of publications that discuss the issue. This fact implies that the nature of technology platforms is insufficiently and imprecisely understood by the Polish public, including business circles, which may adversely affect the utilisation of such platforms. It is especially important in a situation where a growing number of companies in Poland are interested in implementing innovative technology platforms and such implementations are not only in the interest of the entities alone but also of the whole economy and the state.

In particular, it should be mentioned that so far no single work has appeared which would describe in a comprehensive manner the meaning of digital technology platforms for business activity, how they translate into the level of competitiveness of enterprises, their treatment as innovative business models or the extent to which companies are aware and ready to implement them. Accordingly, it is mainly the need to have a comprehensive, overall view of the issues connected with digital technology platforms that was the decisive factor for starting this research to make it possible to show their role in digital business and related development tendencies. It should be emphasised that this monograph will focus on building a general model of digital technology platforms and on demonstrating opportunities they provide to enterprises in terms of innovative business models. To date, no such generalised model of a technology platform has appeared in the literature devoted to this subject matter.

The factors which have affected the choice of the topic for this monograph also include the frequently found problem with the implementation of digital technology platforms related to the observation that not everybody knows what the implementation processes look like and what benefits may be obtained from them. This is because many digital technology platforms are used only in the biggest companies or in Polish branches of foreign corporations. Therefore, it is crucial that the awareness of implementing and using digital technology platforms increases in society and the world of business, to which objective this monograph, it is hoped, will contribute.

In turn, the development of technology platforms to date in Poland shows that some Polish companies are indeed familiar with the practical use of digital technology platforms and there are examples of those which utilise such platforms

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intensively. This creates the need to take a scientific approach to digital technology platforms and fill in the gap arising from the absence of a sufficiently broad discussion in the literature on the subject matter regarding the impact of the platforms on digital business and companies' capabilities to implement them.

The main purpose of this monograph is to examine the influence exerted by digital technology platforms on changes to business models. The utilitarian aim is to identify critical factors for the successful implementation and usage of such platforms, including barriers which may be related, for example, to the absence of sufficient knowledge about digital technology platforms or the inability to obtain a sufficient amount of financial resources.

Detailed objectives related to the foregoing include the scope and nature of benefits that may be generated owing to the use of digital technology platforms as well as business areas where they may be utilised. Moreover, what should be also noted is the desire to fulfil aims and objectives relating to determination of the extent to which Polish companies are prepared to implement digital technology platforms and the degree to which Polish businesses and managers are aware how such platforms may be used. Thus, the scientific aim of this monograph may be divided into two basic areas. The first one concerns the benefits associated with the implementation of digital technology platforms, while the other one is about their practical use by Polish companies. The achievement of the said aims will help answer the following questions: **Should digital technology platforms be treated as mere supporting tools for the existing models used by specific companies? Should they be regarded as the basis for the development and implementation of innovative changes to business models?**

A discussion of these topics requires the formulation of specific problems and research hypotheses. The key research problem has been defined as follows:

What is the role played by digital technology platforms in the process of preparing and implementing business models in a company?

Considering that this monograph also focuses on achieving a utilitarian aim, it is worth formulating a problem relating strictly to this aim. The problem in question concerns the barriers which hinder the implementation and use of digital technology platforms.

Referring to the research problem stated above, the following central research proposition has been put forward:

Digital technology platforms are tools supporting the functioning of companies and form the basis for implementing innovative changes to business models.

The central proposition is supplemented by the following more detailed hypotheses:

H1. Digital technology platforms facilitate the introduction of changes to the operations of companies, especially in the area of management, marketing and sales.
H2. Innovative changes to the business model based on a digital technology platform make it possible to include the consumer in the processes of co-creating innovations.
H3. Digital technology platforms create new opportunities, not encountered to date, for increasing customer experience.

H4. The use of artificial intelligence makes digital platforms increasingly more autonomous in customer service applications.
H5. Digital technology platforms are a new factor for companies' competitiveness in the digital economy.

To verify these hypotheses, a survey was conducted on a randomly selected group of respondents comprised of people representing companies directly involved in using digital technology platforms. To attain the objectives stated above and to solve the problems posed, it was necessary to use three distinct research methods in this monograph. The first of these, content analysis of the literature on the subject matter, was applied during preliminary studies and attempting to confirm the research hypotheses. During the analysis, the following kinds of sources were examined – publications about the concept of technological determinism, assigning a critical role to technical and technological issues and related transformations in shaping modern society and the economy as well as showing the impact of digital technology platforms on companies' business activities.

The second method is called CATI or computer-assisted telephone interviewing. It is a modification of the classic method of quantitative research – direct standardised interviews using tabular analysis (two-variable tables) and inductive tests of inter-group differences.

The third research method is called CATREG (categorical regression) and takes the form of optimal scaling within regression analysis for qualitative variables whose purpose is to assess qualitative data in quantitative terms. Under the method, the correlatives of opinions about the degree to which DTPs impact the operation of companies were taken into consideration.

This monograph is broken down into four chapters. The first chapter discusses basic issues concerning the digital transformation of companies. It describes various aspects of the origin and diversification of digital technologies, the digital transformation of businesses viewed as a process, organisational changes associated with the transformation and the impact of digitisation on broadly construed company management.

The second chapter focuses on the basic aspects of digital technology platforms. First of all, based on the literature, an original definition of the concept is proposed, with a specification of features associated with the functioning of the platforms. What follows is a presentation of typologies of DTPs, a description of the functioning of the global market for such platforms and an indication of fields where they may be used as well as benefits achieved from their use. Furthermore, development prospects of the platforms have been determined based on technologies involving artificial intelligence.

Chapter three deals with issues having to do with innovative changes in business models resulting from the use of digital technology platforms. This, however, is preceded by a description of the nature of business models and innovative organisations as well as a presentation of the concept and model of digital business. Furthermore, that part of this monograph describes development prospects of digital business models, taking also into consideration the use of DTPs.

The fourth chapter presents findings of empirical research. The point of departure was a description of the research methodology, showing how the model of digital technology platforms was built. Further on in the chapter, based on the conducted surveys, each of the research hypotheses is discussed, pointing out how digital technology platforms influence changes in the operations of companies, their level of competitiveness, the consumer's role in the processes of joint development of innovations and the consumer's experience as well as implications of the use of artificial intelligence for the autonomy of DTPs.

This monograph is about issues concerning the science of management and quality. All pertinent analyses and their findings may contribute in a significant manner to the development of this scientific discipline. This work, for the first time, taking into consideration both Polish and foreign literature, discusses extensively the impact of digital technology platforms on innovative business models. The discussion herein focuses not only on various aspects of usefulness of digital platforms in the context of development of modern business models, including those based on consumers' knowledge or experience, but additionally examines which areas of companies' operations may be perceived as especially favourably affected by DTPs and how important artificial intelligence is in this respect. Such discussions not just deepen the research rooted in literature that has been performed to date but also provide grounds for taking up completely new issues in the science of management and quality. Thus, an important research gap has been filled in regarding the knowledge of how modern business models are developed based on various types of digital platforms.

The central point of the discussions in this monograph is the construction of a model of digital technology platforms based on findings from measurement of company managers' attitudes to DTPs. The approach to the research problem proposed in this monograph is innovative in nature because, first, no attempt has been made so far to build such a model, and, second, such an approach may form the basis for constructing further models of digital technology platforms which would take into consideration other areas of business activity, including, for example, those which concern their strictly technical (technological) aspects. Determined on the basis of analysis of literature and findings of the author's own research, they may be used by company managers in management processes. Owing to the constructed model, directions for further research were outlined, noting that significant correlatives of attitudes to digital technology platforms may be factors concerning the structures of companies, including industries in which they operate and the number of employees. It is worth emphasising that a certain novelty is also the integration, within management theory, of two important research methods, namely a CATI quantitative survey and CATREG with optimal scaling. Such integration seems to provide great possibilities and, most importantly, may bring about measurable effects, which is shown by the model presented herein. Accordingly, this monograph demonstrates the importance and the breadth of perspectives for management and quality sciences brought about by the simultaneous use of such methods.

1 Digital Transformation of Businesses

1.1 The Origin of Digital Technologies

In the contemporary world, digital technologies play an enormous role in the functioning of each country, society and organisation. According to E. Brynjolfsson and A. McAfee, "the key building blocks are already in place for digital technologies to be as important and transformational to society and the economy as the steam engine."[1] In turn, A. Łaszek stated that "of key importance for economic growth and, consequently, for our standard of living is the deployment of new technologies."[2] It is worth noting that, contrary to appearances, it is not true that such technologies were invented and become popular only in the 21st century. It needs to be observed though that the 21st century is precisely when the enormous role of technologies in the global economy became visible, to which, among other factors, the intensive development of mobile technologies contributed,[3] but their origin should be already traced back to a much earlier period.

Digital technologies began to appear in the second half of the 20th century. In literature on the subject matter,[4] the first mention of the term *digitalisation (digitisation)* with reference to the wide-ranging changes in the global economy involving the increasingly popular use of digital technologies is found in a 1971 essay by R. Wachal entitled "Humanities and Computers. A Personal View."[5] It discussed the impact on various societies and their members that was to be exerted by computers, which included future social consequences of development of the related technologies. Such development, according to R. Wachal, was likely to lead to the said digitalisation. At present, digit(al)isation is thought of as a process which involves the conversion of analogue information into a digital format. Such a process is also described as digital inclusion, which is connected with the fact that in the course of digitisation, an analogue item is gradually transformed into a digital format, with no other substantive changes taking place.[6] Importantly, according to some authors, it is possible to talk about digit(al)isation or digital technologies with reference to a period as early as the 1950s.[7]

Analysing issues regarding the origin of the technology, it is worth going back to the concepts which proposed phases of economic growth in the world. This is because those concepts have devoted a lot of space to issues of transformation related to digitalisation. One of those concepts was developed by Austrian economist J. Schumpeter and continuators of his work, namely, C. Freeman and L. Soete.

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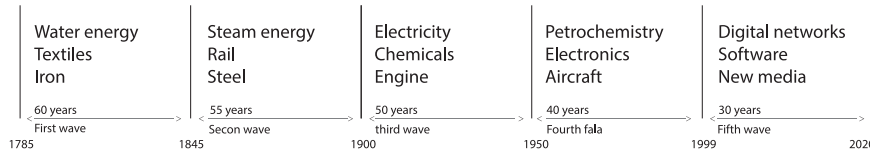

Figure 1.1 "Waves" of economic development according to J. Schumpeter and his followers

Source: Author's own work based on A. Kukliński, *Gospodarka oparta na wiedzy jako wyzwanie dla Polski XXI wieku*, Komitet Badań Naukowych, Warsaw 2001, p. 14.

The authors distinguished five "waves" in the construction of the global economic system. They are presented in Figure 1.1.

Analysing the concept of "waves" of economic growth advanced by J. Schumpeter and his continuators, it is clear that the concept refers to digitalisation and digital technologies. According to this view, a breakthrough in the use of digital networks or new media occurred around 1999, when these inventions began to impact, to an increasingly greater extent, numerous transformations in the world economy or in the system of goods and their distribution. It is therefore a considerably later period than the 1950s or 1970s, when people already started talking about the digital or computer revolution.[8] It should be pointed out, though, that J. Schumpeter and his followers distinguished each "wave" by taking into consideration the decisive impact that each invention had on economic development. In this respect, speaking of a "wave" related to digital networks or new media in the context of the turn of the 21st century becomes justified, which follows from the fact that it was exactly then that the use of the Internet started to be more and more popular and that has had profound impact on promoting the use of knowledge being the main "driving force" of contemporary economies.[9]

A different distribution of distinct phases of economic growth was conceived by American writer and futurologist A. Toffler. In his opinion, the world has witnessed three breakthrough periods which should be referred to as "waves," just like in Schumpeter's concept. For the topics discussed in this work, the most important of those is the third "wave," which, according to A. Toffler, began to be observable as early as in the second half of the 1950s and whose most distinctive feature became the number of white-collar workers and service employees being higher than the number of blue-collar workers. Therefore, even as long ago as then one could refer to it as the age of a knowledge society, which has become to be characterised by the mass use of digital technologies.[10]

Likewise, D. Bell, discussing the division of history into developmental periods of society, distinguished a phase inextricably connected with digitalisation and an increasingly more common use of digital technologies. He called that phase a post-industrial society or post-industrial economy. The most important characteristics of this kind of economy mentioned by D. Bell include:

- shifted importance of economic sectors in the direction of those whose potential is built on knowledge;
- a change from energy-based technology prevailing till then into information technology;

– increased importance of processes associated with planning or monitoring of technologies;
– explosive growth of "intellectual technology," that is one which is based to the greatest extent on knowledge;
– domination of the service sector.[11]

A team of German scientists doing research on technology, represented by K. Schwab, four industrial revolutions are talked about, two of which refer directly to the development of digital technologies. The third of these was the computer or digital revolution, which started in the 1960s, when the production of mainframe computers began (large-sized computers for processing quite a lot of data), and continued in the 1970s, when personal computers appeared, and in the 1990s, when the Internet was applied for commercial purposes. The fourth industrial revolution is characterised by the dissemination of mobile technologies (Internet, smartphones, tablets) or devices based on artificial intelligence.[12]

Following M. Olender-Skorek, one may claim that there have been four industrial (civilisation, technological) revolutions in the history of the world, each marked by a specific breakthrough invention. Apart from steam engine and electricity, it was computer and digitisation.[13] Thus, the origin of digital technologies should be closely associated with the third and fourth revolutions, the former referred to by many authors[14] as the digital revolution, while the latter known as industry 4.0 or digitalisation 4.0.[15] The birth of the digital revolution is usually dated to the 1980s, although some authors argue that it already started in the 1950s[16] or the 1960s.[17] Its characteristic feature was a considerable technological progress, enabling the promotion of digital solutions, which gradually began supplanting analogue devices. At the same time, computers started to a greater and greater extent be used to perform specific projects in a virtual environment.[18] This revolution was followed by a stage referred to as industry 4.0, which is also strictly related to digital technologies and which involves the construction of smart systems, increasingly more interconnected, creating value by initiating and reinforcing coordination and cooperation among various organisations and processes.[19]

It should be noted that the digital revolution would be impossible without creating conditions for a fast and automated collection, processing or transmission of information. The revolution brought about the possibility of generating and analysing information much easier than ever. It is therefore justified to state that the revolution accompanying digital technologies should be actually called a "digital information revolution."[20]

Numerous diverse factors contributed to the creation and development of digital technologies. The following ones should be mentioned in this context:

– ever-increasing technological progress, reducing barriers to access to information;
– free-market competition;
– increased importance of knowledge within the operation of organisations;
– high supply of new products and services;

- need for increasing effectiveness and efficiency and reducing the costs of business processes and operations to achieve a high level of competitiveness;
- gradual disappearance of various barriers against business exchange among states, which made faster flow of information or goods possible, including know-how;
- unpredictability of economic and technological development and high growth rate of this development, making it necessary to continue seeking more and more innovative and competitive systems, tools and solutions;
- necessity to satisfy increasingly changing needs of customers;
- requirement that organisations should adjust to the dynamic situation in the environment.[21]

Based on the above description, it may be concluded that while the origin of digital technologies should be traced back to the 1950s or the 1960s, their real and intensive development occurred when the use of personal computers and the Internet became widespread. It should be remarked at this point that only in the 1990s did the term "digital economy" appear in scientific literature. It was coined by D. Tapscott. He claimed that the new form of the global economy differs considerably from the old economic order, the greatest differences being that digital economy is inherently characterised by a quick turn to virtual reality (virtualisation), the power of digital technologies (digitisation and digitalisation), integration through interconnectivity, promotion of using and sharing knowledge as an immaterial asset by organisations as well as reinforcing the pursuit of innovation.[22] So even if digital technologies started to appear already in the middle of the 20th century, it would be unreasonable to talk about their actual development until the second half of the 1990s or even the beginning of the 21st century.[23]

1.2 Diversity of Digital Technologies

Because digital technologies have been developing for many years, it is possible now to distinguish their numerous and diverse kinds. But first, these technologies should be defined. They are generally regarded as any systems, applications, services or tools that employ digital technique and IT systems. Such technologies may be also construed as a type of organisational, technical or economic activity which involves the adaptation of new systems and digital devices to the activity conducted by companies in various segments of the economy or market sectors. Furthermore, they are distinguished by covering all the systems and tools which use digitally encoded content, so mainly by a binary (consisting of the numerals 0 and 1) sequence of digits which may be read by specific electronic devices.[24] Digital technologies understood in this manner include not only the Internet and everything that is connected with it (intra– and extranets, virtual communities and organisations, etc.), but also the entire cyberspace or a certain environment which functions on the basis of multiple systems, networks and types of software and which enables an individual or an organisation to engage in diverse activities.[25]

The term *digital technologies* is very often used interchangeably and identified with the terms *information technologies* or *information and communication technologies* (ICTs).[26] It seems, however, that such practice is not justified. This is shown by the fact that ICTs cover only the technologies for collecting, recording, storing, processing, analysing, synthesising, sending and presenting data and information in electronic form, but it is also possible, through them, to create and use multimedia messages, to communicate with other entities or ensure the security of various systems and data.[27] In turn, "digital technologies" are a term broader than ICTs, because such technologies refer to any applications, Internet tools or systems which are digital in nature and which are used, for example, to perform procurement, production or distribution processes. Their essence is not simply the collection or processing of certain data and information, but also the operation of many other processes. What both of them have in common is that they are implemented in a digital environment, so their nature and scope may be very broad. In addition, it should be emphasised that digital technologies, as described above, are also perceived as a form of activity whose effect is to introduce modern digital systems to specific areas of the economy.

It is worth pointing out that the current transformations, which are related to the increasingly stronger influence of digital technologies to the functioning of states and societies, are described and classified in different ways by various authors. As already mentioned above, such authors as J. Schumpeter would regard such changes as a certain stage or "wave" in the development of the global economy. In the literature, one may encounter, though, many other terms to describe the present state of the economy where digital technologies play an enormous role. Those terms determine how digital technologies are perceived or classified. They include: *cyber economy*, *digital economy*, *information economy, new economy* or *web economy.*[28] The terms referring to digital technologies in the world economy have been analysed by M. Goliński with regard to their frequency of appearance in the Internet. The analysis has showed that the most frequently used expressions are *new economy*, *digital economy* or *industry 4.0.*[29] Such studies demonstrate that the themes of digit(al) isation and digital technologies, and their impact on the global economy, is very wide-ranging, which undoubtedly follows from the fact that there are a great many such technologies now and their number is on the increase all the time.

At present, it may be quite difficult to attempt to identify or classify these technologies, precisely because of their large number and constant development. What is also greatly important here is that potential areas where these technologies could be used are extended all the time. Furthermore, innovative projects and activities are initiated with the aim to build completely new technologies or integrate ones which have already been used. In spite of all of that, many authors do attempt to distinguish the most important digital technologies which are currently used. According to J. Pieriegud, contemporary digital technologies primarily include:

– hyperconnectivity, which will be discussed below at length;
– Internet of Things (IoT) and Internet of Everything (IoE) – these terms refer to a global network due to which things, such as household appliances (in the case

of IoT) and also human beings and processes (in the case of IoE) may collect, process and share data, for instance, about the manner the things are functioning.
– applications based on cloud computing, which is a kind of service entirely provided on a specific server, which makes it unnecessary to purchase and have specialist hardware or software;
– systems based on automation and robotisation;
– technologies which allow for collecting and analysing big data sets (big data analytics, BDA), including those based on the operation of cloud computing (big-data-as-a-service, BdaaS);
– artificial intelligence (AI), or any technologies and systems making it possible for machines or computer programs to simulate and perform specific operations typical for the human brain;
– mobile systems which make it possible to perform specific operations in the Internet in a wireless manner;
– modern security systems – assuming the form of both definite products and digital platforms, guaranteeing for users an ever-increasing level of security;
– social media, which allow people to communicate and initiate various interactions as well to share content (e.g. Facebook, Twitter, Instagram, YouTube);
– models of multi-channel and omni-channel distribution of products and services, where, apart from the traditional channel, some products and services are also offered online.[30]

It should be emphasised that within the said technologies, many other ancillary digital tools, systems or solutions may be distinguished. So, for example, as far Internet of Things is concerned, it is possible to distinguish some of its types and modifications, such as *cyber physical systems* (which control, among other things, road traffic, which is possible owing to integration of computational algorithms with physical systems), *networked control*, *machine learning* (self-learning of machines), *high performance computing* (which refer to Big Data) or *embedded systems* (which allow for autonomous operation of cars or airplanes).[31]

Issues concerning digital technologies have been discussed in one study on digital transformation prepared by the European Commission. It stated that apart from Internet of Things, Big Data and robotics, digital technologies which are the most important now and have the greatest impact on the world economy also include blockchain technology (which is used for recording financial operations and is open and transparent without, however, a centralised form), 3D printing and advanced manufacturing (which use systems, devices and machines controlled by computers or microelectronics and used for designing, manufacturing and transporting various products).[32]

In turn, in a report prepared by UNCTAD (*United Nations Conference on Trade and Development*), many digital technologies are mentioned and characterised as "frontier technologies for the sustainable development." These are said to include Internet of Things (IoT), 3D printing, 5G mobile phones, various data sharing technologies, massive open online courses, smart electricity grids and financial transaction systems (e.g. digital wallets or mobile money).[33]

The analysis made by D. Batorski, E. Bendyk, M. Filiciak and A. Płoszaj lists the most important trends in digital technologies and manifestations of their use in the contemporary world. A list of the most important of those is given in Table 1.1.

Among the most important trends which are relevant to digital technologies there are many of those in which the key role is played by digital technology platforms. Such platforms, after all, give grounds for increasing effectiveness of the performance of distribution tasks or globalisation of competition, resulting in, on the one hand, the appearance of completely new opportunities for companies connected with internationalisation of activity conducted by them and acquisition of new outlets for their own products, and on the other, an increase in the level of competition, entailing, among others, a better quality of customer service.

Table 1.1 The most important trends in digital technologies according to D. Batorski, E. Bendyk, M. Filiciak and A. Płoszaj

Trends in digital technologies	*Types of digital technologies*
Autonomysation of customers	• Systems for customising the digital offer
Cyborgisation	• Controlling a smartphone with your voice, which is a manifestation of close coupling of the contemporary human being with various systems, applications and digital devices
Network distribution	• Digital technology platforms
Evolution of business models	• SaaS – *software as a service*, providing an access to the licence authorising to use the software
Globalisation of competition	• Digital technology platforms
Convergence of bits and atoms	• 3D printing
Convergence of ICT networks	• Triple and quadruple play, or broadband and wireless access to the Internet • Internet of Things
Mobility	• Mobile Internet, smartphones, mobile first strategies, where mobile systems are built first before physical systems
Openness as a new business model	• Curated computing system, in which the manufacturer renounces control, to a considerable extent, of its products in exchange for cooperation with other companies or users themselves
Platformisation	• Digital technology platforms
Online availability of computing resources	• Cloud computing
Network of Things (autonomysation of electronic devices)	• Monitoring of health condition or condition of household appliances
Declining importance of intermediaries	• Just-in-time system, making it possible to perform deliveries of raw materials and products exactly at the moment when there is demand for them
Exchangeability of functions among devices	• Home entertainment centres making it possible to use digital content on many different devices

Source: D. Batorski, E. Bendyk, M. Filiciak, A. Płoszaj, *Cyfrowa gospodarka. Kluczowe trendy rewolucji cyfrowej. Diagnoza, prognozy, strategie reakcji*, MGG Conferences, Warsaw 2012, pp. 14–43.

Discussing the issues relating to the complexity of digital technologies, several types of such technologies which have not been mentioned yet should be presented. They have been distinguished by I. Bojanova. According to her, such technologies include:

- micro-electro-mechanical systems (MEMS), which make possible wireless detection of light, temperature, magnetism, vibration or chemical substances;
- systems exploiting quantum computing;
- brain-computer interfaces, due to which it is possible, for example, to augment cognitive functions in people with disabilities;
- technologies aiming to increase the effectiveness of actions improving natural human abilities (for example, prosthetic replacement limbs using 3D printers);
- volumetric and holographic systems;
- neurobusiness – which involves using insights from neurobiology to improve business relations and effective decision-making;
- mesh networks – which make it possible to combine many diverse sensors in a virtual and wireless manner.[34]

It should be added that some of the technologies described above are known as transformational technologies or emerging technologies. This refers primarily to Big Data, artificial intelligence, the Internet of Things or mobile technologies. Such names suggest that it is exactly these technologies that will play a key role in the growth of companies and economies in the years to come, being decisive for their degree of innovativeness.[35]

Digital technologies which are used at present both by companies and public organisations or individual users undoubtedly manifest large diversity. This is because it is possible to list very many such technologies and those listed above are merely examples. Based on these, one may state that digital technologies are developing now at a very fast rate and have an extremely broad range of applicability, covering, among others, the provision of support to the operation of companies. Importantly, digital technology platforms play a key role among digital technologies, which will be discussed in more detail in Chapter II of this monograph.

1.3 Digital Transformation of a Company Viewed as a Process

In view of an increasingly broader dissemination of digital technologies, many companies are facing the necessity of undergoing the so-called digital transformation. Such transformation becomes indispensable mainly because the present environment in which businesses operate is highly variable and thus unpredictable as well as extremely complex. Without exaggeration, such a situation calls for using the acronym VUCA (*volatility* – high dynamics of changes, *uncertainty* – high risk of unexpected developments, *complexity* – making it impossible to plan activities in a reliable manner, *ambiguity* – the situation is unclear), which was originally used by the US army to refer to unpredictability of a battlefield.[36] Such unpredictability

may be also related at a large scale to the functioning of contemporary enterprises in the period of digital economy.[37]

In this respect the words written by G. Mazurek acquire significance when he stated that digital technologies, identified by him with ICT technologies,

> during last 20 years, invaded the life of societies not unlike a powerful tsunami, changing the way humans live nearly all over the world. […] The changes caused by ICT, so far affecting local points, individuals or having a vertical impact on the reality, started transforming entire societies, industries or organisations, not partially and temporarily but totally and permanently, changing how they look and act.[38]

At present, digital transformation affects a large part of the world economy and in connection with this each entity operating on a global scale is just forced to undertake initiatives for such transformation.

Companies in their operation may experience certain organisational changes. A special type of such changes is digital transformation, which happens intensively in the situation of digital economy and digital revolution. According to E. Stolterman and A. Fors, the above transformation is a change which causes digital technologies to begin permeating all aspects of human or organisational existence.[39] Similar views are expressed by other authors,[40] who add that during digital transformation, integration of digital technologies and business processes acquires key significance, resulting in a new organisational model as well as the implementation of changes in IT systems, which involve modernisation of infrastructure and architecture of the systems, transformation of their operational model and automation of processes connected with managing and providing IT services.

According to the European Commission, digital transformation is a type of process whereby digital systems are integrated with physical ones and advanced technologies are combined into uniform systems. What is significant, the process is based on innovative business models, which constitutes grounds for initiating further, frequently completely new, processes as well as developing smart products and services. From the European Commission's perspective, this presents simply "enormous growth potential for Europe."[41] Digital transformation is also a certain capability which involves conversion of existing products or services into digital ones. Such capability allows for using specific advantages, especially for effective development of competitive edge in the market.[42] In turn, according to a report by the MIT Center for Digital Business and Capgemini Consulting, digital transformation is a process where it is of key importance to use digital technologies to radically improve performance ratios. Such transformation, according to the authors of the report, affects first of all a company's customer service process, operational processes and business model.[43]

It follows from the above discussion that digital transformation of an enterprise is a certain process which is, often very much, spread over time and for which more and more common and effective use of digital technologies takes on fundamental

importance. In P. Adamczewski's opinion, the process is inextricably intertwined with customer service, including, primarily, building of increasingly closer and more effective relations with customers based on modern business models and innovative digital technologies.[44]

Digital transformation is usually implemented in several fundamental areas of a company's operation. This is shown in Figure 1.2.

Digital transformation usually includes activities in the area of automation (for example robotics technologies), communication and connectedness (cloud computing, broadband Internet), digital data (Big Data, the Internet of Things) and initiation of close cooperation with customers through mobile Internet and related available applications as well as social portals. Crucially, activities in all these areas should be performed simultaneously, and therefore in a coordinated manner. In effect, it becomes possible for companies to engage in entirely new projects and activities, including e-commerce, demand forecasting, a smart factory or infotainment.

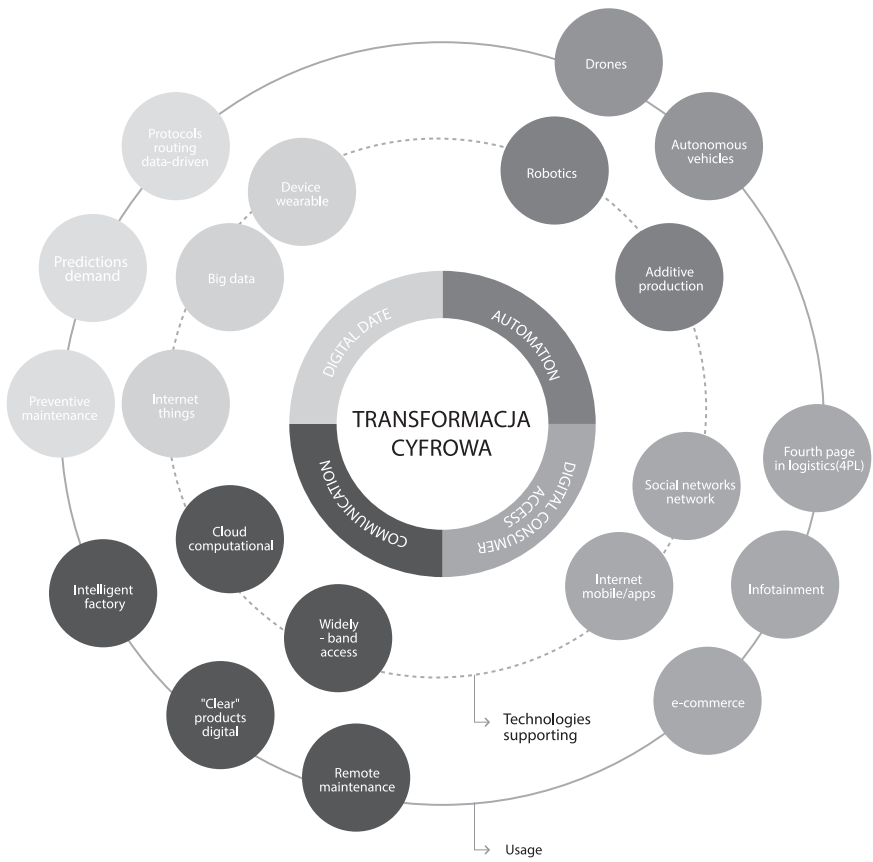

Figure 1.2 Areas where digital transformation is implemented in a company

Source: Author's own work based on J. Pieriegud, *op. cit.*, p. 13.

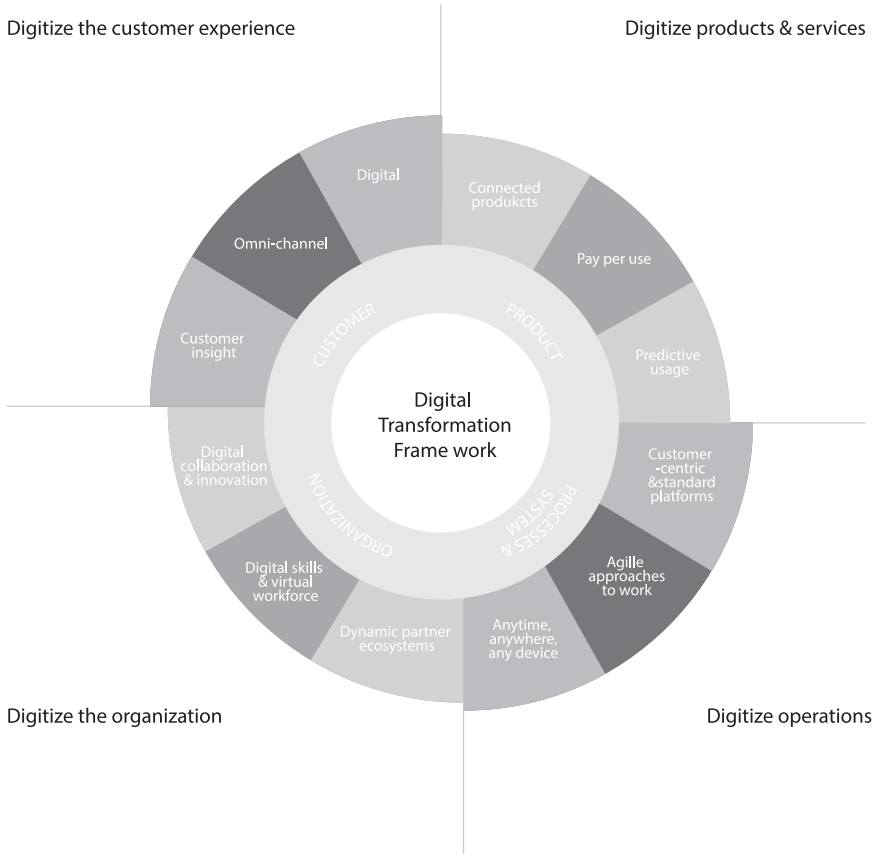

Figure 1.3 Areas of digital transformation according to Q. Corver and G. Elkhuizen

Source: Author's own work based on Q. Corver, G. Elkhuizen, *A Framework for Digital Business Transformation*, Cognizant, Teaneck 2014, p. 4.

Areas of digital transformation have been also discussed by Q. Corver and G. Elkhuizen. Their views about it are presented in Figure 1.3.

According to Q. Corver and G. Elkhuizen, the most important areas of digital transformation include digitisation of customer relations through digital marketing or omni-channel distribution, digitisation of products (for example, a pay per use model), digitisation of operations (customer-oriented platforms) and digitisation of the entire organisation (digital innovations, acquisition of digital skills). Thus, digital transformation should be perceived as a process which takes place both at the level of the whole company or in each areas of its activity as well as processes performed within the areas.

Like any process, digital transformation is carried out following strictly defined stages. These stages have been distinguished by B. Solis. They are presented in Figure 1.4.

Figure 1.4 Stages of digital transformation of a company according to B. Solis

Source: Author's own work based on B. Solis, *The Six Stages of Digital Transformation Maturity*, Altimeter Group, San Mateo 2016, p. 9.

At the first stage of digital transformation, the present state of a company's functioning is determined. According to B. Solis, although in many or even in most companies digital technologies are used, very often they are not used correctly or to a sufficient extent. Such a situation can be seen, for example, when there is no room for innovativeness in the organisation, therefore possible additional opportunities connected with the use of digital technologies, including their integration, are blocked. When any adverse aspects of using digital technologies are revealed, this is a reason for moving on to the second stage of digital transformation, where a company, in accordance with the nature of its activity and available resources, may start seeking accurate solutions based, for example, on the use of digital technologies in modern sales and communication channels. Another stage of digital transformation involves systematising identified streamlining proposals, defining strategies for their implementation, also in view of the liability incurred in connection with the implementation, and selecting persons or groups of employees who will coordinate the transformation activities. Then, digital transformation starts covering wider and wider circles in the organisation and if resistance is encountered, for example in the form of the employees' unwillingness to make changes or their insufficiently low level of digital skills, the transformation may end in failure. However, if it is progressing, then at the fifth stage, specific effects become already visible, for example as digital products and services. The last, sixth stage,

involves constant reinforcement of the progress of digitalisation in the company, which may be achieved, for instance, by investing in human capital and strengthening the level of employees' pursuit of innovation, further creation of a favourable organisational climate or putting together teams (centres) for digital innovations. It should be emphasised that even during the last stage all the efforts till then may be wasted. It may happen so when unwillingness to further changes appears (digital transformation must continue so that it is possible to adjust the company to constantly changing circumstances in the environment and to exploit cutting-edge digital technologies) or when appropriate resources are found to be missing.[45]

The major objective of a digital transformation is to achieve the so-called digital maturity, which is when a company shows an adequate level of digitalisation. This concerns, for example, use of electronic document circulation, extensive use of cloud services, active participation in social media, use of digital technologies to develop and intensify business relations or employee's appropriate digital competences.[46] A company which has gone through a systemic transformation is able to use the technologies and digital networks effectively to perform various business processes, including purchases and sales of goods, initiation of interactions with any stakeholders or communication inside or outside the organisation.[47]

A company's digital transformation is strictly connected with the manifestation by the organisation transformed in this manner of *digital technology entrepreneurship*. It is a very important aspect of the discussed matters because without such entrepreneurship it is not possible to achieve digital transformation effectively. The definition of digital technology entrepreneurship developed by F. Giones and A. Brem stresses that this kind of entrepreneurship focuses on broad use of technological knowledge and present scientific achievements so as to make it possible to identify and effectively exploit any chances and opportunities which emerge in the environment and relate to the activity conducted by the organisation. This concerns, for example, opportunities to perform innovative projects. A digital transformation without the above knowledge or achievements is not possible.[48]

Companies have undergone digital transformations gradually since the 1990s. It began, as already mentioned, with the popularisation of personal computers and the Internet. As seen from the discussion by S. J. Berman and R. Bell, the first stage of digital transformation was the 1990s when digital products and infrastructure in the form of software or IT systems started to appear in the market on an increasingly larger scale. The second stage fell to the period following the year 2000, thus when digital and electronic sales developed considerably, while the third (since approx. 2010) is the so-called mobile revolution as well as the dissemination of social media, big data systems and hyperconnectivity.[49] Obviously, not every company has gone through systemic transformation in stages as described above. These stages concern global rather than individual transformations. Whether the respective company will achieve digital transformation and what its character will possibly be like depends on the scope of activity conducted by the company, its resources and competition in the relevant market. It is a fact that if the respective organisation decides on digital transformation, it is desirable that the transformation should be performed with the use of any available and necessary digital technologies in the

case so that the level of the company's competitiveness or pursuit of innovation might grow fast.

When viewed as a process, then, digital transformation should be regarded as a sequence of precisely planned, thought out, coordinated actions, implemented at the level of the entire company, aiming to bring about the situation where digital technologies are effectively deployed in the company, which may contribute to the achievement of competitive advantage and an appropriate degree of innovativeness. In principle, such transformation may be carried out at each stage of a company's functioning but at present, considering hypercompetition, highly volatile environment and extremely intensive development of digital technologies, it becomes nearly necessary to transform for all the enterprises that still operate in a traditional manner.

1.4 Organisational Changes Accompanying Digitalisation

In any case, digitalisation causes many changes of organisational nature. According to W. Dobrowolski and A. Dobrowolska, "scientific and technological progress, especially dynamic as regards IT solutions, has an impact on the changes introduced to the organisation's processes."[50]

First, it should be noticed that in the contemporary world, digitisation has been progressing very quickly. It is proved by data showing that digital technologies are spreading in the world much more intensively than any of the inventions from the industrial age. As an example, it may be observed that while it took 30 years for electricity to reach 10% market penetration in households in the United States, the same process for landline telephones took 25 years, for television sets, mobile phones and personal computers – 10 years, and tablets – merely 2.5 years.[51] This shows how fast digitalisation is spreading in the world. And the process actually applies not only to developed countries but also to developing ones. An example can be Vietnam, where computers were launched within 15 years after they were invented, while for mobile phones and the Internet, it was merely a few years.[52]

What is also significant is that in 2014, for the first time in history, the number of users of mobile devices became higher than the number of desktop computers connected to the Internet. Considering this, various companies to an increasingly larger extent place an emphasis on using the mobile first strategy, where mobile solutions and technologies are implemented first, before those related to brick-and-mortar activities.[53] The transformations described above have a great impact on the organisational sphere of companies.

Digitalisation in companies may take place at an ever-faster rate due to many various factors. According to D. Andriessen, the most important of these include:

– globalisation, which has two kinds of consequences – first of all, it leads to the development of various types of ties and co-dependencies among states, societies or organisations, which brings about the necessity of their constant cooperation, to a large extent with the use of digital technologies, and furthermore

forces those enterprises which want to be competitive to show their uniqueness based on wide-ranging deployment of intangible resources, such as knowledge and expertise;
– gradual deregulation of key sectors of the economy, such as transport, telecommunications or power industry, which results in intensification of global flows of resources and information;
– dramatic technology-related changes which, through the emergence of new information technologies or communication channels (the global mobile phone network, the Internet), lead to a considerable reduction of costs of acquiring, storing, processing or sharing information.[54]

Fast progress of digitalisation entails changes in company management. According to a report by Capgemini Consulting and the MIT Center for Digital Business,[55] organisational changes accompanying digitalisation can be seen in three fundamental areas of a company's operations. They are presented in Figure 1.5.

As for the customer service area, digitalisation allows, primarily, for better understanding and identification of customers' needs. As a result, responding to these needs becomes effective but also new needs are generated. Furthermore, customer segmentation is performed fully effectively on the basis of the mass of data collected due to digital technologies as well as numerous areas of cooperation created between a company and customers, for example, with regard to the kind of offered products or services or ways of delivering them to locations of consumption, including, for example, digital or self-service sales.[56]

With respect to operational processes, as a result of the implementation of digital technologies, the processes are performed more efficiently and completely new functions may be introduced in them. In addition, considerable opportunities are created

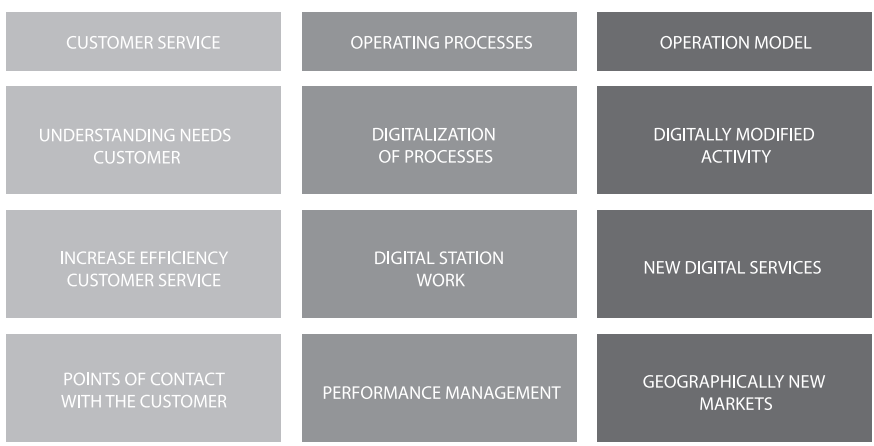

Figure 1.5 Areas of organisational changes resulting from digitalisation

Source: Author's own work based on A. Sobczak, "Koncepcja cyfrowej transformacji sieci organizacji publicznych," *Roczniki Kolegium Analiz Ekonomicznych* 2013, no. 29, p. 280.

for implementing some innovations to specific workstations. Such innovations may pertain, in particular, to doing work at any place and time, development of multi-channel, automatic ways of communication or finally sharing one's own professional knowledge in the workplace with other company employees, for example via Intranet or articles published in a newsletter.[57]

Digitalisation also contributes to modifying existing business models or creating entirely new ones. In this respect, such models may function based on a digitally modified activity which focuses on constant expansion of the offering of products and services, changing from physical form of goods into digital form and using digital packaging. What is also important is digital globalisation of activity, which may take place through integrating a company with numerous entities operating on the market and offering by them joint digital services.[58]

According to M. Goliński, digitalisation causes many transformations in the functioning of companies. First and foremost, these amount to:

- considerable increase in the flexibility level of each organisational structure and business processes performed within those structures;
- continuously growing effectiveness of such structures, which translates into more effective performance of strategic objectives;
- globalisation of conducted activity, supported by gradual removal of organisational or language barriers as a result of using modern digital technologies, including communication technologies;
- accelerated speed of responding to changes taking place in the company's surroundings;
- possibility of adjusting the company's organisational structure exactly to the needs and expectations of not just customers but also any other stakeholders (suppliers, local authorities, society in general), which is in turn conducive to building the so-called experience economy;
- promoting and strengthening the pursuit of innovation on a large scale, at each level of the organisational structure, which becomes possible by generating completely novel consumer needs;
- possibility of offering smart products and services in which information component is playing an increasingly greater role;
- expansion of the network of business connections;
- decrease of the role of human factor in multiple organisational processes, which then makes it possible to reduce the risk of errors made by managers or employees while fulfilling their professional duties;
- opportunities for sharing resources with other organisations and business entities (known as sharing economy).[59]

Digitalisation leads companies to gradual evolution, which follows from the fact that their organisational structures are getting closer and closer to a model typical of the age of knowledge. This is shown in Figure 1.6.

Among the most important changes associated with the transformation of a company from a model characteristic of the industrial age to a model of the age of

Organization of the industrial age	TRANSFORMATION	Organization of the knowledge age
focus on functions	→	focus on processes
implementation of all functions	→	order for the implementation of selected ones functions outside
complicated structure	→	simplified structure
dominant solo work	→	dominant teamwork
reacting to problems	→	antycypowanie szans i okazji
single inventions	→	constant innovative changes
mainly focused on resources financial, human and material	→	the dominant focus is on intangible resources
mass client	→	smart customer
narrow range of production	→	wide range of production
long production lines	→	short production runs
low flexibility of the park machine and high assembly costs	→	high flexibility of the park machine and low cost of assembly

Figure 1.6 Evolution of organisational structures of contemporary companies from a model characteristic of the industrial age to a model of the age of knowledge

Source: Author's own work based on K. Beyer, *Od epoki agrarnej…*, *op. cit.*, p. 14.

knowledge, the following should be mentioned: considerable streamlining of the organisational structure, focusing on processes rather than functions, and on intangible resources rather than on financial or tangible goods, dominance of teamwork, constant implementation of innovative ideas and initiatives as well as handing over certain management functions to specialised external entities (possibly on the basis of outsourcing).

It follows from the above discussion that organisational changes resulting from digitalisation are complex in nature. In turn, they result more than once in a complete metamorphosis of a company's organisational structure. The aim of such transformation is for the company to use digital technologies effectively, generate innovative ideas and put them into practice and take advantage as far as possible from employees' skills, abilities and knowledge.

1.5 Impact of Digitalisation on Company Management

Apart from the organisational sphere, digitalisation also has a great influence on company management. As emphasised by E. Czyż-Gwiazda,

> universal digitalisation […] created opportunities for the emergence of a new digital business model and the birth of the so-called digital economy. It is digitalisation that determines the contemporary level of operational effectiveness of an organisation and implies deep changes in production systems and management systems of organisations.[60]

According to O. Kohnke, digitisation makes it necessary for company management to consider four major areas. They are as follows:

- aligning leadership to increase employees' participation in company management activities;
- mobilising the organisation for action, including mainly to demonstrate innovative attitudes on a large scale;
- building capabilities, including digital skills;
- ensuring sustainability of a company's operation, for example, by continuing to improve and modify digital technologies used, aiming to respond to challenges presented by the market more effectively than to date.[61]

The impact of digitalisation on the management sphere is visible through creating plenty of opportunity for company growth, which thereby entails the nature of company management. Such opportunities, which follows from the conception of creative destruction proposed by Joseph Schumpeter, are provided by innovative (and thus based on digital technologies) activity strictly oriented to customer needs and creating their needs, which is able to bring about collapse of entire industries or economies if they cannot meet the requirements connected with building a digital economy. Due to the above, there is a growth of competitiveness for those companies whose activity is based on digital technologies, which in turn creates wide-ranging prospects for managing them and directing their development effectively.[62] It is worth pointing out that surveys conducted in 2015 by the Global Center for Digital Business Transformation showed that by 2020, as many as 40% of companies could disappear from the following markets as a result of digitalisation: telecommunications, media, entertainment, commercial and financial, in spite of holding strong market positions now. It would be so just because it is precisely those market sectors that are affected most by the changes associated with the implementation of cutting-edge technologies.[63]

Digitalisation is furthermore conducive to intensive deployment of modern technological solutions and their integration, which is manifested, for instance, by *hyperconnectivity*,[64] or omnipresent connectedness.[65] This term has been used for the first time by Canadians, A. Quan-Haase and B. Wellman. These authors noticed that in the contemporary economy, enormous numbers of interactions are initiated and, what is significant, they do not refer to people only (P2P – *people-to-people*), but also, more and more often, people and machines (P2M – *people-to-machine*) or even machines themselves (M2M – *machine-to-machine*). This way, the discussed hyperconnectivity takes place, with tools such as online messengers, mobile phones, e-mail or Web 2.0 services.[66] This omnipresent connectivity makes it easier to manage a company. It happens because at present, it takes a few minutes or even seconds to get in touch with a person staying several thousand kilometres away and furthermore the opportunity to build long-term business relations using communication technologies allows for obtaining data and information about the most effective ways to manage a company. Besides, many barriers connected with space, time, technology, languages or industries are disappearing, which creates

nearly unlimited opportunities for managing an organisation. It is not irrelevant, either, that digitalisation entails full automation of information exchange and creates conditions for developing completely new business models, innovative in organisational, technological, social or cultural terms, based on a combination of modern digital technologies.[67]

It should be emphasised that new technologies make it necessary for management to be based to a great extent on a simply enormous amount of various kinds of data and information. They are needed to get indispensable knowledge, which is the foundation for the operation of modern organisations and which makes it possible to manage contemporary companies on the basis of building and reinforcing the pursuit of innovation, creativity and entrepreneurship.[68] As already mentioned in one of the preceding sections, digitisation brings along a considerable volatility of conditions in which various companies operate. One of the results of this as far as the management sphere is concerned is that in order to measure organisational results, it is necessary now to use much more complex and comprehensive ratios than those used several decades ago or even between ten and twenty years ago. Such ratios have to cover not only financial indicators but also those which are able to measure intangible values, including those connected with knowledge.[69] Here, however, digitalisation not just creates additional problems concerning measurement of results but furthermore provides entirely new possibilities in this area. It is a fact, after all, that, for example, big data systems create ample opportunity for collecting nearly unlimited amount of data to perform complex measurements on them.[70]

Managing a digital enterprise, compared to a traditional organisation, has to a much greater degree strategic and social character. This means being oriented not just strictly to the operational or internal sphere of the organisation but being based on establishing broad relations with various stakeholders. Such relations may aim, for instance, at cooperation in the area of performing complex, advanced, innovative projects or sharing specific digital technologies. Thus, digitalisation make company management to become increasingly open to influences from the outside.[71]

Under the influence of digitalisation, management undergoes a major evolution with regard to marketing. Considering a wide access of society to digital technologies, including also the elderly, as well as a variety of available marketing forms, managing a digital enterprise in the sphere of marketing must be based on possibly most widespread activities. It is important that these activities should be carried out all the time, even 24 hours a day (this is possible, for example, with online advertisements), should be addressed to all groups of consumers, should use on a large scale all types of digital technologies (mobile apps, social media, cloud computing), exploiting their interactive nature. Furthermore, these activities should convey as much content as possible, providing information not only about specific features of a product or service but also about added value or smart offers.[72] This is shown in Figure 1.7.

Managers are significantly affected by changes resulting from digitalisation. This is because the implementation of digital technologies forces them to acquire completely new competences and to change their approach to many issues in the area of management. It is characteristic in that regard that digitalisation causes

Figure 1.7 Key aspects of marketing in a digital company

Source: Author's own work based on W. Świeczak, "Wpływ współczesnych technologii na zmianę działań marketingowych w organizacji. Marketing 4.0," *Marketing Instytucji Naukowych i Badawczych* 2017, no. 26, p. 183.

each manager to act in a decentralised and flexible manner, adjusting leadership strategies to make it possible to ensure the highest level of innovation, to get the full innovation potential out of their employees and to use digital technologies as effectively as possible. In addition, a modern manager is obliged to establish and support the functioning of teams or working projects and to use new media to communicate with employees.[73] What plays an enormous role is also providing employees with the opportunity to take an active part in the performance of management tasks and making decisions of key importance from the perspective of ensuring the appropriate level of innovativeness and effectiveness.[74]

According to W. Gonciarski, changes in the sphere of management following from digitisation amount to the construction of the so-called management 2.0 (new generation management). Such management is based on multi-aspectual use of digital technologies. The fundamental features of such management include:

– limiting hierarchical structures in favour of flexible, networked and decentralised and flattened systems;
– using more and more complex digital technologies within management of relations within the organisation and those which concern external stakeholders;
– attaching overriding importance to resources which are intangible in nature;
– transferring a major part of an enterprise to a virtual level, continuing, however, its activity in the real zone;

– focusing attention of the environment, including customers and their needs;
– dispersed leadership based on limitation of directive power of managers and promotion of multifaceted cooperation and use of collective intelligence;
– acting both on a global and local scale;
– continual implementation of modern solutions in the area of knowledge and AI management to adjust to ever changing conditions in the environment;
– constant search for innovative business models due to which it is possible to use cutting-edge solutions in management.[75]

Issues of the impact of digitalisation on the sphere of company management have been discussed in a synthetic manner by K. Jasińska. The author singles out manifestations of the impact in the context of each function of management. They are discussed in Table 1.2.

Table 1.2 Impact of digitalisation on various management functions

Management function	*Impact*
Monitoring	• Strong determination to ensure self-monitoring of managers and employees • Putting an emphasis on monitoring effectiveness of the performance of each process • Monitoring resources, taking into consideration growth possibilities and based on feedback received from employees
Motivating	• Reinforcing any attitudes promoting innovation by rewarding them with bonuses • Promoting a management style based on building a leader position • Motivating in order to build new competences, including digital skills
Organising	• Implementing a flat organisational structure • Orientation towards performing processes generating specific values • Organisational culture promoting the pursuit of innovation • Constant development of new business models • Risk taking • Implementing structures and solutions in the area of knowledge management and automation • Building structures making it possible to acquire, store and process data to create value • Sharing information and messages in an interactive manner • Pro-active decision-making
Planning	• Formulating plans on the basis of continuous observation of the situation in the environment • Analysing many alternative solutions • Short-term planning for projects being performed • Taking digitalisation into consideration in the company's strategy • Ensuring the opportunity to modify plans • Allowing for improvisation in planning

Source: K. Jasińska, "Konsekwencje cyfryzacji gospodarki dla systemu zarządzania przedsiębiorstwem z sektora IT," [in:] J. Gajewski, W. Paprocki, J. Pieriegud, eds., *Cyfryzacja gospodarki i społeczeństwa. Szanse i wyzwania dla sektorów infrastrukturalnych*, Instytut Badań nad Gospodarką Rynkową – Gdańska Akademia Bankowa, Gdańsk 2016, pp. 100–101.

Finally, one may describe as an example a company whose way of management was completely redirected as a result of using digital technology. The company's name is Nike. Management there is at present strongly oriented towards digitalisation and in principle most or perhaps even all the management decisions are strongly dependent on the use of modern digital technologies. This can be seen primarily in management decisions about marketing (promoting products by initiating a global dialogue about healthy lifestyle or sports events, obtaining information on customers and their preferences from the company's activity in social media), customer service (customers may design the colour of footwear on their own), sales (numerous digital products, such as sport bands which allow for monitoring running parameters but also taking advantage of a virtual trainer's advice and making data on running achievements available to others) or distribution (online channel). For Nike, digitalisation changed completely the management philosophy, as a result of which the company's activity may be conducted in a much more innovative and complex manner than before.[76]

Summing up, it should be observed that the essence of company management through digitalisation is aiming directly, first, to have any processes and actions performed in a most efficient, coordinated and effective manner, using any available digital technologies, and also, second, to create, also with the use of these technologies, the grounds for establishing broad cooperation with any stakeholders. Such management places an emphasis on innovativeness, which thus generates the need for a completely new approach compared to the traditional model to issues connected with managing employees or contacts with the environment.

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2 Digital Technology Platforms

2.1 Concept of a Digital Technology Platform

For the topics discussed in this monograph, the concept which acquires key importance is that of digital technology platform (abbreviated as DTP). It should be immediately noticed that although in English-language literature, the term has been widely used (also known as *digital platform*,[1] *digital business technology platform*,[2] *technology platform*, *virtual technology platform*[3] or even *IT platform* or *digital industry platform*[4]), it is hardly encountered in Polish publications. Exceptions are works by M. Odlanicka-Poczobutt, S. Olko and M. Krannich (referring mainly to digital library platforms)[5]; K. Stachura (the author discusses digital social platforms)[6]; M. Kulka (digital platforms)[7]; D. A. Myślak (digital television platforms)[8] or B. Twardowski (digital service platforms).[9] It should be mentioned that the concept is further recalled by such terms as *digital procurement platforms*,[10] *virtual commercial exchange platforms*[11] or *Internet platforms*.[12]

It must be noticed that in principle, in each case indicated above, what is being discussed are specific varieties of DTPs rather than their general form. This also applies even to Internet platforms, with respect to which the concept of DTP is much broader, as is discussed below. This undoubtedly shows that the topics connected with DTPs are still not completely described,[13] which makes it necessary to explain in detail the nature of DTPs.

In the first place, it is worth pointing out that the very term *platform* has been used for a relatively long time. As stated by T. Saarikko, the concept has been used on a large scale as early as in the 19th century. It denoted then a pattern or design that could be applied in industrial manufacturing. In recent years, however, the term has acquired additional meaning and started to be widely used in the management literature.[14] According to M. A. Cusumano, a platform is a foundation of components around which it is possible to create and develop a differentiated set of related products or services.[15] It should be stressed that, as noted by L. D. W. Thomas, E. Autio and D. M. Gann, most of the concepts and views in platform research are based on IT-oriented platforms, therefore primarily digital platforms.[16] In connection with this, the definition presented above, referring strictly to platforms, may be to some degree extended also to DTPs. The crucial aspect here is

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that platforms are a kind of foundations making it possible to construct various other systems or use specific functionalities.

From the most general perspective, DTPs are said to be tools through which it is possible to efficiently connect commercial partners and to intensify contacts established between various entities operating on markets (including mainly business partners, hence one more different term for DTP – B2B ("business-to-business") platforms, which thus form grounds for effective performance of specific transactions).[17] P. Constantinides, O. Henfridsson and G. Parker define DTP as types of digital tools which include services and content forming grounds for value-creating interactions. These are mostly interactions between producers and consumers, although other entities may be also included. In the approach discussed, it is exactly the interactions that are crucial for the operation of digital platforms and are decisive for their effectiveness and opportunities for multidimensional use.[18] In turn, in one document prepared in the European Commission, it was noticed that DTPs unite specific stakeholders with a shared vision and an approach to development in concrete areas, which may pertain both to the strictly business sphere and, more generally, social or technological ones.[19]

The definitions presented above state that DTPs are certain tools that create opportunities for initiating and intensifying interactions among various entities. In M. Kulka's opinion, such platforms should be regarded as a "stake of digital technologies" which form the grounds for performing actions for digital transformation.[20] M. de Reuver, C. Sørensen and R. C. Basole indicate that DTPs may be defined while taking into consideration two perspectives. The first of those, technical, leads to a statement that DTPs are databases of codes, which are extensible, which means that at any time it is possible to add to them new modules and functionalities. In turn, from a socio-technical perspective, DTPs should be regarded as the entire set of technical elements, including software and hardware, as well as related organisational processes and standards.[21]

In a dictionary definition, digital platforms (rather than DTPs) are complexes of services which relate to delivery of digital signal to subscribers using the Internet.[22] It should be noticed, though, that the definition refers to one type of DTP, namely digital television platforms, therefore it cannot be extended to all DTPs. It is, however, a fact without any doubt that DTPs may be perceived as "complexes of services" provided to specific users.

In some definitions, DTPs are even seen as separate business models. Thus, for example, in a report by Accenture, one of the biggest consulting and outsourcing company in the world, it is observed that digital platforms are business models based on specific technologies that create value by facilitating exchanges between representatives of various professional or social groups. The definition emphasises that DTPs are able to bring together producers and end users to transact with each other; furthermore, they also enable various companies to enhance collaboration, for example, to produce and offer innovative products and services.[23]

DTPs may be also construed as some actions taken by enterprises. Such understanding of DTPs is presented by D. Corin Stig, who states that such platforms

are specific actions and initiatives organised around certain functionalities carried out by a company whose main aim is to help to manage and optimise technology investments.[24] In turn, H. LeHong, C. Howard, D. Gaughan and D. Logan defined DTPs as interoperable sets of services which are complex in nature and serve to develop diverse applications.[25] This way, DTPs may be perceived as foundations for creating other tools contributing to intensification of relations among various entities active on the market. In this context, R. Sun, B. Keating and S. Gregor were right to refer to these platforms as "technological foundations" for building diverse tools or relations.[26]

In the beginning of this chapter, it was mentioned that DTPs are perceived by some authors as Internet platforms, which are referred to as *online intermediary platforms* by C. Busch, G. Dannemann, H. Schulte-Nölke, A. Wiewiórkowska-Domagalska and F. Zoll.[27] Ultimately, this is not correct usage because online platforms should be regarded as merely one of the types of DTPs. This is because such platforms are defined as types of websites which, apart from fulfilling the information function, also make it possible for their users to engage in interactions.[28] Although it should be stressed that at present it is online platforms which definitely dominate among DTPs but it is not justified to identify the two completely. After all, DTPs refer to any tools for integrating market participants, even having very little to do with anything digital.

R. G. Fichman, while referring to DTPs, uses the term *IT (information technology) platforms*. According to him, IT platforms include any general-purpose technologies that consist of a variety of applications and enable related business opportunities. Furthermore, the author makes it clear that the term *IT platform* may be viewed as a generalisation of the term *software platform*.[29] In connection with this, it should be remarked that both terms – IT platforms and software platforms – may be used to refer to DTPs. It should be, however, always borne in mind that *digital technology platforms* is definitely the broadest of the terms presented here, which therefore subsumes all such terms as *IT platforms*, *digital platforms*, *digital business technology platforms* or *online intermediary platforms*.

In turn, according to A. Faber, F. Matthes and F. Michel, DTPs, which may be also referred to as: *software-based platforms*, *platforms governance, two-sided markets* or even *platforms ecosystem*, should be construed as two-sided markets leading to the co-creation of specific values by market participants.[30]

It is worth explaining here why DTPs are quite often referred to as "ecosystems." What may be helpful in explaining this issue is a definition of *external platforms*, or industry platforms. They are regarded as products, services or technologies which are similar in many respects and make it possible for enterprises operating on the given market to develop their own technologies or products. Such enterprises make up the said ecosystem, which may be specified as *business ecosystem*.[31] The operation of every DTP undoubtedly involves grouping many companies active in a certain area of the market or collaborating with one another. It can be therefore acknowledged that they do create an ecosystem of some kind. Such an ecosystem is made up of many different entities, including those which make it possible for the enterprise to conduct its core activity (major partners, suppliers) and extended activity (suppliers' suppliers, customers) as well as remaining

organisations creating the technological, social or political and legal environment (competitors, government administration, research institutes and universities, trade unions, trade organisations).[32] The operation of a DTP leads, without any doubt, to the development of ecosystems by bringing together many diverse entities and creating opportunities for them to initiate cooperation. It is enough to mention the activity of Polish technology platforms (PTP), including for example Aviation PTP, Production Processes PTP or Road Transport PTP, which will be discussed below.[33]

Apart from the above definitions, many more proposals on how to capture theoretically the essence of a DTP may be indicated. R. Sun, B. Keating and S. Gregor presented these issues synthetically, listing what they thought are the most important approaches to DTPs. These approaches have been depicted in Table 2.1.

Analysing the definitions of DTPs compiled in Table 2.1, it should be noted that DTPs are construed in the literature in many various ways. Several basic groups of these definitions may be nevertheless distinguished. They state that DTPs are some tools (the definition by Markus and Loebbecke), including, for example, websites (the definition by Banker), sets of specific components, such as software (the approach of Taudes et al.) or specific technologies (the definition by Giessmann and Stanoevska) and even markets on which certain transactions are performed (the definition by Tan et al.). Equally complex is defining aims and objectives for creating DTPs. These aims and objectives, considering the definitions presented in Table 2.1, include not only to contribute to specific interactions but also to take advantage of network effect (the definition by Tan et al.), to support various business processes (the definition by Banker), to increase a company's competitive edge (Richardson's approach) or to transfer information (the definition by Rai et al.). Such multiplicity of approaches to DTPs shows that the platforms are highly complex systems, affecting their users in many aspects and consequently having an impact on the whole market and the economy.

The definitions which indicate that DTPs are some kind of markets are invoked by the approach proposed by B. Gregor, A. Łaszkiewicz and M. Stawiszyński. The authors, as mentioned above, put forward a category of "virtual commercial exchange platforms," explaining that these are virtual markets which make it possible for registered entities to share information, perform commercial transactions and establish mutual cooperation. In addition, according to the authors, the basis for the functioning of such markets are instruments offered by market operators, including mainly auction systems and directory services.[34]

Summing up, it must be concluded that the term *digital technology platforms* has been widely discussed in the literature, but characteristically with reference to quite a few related terms, such as, for example: *digital platforms, IT platforms*, *online intermediary platforms*, *platforms governance* or *platforms ecosystem*. To sort out the related topics, it is worth making an attempt at formulating a comprehensive definition of DTPs, taking into consideration their diverse aspects. Such platforms should be regarded as electronic (digital) tools which may assume the form of services or content, through which it is possible to provide basis for initiating or intensifying contacts among various entities operating on the market, and which – this is a very important property – may be expanded by adding new modules or functionalities.

Table 2.1 The most important definitions of digital technology platforms according to R. Sun, B. Keating and S. Gregor

Definition authors	*Year of formulating the definition*	*Digital technology platform*
Banker	2011	A website that allows participants to perform certain trading practices
Basole	2009	Multi-sided market that brings together various types of market participants
Ceccagnoli	2012	The set of components used in common across a product family that can be extended by new applications
Fichman	2004	A general-purpose technology that includes a variety of applications
Heitkotter	2012	A combination of hardware, operating systems and app store
Markus and Loebbecke	2013	A tool supporting business processes which may be simultaneously used by multiple companies
Meyer and Seliger	1998	A set of subsystems that form a common structure from which derivative products can be efficiently developed and produced
Rai et al.	2006	A platform which enables real-time transfer of information between various applications and functions that are distributed across partners
Richardson	2014	A tool for building a business infrastructure that shapes the capacity of companies to launch competitive actions
Saarikko	2014	A core of fixed set of attributes that can be extended and supplemented with applications and functionalities to the benefit of its users
Shaw and Holland	2010	A structural solution which makes it possible to support development of some phenomena
Tan et al.	2015	Two-sided markets, which brings together two distinct sides (interacting partners) allowing them to benefit from network effect
Taudes et al.	2000	A software package that enables the realisation of certain systems and applications
Tiwana	2015	"A technological foundation" with various interfaces used by extensions that interoperate with it
Giessmann and Stanoevska	2012	A set of technologies that are developed and evolve in certain systems

Source: R. Sun, B. Keating and S. Gregor, *op. cit.*, p. 5.

2.2 Properties of Digital Technology Platforms

Each DTP, in view of the scope and nature of conducted activity, may have distinct characteristics. It is a fact, though, that about a dozen features may be found which are common to all DTPs. These common properties will be discussed at this point.

First, the properties should be mentioned which are inextricably connected with digital economy and which therefore may be extended also to the sphere of the operation of DTPs. These properties include:

- being strictly based on digital components;
- putting a heavy emphasis on innovativeness, flexibility and effectiveness;
- hyperconnectivity concerning all the entities and elements of a DTP;
- combination of elements of traditional and digital economies in many aspects (for example, co-existence within a DTP distribution channel based on brick-and-mortar facilities and an online channel), in many cases it being impossible to demarcate the two areas precisely;
- being innovative;
- disappearance of many barriers, including spatial and temporal ones;
- nearly unlimited development opportunities;
- intensification of business relations;
- use of cutting-edge technologies;
- great importance of knowledge;
- correlation and convergence of many areas in which the economy and various enterprises function, including mostly IT technology, telecommunications and digital content;
- development and deployment of novel, innovative business models;
- ensuring maximum benefits to any stakeholders;
- a consumer quite often acting as a manufacturer;
- work and integration in a network;
- automated information sharing;
- molecularisation as a result of which DTPs are developed whose application is restricted to a relatively narrow scope of activity (for example, platforms for start-ups operating in a specific market sector).[35]

The fact should be emphasised that all the said properties traditionally assigned to digital economy are also characteristic for DTPs. This is so since their operation involves first of all integration and coordination of activities of many diverse entities, with key importance being acquired by the use of cutting-edge technologies or business models. This implies that DTPs are based on innovativeness and operational flexibility, that within them there is a large-scale promotion of processes of searching, collecting and disseminating knowledge on various areas of human activity and that they lead to intensification of business relations and, furthermore, they are developed to reduce various types of barriers.

One document prepared by the European Commission lists five basic characteristics of online platforms. They include:

- the ability to create and shape new markets, to challenge traditional ones, which is possible due to collecting, processing and editing large amounts of data;
- operation in multi-sided markets but with each platform exercising varying degrees of control over users;
- benefiting from "network effect," which may be reinforced, for example, by an increase in the number of users;
- strict reliance on cutting-edge technologies to be able to reach their users instantly;
- playing a key role in digital value creation, which is achieved by initiating new business ventures and reinforcing strategic dependencies.[36]

The discussed document focuses to a large extent on those properties of online platforms which are connected with their operation within specific markets. This is because such platforms may even contribute to the development of entirely new markets. A perfect example in this respect are online marketplaces, therefore online markets, where it is possible to perform buying and selling transactions and which are regarded as one of the most important type of a DTP.[37] Among properties of the platforms which may be pointed out is the their functioning on many markets (many platforms have a global character, which is exemplified by Skype) and also taking advantage, due to establishment of various connections among participants, of the network effect, which contributes to the creation of digital values, resulting, for example, from innovations.

One of the most significant properties of all DTPs is the fact that they are highly complex tools, systems or technologies consisting of many diverse elements. In the previous section, it was mentioned that DTPs bring together stakeholders within a certain ecosystem. Figure 2.1 presents basic layers and elements of such an ecosystem.

A business ecosystem, around which DTPs usually operate, is made up of various layers, including the environment consisting of many diverse entities. They include, for example, customers, suppliers or research institutions supporting the

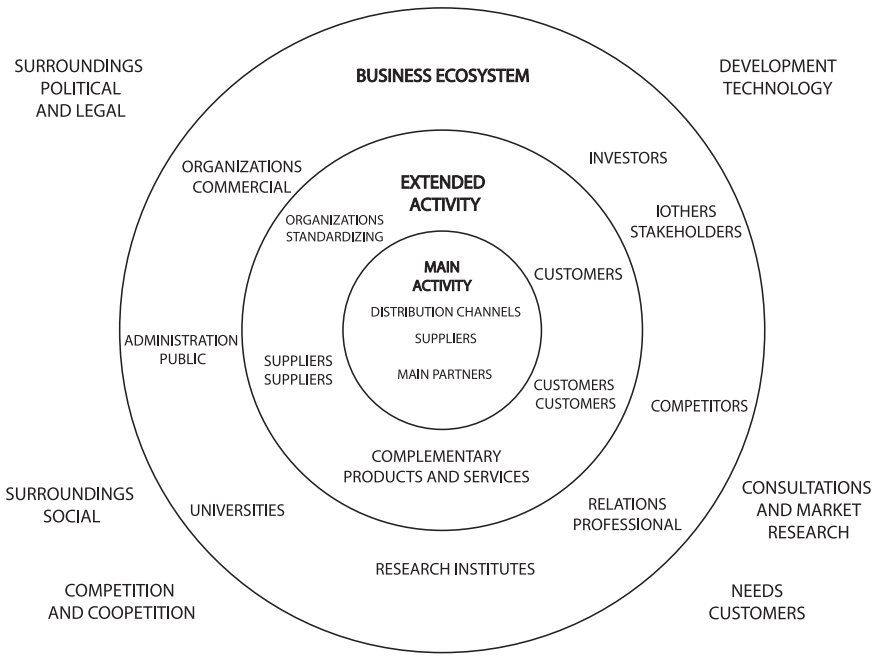


Figure 2.1 Components of a business ecosystem

Source: Author's own work based on A. Lipińska, *op. cit*., p. 48.

operation of platforms with technical knowledge and an innovative approach to performing processes. The construction of a business ecosystem shows it clearly that DTPs are very developed and complex systems, in which frequently an enormous number of entities participate. For this, examples may be provided by auction services, such as Allegro or eBay, which bring together millions of entrepreneurs, suppliers and private users.

It should be observed here, though, that a business ecosystem, discussed in the context of DTPs, is made up of not only certain entities which collaborate within the platforms but also refers to any add-ons in the form of, say, applications which are provided to the platform by some organisations.[38] Construed in this manner, a business ecosystem within a DTP becomes an even more complex system which has a really enormous number of components.

Considering that DTPs operate on the basis of business ecosystems, many properties may be indicated which are typical for such ecosystems. Apart from a large number of stakeholders and numerous connections among them, they are also characterised by:

– sharing various resources, mainly knowledge and technology, by those stakeholders, while maintaining, though, a high level of competitiveness (this is known as co-opetition, or cooperative competition);
– members of a DTP play specific roles, and each change of position of one element in the system affects the remaining ones;
– dynamic structure, constantly changing under the influence of market conditions or social needs, as a result of which ecosystems may evolve and develop on the basis of modern technologies;
– possibility of competing with other ecosystems;
– multi-directional and complex interaction with the environment, which refers to the sphere of politics, technology, market or human resources.[39]

These properties may be also assigned to DTPs. After all, these platforms provide access to various technologies and related knowledge to be shared by participants, cause the participants to play strictly defined roles (e.g. sellers, suppliers and buyers, as in auction systems, or teachers and students, as in e-learning platforms), and DTPs are subject to large amount of interaction with the environment (this can be seen, for example, in the possibility of co-creating specific functionalities of platforms by users) and DTPs constantly develop, using cutting-edge technologies, due to which they can compete with other platforms effectively.

What definitely distinguishes DTPs is also the possibility of continuing improvement and expansion with newer and newer functionalities and elements. This feature is emphasised in many definitions of DTPs.[40] M. de Reuver, C. Sørensen and R. C. Basole described the above possibility as openness of a DTP.[41] In this context, T. Saariko stated accurately that the architecture of any platform, including a DTP, is made up of a stable core, which is relatively nearly invariable, and many complements or add-ons, which are characterised by high variety. This causes each platform to be highly flexible.[42]

The discussed property of DTPs is very significant because due to it is becomes possible to ensure a high degree of innovativeness of their operation, which follows from the fact that they are constantly improved using most recent technologies. This way, they are able to respond effectively to continuously changing requirements and needs of customers as well as market or industry transformations. In addition, H. LeHong, C. Howard, D. Gaughan and D. Logan observed that the discussed openness may refer to the following five perspectives connected with the operation of a DTP:

- an infrastructure and operations perspective, including data centres or cloud computing;
- a data management and retention perspective;
- a security and risk perspective;
- a comprehensive integration strategy, which assumes maximum flexibility to support shifting market or business demands;
- outsourcing or cloud sourcing guidelines, which may assume a broad combination of internal and external resources and services received from various partners.[43]

Analysing fundamental properties of DTPs, it is also worth drawing attention to the proposals by R. Sun, B. Keating and S. Gregor about the most important dimensions of these platforms, and therefore also their components. These dimensions are presented in Table 2.2. In addition, it gives examples of alternative terminologies relative to these dimensions, used by other authors.

The fundamental features of a DTP may be described taking into consideration the dimensions distinguished in Table 2.2. The one which appears to be the leading dimension is the so-called technological base, which entails both openness and complexity of DTPs and related add-ons or standards, as well as interoperability, transactionality and platform governance. Each of these dimensions is part of every DTP, so the existence of such dimensions is one of the key distinguishing features of such platforms, which makes them distinct from, for example, IT or ICT systems.

To recapitulate the issues discussed in this section, it should be stressed that DTPs have many characteristic properties. Some of them follow directly from the manner of operating of the entire digital economy (e.g. innovativeness, hyperconnectivity, unlimited development opportunities, disappearance of many barriers, creation of new business models) or business ecosystems (sharing specific resources by DTP users, playing by them various roles, a dynamic structure). Others concern furthermore large complexity, openness, interoperability, transactionality and platform governance. In view of such a great number of properties, DTPs should be regarded as systems or tools strongly developed technologically which are constantly improved and have a considerable impact on the contemporary economy as a whole. These issues will be discussed in more depth in the further part of the chapter.

Table 2.2 Dimensions of digital technology platforms according to R. Sun, B. Keating and S. Gregor

Dimension	*Description*	*Alternative terminology*
Technological base	• Foundation which allows for using various add-ons, as a result of which DTPs are technologies used over long term	• Set of components • General-purpose technology • Extensible code base • Core fixed set of attributes • Core products or services • Common architecture, resource or structure
Add-ons	• A software extension to the technological base to add functionality of a DTP	• Applications, distributed applications • Complementary extensions (elements, products), including modules • Associated components • Plug-ins • Complementors offering products or services complementary to the offer of a DTP
Interoperability	• The ability to interact between a technological base and add-ons	• Real-time connectivity • Ways of connecting
Standards	• Design rules that allow programmers to access a DTP on the same terms and conditions, which is especially important for effective integration of add-ons with the technological base	• A set of rules • Platform or programming interfaces
Transactionality	• Possibility of performing certain transactions on a DTP, such as buying and selling, which supports interests of platform users	• Interactions • Transactions
Governance	• Structures, principles, policies, mechanisms, communication and relation models or license agreements involved in managing a DTP	• Coordination • Platform management • Transparency

Source: R. Sun, B. Keating, S. Gregor, *op. cit.*, p. 6.

2.3 Typology of Digital Technology Platforms

At present, a huge number of DTPs are available on the market. For this reason, it is impossible to list all of their kinds. A description of the most important typologies connected with DTPs will be presented below.

One of such classification is that proposed by to H. LeHong, C. Howard, D. Gaughan and D. Logan It is presented in Figure 2.2.

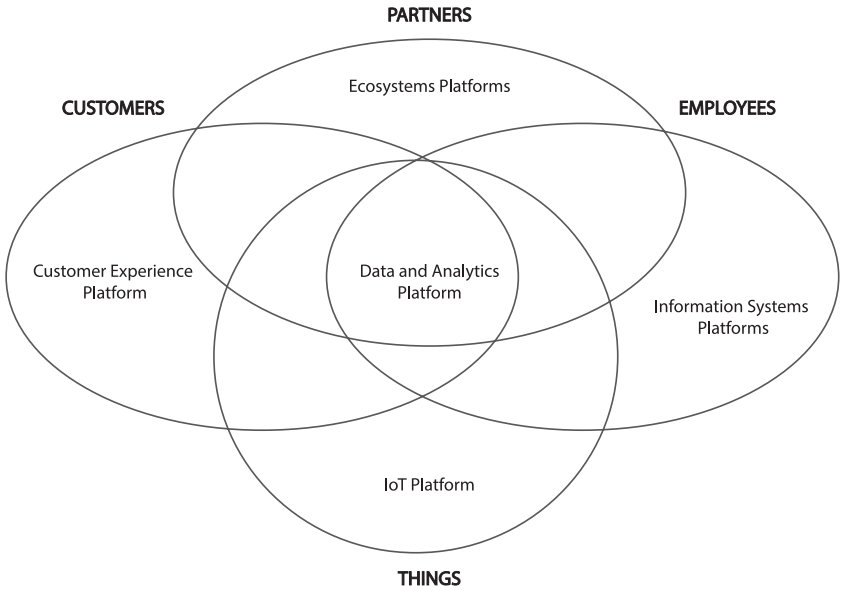


Figure 2.2 Classification of digital technology platforms according to H. LeHong, C. Howard, D. Gaughan, D. Logan

Source: Author's own work based on H. LeHong, C. Howard, D. Gaughan, D. Logan, *op. cit.*, p. 3.

According to the authors, DTPs may be divided into five types, with the division being based on the criterion regarding main areas of application of DTPs, or *customers*, *partners*, *employees* and *things*. It is typical that each kind of a DTP operates in all of the above areas, although obviously the scope of operation is different depending on a particular platform. The kind of platforms which participate to a greatest extent in each of the areas are *data and analytics platforms*, which is connected with the fact that they enable information management and analysis, and thus effective decision-making based on available data. Another kind of DTPs are *customer experience platforms*, which are strongly oriented to consumers by offering them access to applications dedicated to them or omni-channel distribution systems. *Ecosystem platforms* make it possible to create systems external to a DTP for cooperation with other entities and their integration, while *information systems platforms* are solutions due to which it is possible to control certain entities, including with the use of such systems as, for example, ERP (*enterprise resource planning*). The last kind of a DTP distinguished by H. LeHong, C. Howard, D. Gaughan and D. Logan is *Internet of Things (IoT) platforms*. They are used to combine resources, systems and physical devices to monitor, control and optimise their operation.[44]

A slightly different classification of DTPs was proposed in one publication by Oxera, a consulting firm. The classification is based on surveys performed by the firm in many European countries, including France, Germany, Spain and Poland,

among 6,000 consumers (including 1,502 from Poland). The surveys were about the level of use of digital platforms by consumers as well as related benefits or concerns.[45] The above classification of DTPs is presented below:

– *communication platforms* – platforms for communication among various entities;
– *information platforms* – platforms for obtaining and sharing all sorts of information;
– *comparison platforms* – platforms for comparing various products or services;
– *entertainment platforms* – platforms for accessing and sharing content used for entertainment;
– *online marketplaces* – platforms for entering into buying or selling transactions.[46]

A still different typology of DTPs was presented by A. Kosieradzka and K. Rostek. This typology distinguishes four types of platforms, which are restricted to "technology platforms accessible via web browsers":

– communication platforms – aiming to support group decisions;
– analytics and communication platforms – make it possible to make decisions aiming to, for example, increase a company's competitiveness;
– integration and information platforms – used mainly in the area of data and information analysis;
– platforms for solving problems and perform tasks with the use of knowledge and potential of external entities.[47]

Issues connected with types of DTPs were discussed in a slightly more limited manner by A. Gawer. She listed only three types. They are described in Table 2.3.

According to A. Gawer, technology platforms, including digital ones, include internal platforms, operating within one company, platforms operating within one supply chain as well as those defined as industrial ones. The differ from one another, in principle, in all components and aspects, starting from the level of use, up to coordination mechanisms or innovations. One common element regarding their construction may be nevertheless found. This is architecture, which is modular, making it possible to attach to the core (technological base) further elements, such as modules or applications.

R. G. Fichman distinguished four basic types of DTPs. These are as follows: computer platforms (for example, operating systems dedicated to mobile devices, such as Android), infrastructural platforms (wireless networks), corporate application platforms (for example, ERP) and platforms for programming (Java).[48]

In turn, according to K. Mohanty, various DTPs which are claimed to be earmarked primarily to deliver technology-based services for business, may be divided into: social media platforms (Facebook, Twitter, Instagram, Pinterest), which are used by companies to advertise their products and services and establish relations with stakeholders, remaining advertising platforms, including Google or various blogs, cloud computing platforms (for example, Microsoft Azure or Amazon Web Services), offering data storage or hosting, as well as platformy in the form of

Table 2.3 Kinds of technology platforms according to A. Gawer

Platform dimensions	*Internal platforms*	*Supply-chain platforms*	*Industry platforms*
Architecture	• Modular construction • Core and add-ons		
Access to innovations	• Wide	• Innovations within a supply chain	• Potentially unlimited
Interface	• Closed – accessible to platform users but not to external entities	• Selectively open, therefore accessible only within a supply chain	• Open for all
Coordination mechanisms	• Strictly defined governance hierarchy	• Contractual relationships within a supply chain	• Ecosystem governance
Level of use	• Enterprise	• Supply chain	• Industrial ecosystems
Entity establishing the platform	• One enterprise and its subcontractors	• Supply-chain members	• Platform leader and complementors
Examples	• Black and Decker (production of tools) • Sony (production of electronics)	• Boeing (production of airplanes) • Renault – Nissan (production of cars)	• Apple (mobile technology) • Facebook (social portal) • Google (search engine)

Source: A. Gawer, "Bridging Differing Perspectives on Technological Platforms: Toward an Integrative Framework," *Research Policy*. Elsevier 2014, vol. 43, no. 7, p. 1244.

separate e-commerce business models, such as Amazon or eBay, making it possible to buy products without leaving home.[49]

DTPs may be also divided into types on the basis of relations that take place between participants of activities in the digital environment, including e.g. within e-business. This way, platforms may be distinguished where the following types of relations occur:

– B2B (*business-to-business*) – "classic" relationships on the market between two enterprises;
– B2C (*business-to-consumer* or *business-to-client*) – relations concerning DTPs, which make interactions between enterprises and consumers possible;
– B2G (*business-to-government*) – relations between enterprises and public administration (platforms for tenders or public procurement);
– C2C (*customer-to-customer*) – transactions between consumers using platforms in the form of auction systems and portals;
– C2B (*customer-to-business*) – relations between consumers and enterprises, initiated by the former (for instance, comparison-shopping websites);
– C2G (*customer-to-government*) – transactions between citizens and public administration performed through public platforms for taxes or social insurance;
– G2C (*government-to-citizen*) – flow of administrative information between offices and citizens;

– G2B (*government-to-business*) – flow of economic information between offices and enterprises;
– G2G (*government-to-government*) – relations between public administration authorities making it possible for them to coordinate internal processes.[50]

It should be added that at present DTPs most often concern initiation and intensification of B2B, B2C, C2C and C2B relationships, therefore between consumers and enterprises. It is a fact, though, that increasingly faster development can be observed also with respect to platforms for communication between citizens and enterprises on the one hand and public administration on the other. Examples of these are platforms operating in Poland, e.g. ePUAP (Electronic Platform of Public Administration Services), PUE ZUS (Electronic Service Platform of the Social Insurance Company) or CEIDG (Central Registration and Information on Business).[51] A decisive majority of B2B, B2C, C2C or C2B platforms operate within e-commerce, which T. Wallace regards as applications allowing enterprises conducting activity in the Internet to manage websites, sales and marketing, in addition offering integration with traditional business tools.[52]

The United Nations also prepared its own classification of DTPs. It considered a gradual development of the platforms, dividing it into three basic periods, which also entails three kinds of DTPs. This is depicted in Figure 2.3.

As shown in Figure 2.3, the gradual dissemination of digital platforms in the world began with the emergence of mainframe computers, which, as already mentioned, took place in the 1960s. The stage lasted to the second half of 1980s and the beginning of the 1990s, when personal computers were invented and started to be commonly used, as well as the Internet, which the UN considers as the second type of digital technologies. That made it possible to build more developed digital platforms. The third platform growth stage, which started in the beginning of the second decade of the 21st century and is ongoing, when mobile technologies began to be ubiquitous and more and more solutions appeared such as big data analytics, the Internet of Things, cloud services or social media, allowing for promotion of innovative business models and services. Importantly, combined use of digital technologies and platforms is now possible, which gives rise to completely new opportunities, not only just to individual users or enterprises but also the public sector and social organisations. What should be also emphasised is that whereas at the first stage of development, DTPs were used by several millions of people, at the second and third stages, the number of users reached hundreds of millions and several billions of users respectively. This demonstrates an unusually intensive growth of DTPs.[53]

The classifications of DTPs presented above are undoubtedly general in nature. Others concentrate on singling out more specific platforms from the classification, applying for that various kinds of criteria. So, for example, in the report by Aleo and Deloitte, quoted above, platforms were selected which are used in the performance of procurement processes, known as source-to-settle platforms. Such procurement platforms include:

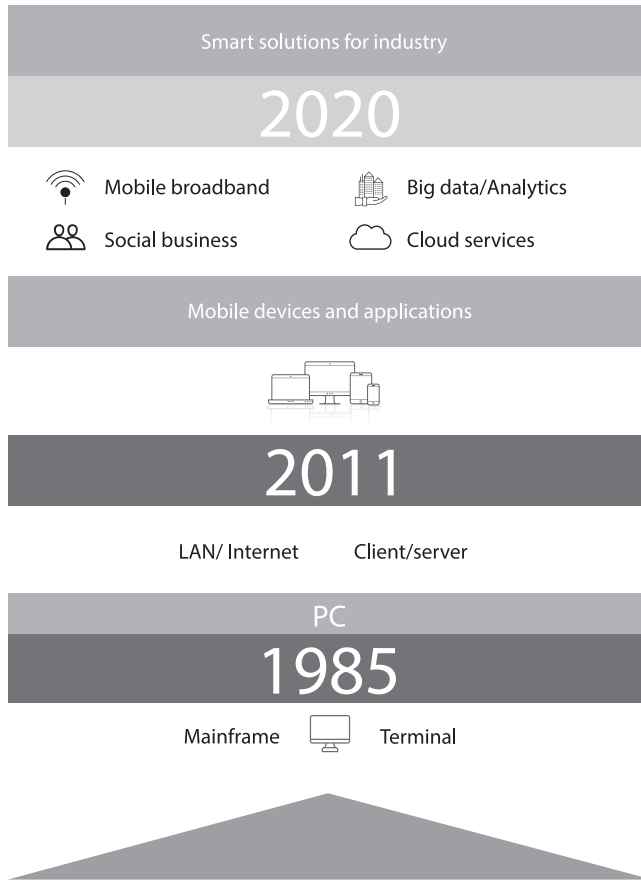


Figure 2.3 Types of digital platforms in historical perspective according to the UN

Source: Author's own work based on A. Bárcena, A. Prado, M. Cimoli, R. Pérez, *The new digital revolution. From the consumer Internet to the industrial Internet*, United Nations, Santiago 2016, p. 29.

- *eSourcing* – a platform for searching for offers and suppliers;
- *contract management* – a platform for managing contracts;
- *eProcurement* – a platform for document circulation;
- *eInvoicing* – a platform allowing for automatic settlement of invoices received from suppliers;
- *data analytics* – a platform for analysing and forecasting internal demand;
- *vendor management* – a platform supporting management of relations with suppliers.[54]

It should be added that such technologies may be assigned to several from the most important types of DTP. They are, for example, *customer experience platforms* (*eProcurement*), *communication platforms* (*eInvoicing*) or *information platforms* (*data analytics*).

In addition, considering the area of application, it is possible to distinguish Internet (online) platforms,[55] television platforms (digital broadcasts on terrestrial, cable, satellite and Internet platforms)[56] or library platforms (digital libraries).[57] In one of the documents of the European Commission on digital single market, basic types of DTPs are mentioned, though only strictly online platforms were taken into account. These include search engines (such as Google), social media (Facebook, Twitter, YouTube), app stores (Google Play), price comparison websites (Ceneo) and e-commerce platforms (Amazon, Allegro).[58]

Among the most significant DTPs are online markets.[59] Table 2.4 presents their most important kinds.

Cloud computing solutions are also regarded as DTPs. This is because cloud computing is a type of platform which operates based on a data centre, making it possible for users to gain access to specific resources found on a server, applicable, for example, to e-commerce or scientific research.[60] In that regard, the most frequently used solutions are jointly referred to as XaaS ("anything as a service"):

Table 2.4 Types of online marketplaces

Criterion for classification	*Kinds of online markets*
Sales channels	• Online platforms (pure players) • Online platforms and bricks and mortar players
Presentation of products	• Catalogue of products to which further sellers may attach their offers • A list of products compiled by various sellers
Purpose	• External, which may be used by both sellers and customers, after satisfying certain conditions • Internal, which may be used only by selected sellers and customers • Mixed, which are only for selected sellers (for example, shopping clubs)
Type of customers	• B2B – only business customers • B2C – natural persons and business customers • C2C – only natural persons
Type of offer	• Commodity • Service • Mixed – commodity and service
Type of products	• Horizontal, where commodities from various industries and categories are offered • Vertical, where commodities from the same industry or category are offered • Mixed, where various sellers offer commodities from various industries or categories
Type of relation	• Direct • Indirect (e.g. comparison-shopping websites)
Reach	• Domestic • International
Source of origin	• Primary – platforms created only in digital version • Secondary – platforms which previously operated in traditional form

Source: Elektroniczne platformy sprzedażowe (marketplace'y) w Polsce, https://www.gs1pl.org/kontakt/broszury-i-foldery/382-elektroniczne-platformy-sprzedazowe-marketplace-y-w-polsce-raport/file [accessed 14 November 2019], p. 9.

- SaaS (*software-as-a-service*) – a platform allows users to use selected functional applications or software elements;
- PaaS (*platform-as-a-service*) – covers sales of all software and is addressed mainly to enterprises from the IT sector performing programming or testing;
- IaaS (*infrastructure as a service*) – a platform making it possible to deliver IT infrastructure to users in the form of hardware and maintenance service;
- DaaS (*data as a service*) – sales of space for databases and in mass storage;
- FaaS (*framework as a service*) – makes it possible to develop applications available on SaaS platforms;
- CaaS (*communication as a service*) – on this type of platform, the vendor makes it possible for users to use various communication tools, such as, for example, videoconferences;
- StaaS (*storage as a service*) – a platform for storing and archiving data;
- IPaaS (*integration platform as a service*) – a platform managing data stored in a cloud;
- BpaaS (*business process as a service*) – a platform which enables a vendor to perform specific business processes such as, for example, *e-learning*;
- DbaaS (*database as a service*) – covers database management and maintenance.[61]

One type of DTPs within big data platforms which are developing to an increasingly greater extent are known as DMPs. This acronym stands for *data management platforms*. Their task is to collect information about users which may be used by enterprises, for example, to adjust their own product or service offer to changeable requirements of consumers or to apply appropriate marketing strategies. Such platforms are also used for performing analytic tasks, including data aggregation, modelling or correlation search with regard to behaviours of Internet users and for real-time information sharing.[62] At present, the most expanded DMPs with respect to the amount of data are managed by Oracle (data of 700 million users), Yahoo (20 million users, processing 13.5 TB of data), Google (platforms such as BigQuery or Cloud Data Flow) and Microsoft (Azure, SQL Server).[63]

At present, an ever-greater role is also played by e-learning and crowdfunding platforms. The former allow for remote learning with the use specific IT systems, with third-generation platforms being used now at the greatest scale (the so-called synchronous tele-education model, using audio– or videoconferences) and fourth-generation platforms (asynchronous or virtual tele-education model, based on materials presented interactively on a computer and over the Internet).[64] Crowdfunding platforms for collecting financial support for various initiatives, may operate as *specialised platforms*, when grouping users who want to support projects of a specific type (recording music or making a film); as *activity specific platforms*, within a specific industry, including IT or sport; or within many industries.[65]

Apart from crowdfunding platforms, also crowdsourcing and crowdworking platforms are becoming more and more popular. The operation of the former type involves providing enterprises or public organisations with opportunities for acquiring specialised knowledge, which originates from all the people who want to support these enterprises (this may assume the form of crowdsolving, which

means generating ideas, or crowdvoting, which means public opinion surveys). The latter type of platform also involves offering jobs online to many people during the performance of a project or a set of tasks. Platforms of such types create broad development opportunities for enterprises, allowing for efficient acquisition of knowledge needed to conduct business processes and for shortening considerably the time for completing various tasks.[66]

Discussing the basic classifications of DTPs, one more must be mentioned, that based on the criterion of their accessibility. This makes it possible to distinguish open access and closed access platforms. This classification is recalled to some extent by the proposal by A. Gawer (see Table 2.3). In open access platforms, their founders give up some control or some portion of profits connected with their operation, receiving in exchange the opportunity to initiate wide-ranging cooperation with many various entities and thus to develop a business ecosystem, increase the value of the platforms or stir up greater interest in them on the part of users. In turn, closed access platforms are designed for strictly defined users, who e.g. pay for access or take part in a specific project, closely related to the operation of the platforms. Practically, for any DTP, there is a dilemma whether it should be open or rather closed. According to G. Parker and M. Van Alstyne, the most desirable situation in terms of openness is when there is a balance of access to digital platforms, so for instance when a platform is addressed to some users but also accessible to some degree to entities generating innovative ideas.[67]

DTPs, then, assume many forms and the above classifications do not exhaust all the types of the platforms which have been distinguished in the literature to date. The most important types are communication, information, data analytics platforms and also online markets. It should be noted that it is frequently difficult to classify a specific platform strictly to one type of DTP, since, for example, Facebook may be assigned both to online platforms and industry platforms (A. Gawer's classification) as well as communication platforms (typology by Oxera). This shows high complexity and intensive development of DTPs.

2.4 Global Market of Digital Technology Platforms

It should be noticed that at present, DTPs are thought to play an increasingly more important role in the growth of the economy and the sphere of business as well as in the intensification of mutual relationships among diverse entities. What is significant, the trend can be also observed in Poland. To provide examples, in a report entitled *Cyfrowa Polska* ("*Digital Poland*"), there is a statement that "the major drivers of break-through changes [in the contemporary economy] will be […] platforms operating on a hyper-scale, e.g. Google or Apple."[68] In turn, in a report entitled *Klient w świecie cyfrowym* ("*A Customer in a Digital World*"), it was stressed that

> today, communication with customers takes place on so many planes that platforms which support it are becoming more and more relevant. Scalable, providing access to real-time data, mobile – these are just some of the properties which make the best of them stand out today.[69]

DTPs are growing extremely fast, which follows from many different factors. The most important of these seem to include:

- gradual dissemination of digital economy and organisations based on knowledge;
- increasingly better access to digital technologies;
- a greater extent to which the society uses various digital tools and thus a higher demand for solutions such as DTPs;
- development of digital competence among members of the society;
- an easier access to employees and experts with digital skills for innovative enterprises and organisations;
- reduction of organisational, administrative, temporal or spatial barriers, possible, among other factors, due to globalisation and development of international economic unions, as a result of which it is possible to intensify cooperation and partnership between enterprises or research institutions with respect to the implementation of projects relating to DTPs;
- actions of many states and international organisations supporting the development of digital economy (for example, the application of preferential tax rules for innovative projects and investments).[70]

In view of the considerable popularisation of DTPs, the literature on the subject matter has even been referring to *platform economy*. This economy may be only in its infancy,[71] nevertheless the fact that this term is used shows how enormous is the importance of various types of platforms, including mainly DTPs, in the contemporary market reality. In this context, the term *platformisation* is also used with reference to the departure from the trend, prevailing in recent years, whereby enterprises and consumers, instead of installing and using various applications, would rather take advantage of opportunities, expanding all the time, provided by DTPs. In the words of Michał Kreczmar, Director for Digital Transformation at PwC, a consulting firm:

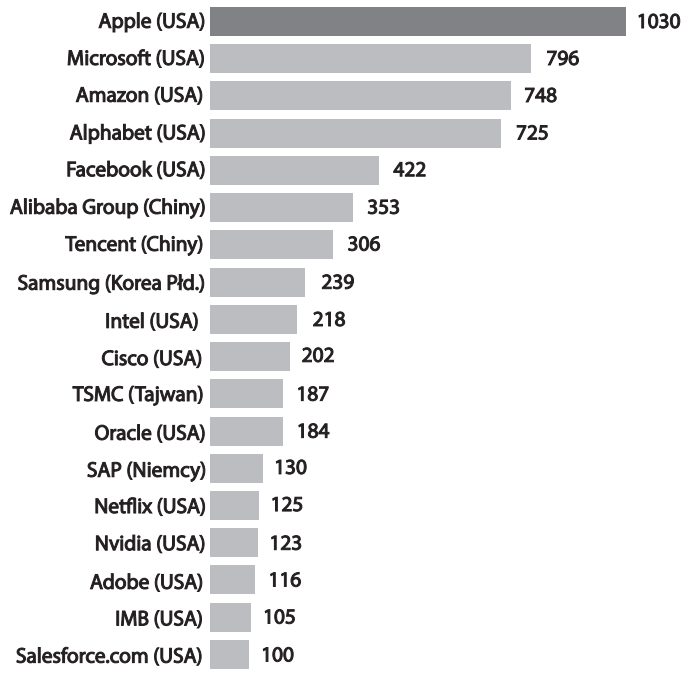
> founders of such platforms as Facebook make it possible for independent firms not only to win customers through advertisements published on the pages of their digital properties but also to perform sales of products and services, payments and even customer service and after-sales support. All of this within one online system, without the need to leave it. Traditional firms wanting to become known in the digital reality would have to adapt better and better to this type of platformisation. […] Platforms are taking over more and more of our activity. Who would have thought 6–7 years ago that Facebook would replace newspapers, television or customer service?[72]

In this context, it should be underlined that according to one report by Accenture, as many as 81% of company managers believe that it is exactly DTPs rather than applications that will be the basis for their strategies in the coming years.[73]

Even though the global market of DTPs is made up of thousands of all sorts of platforms, the most important of these are the so-called "digital giants" (a.k.a. "four

technology giants," "Big Tech," "Big Four").[74] They include four companies – Google, Amazon, Facebook and Apple (all of them together referred to by the acronym "GAFA"[75]), although frequently Microsoft is added to the group, which is then called "Big Five."[76] All these companies may be regarded as both global technology platforms or as entities which offer access to various types of DTPs. "Big Five" definitely dominates on the market of global DTPs. This is shown, among other things, by data about their capitalisation levels. They are presented in Graph 2.1.

"Big Five" hold five leading positions in terms of capitalisation compared to the biggest players on the technology market. As at 31 October 2018, their capitalisation was USD 3,721 billion, which means a total result of 61% of the overall capitalisation among the eighteen leaders of the technology industry in the world. This undoubtedly confirms the leading positions of the "digital giants" in the global market of DTPs. It is no exaggeration when more and more people are claiming now that the global digital market, including also DTPs, is apparently controlled by the oligopoly of these five corporations.[77] It is worth adding that all over the year 2018, the total stock exchange valuation of the corporations making up "Big Five" amounted to 4.2 billion dollars, or eleven times more than the value of all the companies listed on Warsaw Stock Exchange in Poland.[78]



Graph 2.1 Capitalisation of the biggest technology companies in the world (data as at 31 October 2018, in USD billion)[124]

Source: H. Kozieł, *Cyfrowe giganty stają się jeszcze większe*, https://cyfrowa.rp.pl/globalne-interesy/28881-cyfrowe-giganty-staja-się-jeszcze-wieksze [accessed 20 November 2019].

Table 2.5 The most valuable brands in the world in 2017 according to Forbes' report

Rank	*Brand*	*Brand value (in USD billion)*	*2017/2016 growth (as %)*	*Revenues (in USD billion)*	*Industry*
1	Apple	170.0	10	214.2	Technology
2	Google	101.8	23	80.5	Technology
3	Microsoft	87.0	16	85.3	Technology
4	Facebook	73.5	40	25.6	Technology
5	Coca-Cola	56.4	−4	23.0	Beverages
6	Amazon	54.1	54	133.0	Technology
7	Disney	43.9	11	30.7	Entertainment
8	Toyota	41.1	−2	168.8	Motor industry
9	McDonald's	40.3	3	85.0	Catering
10	Samsung	38.2	6	166.7	Technology

Source: M. Lewicki, "E-handel w Polsce – stan i perspektywy rozwoju," *Handel Wewnętrzny* 2018, no. 4, p. 177.

Global DTPs play dominant roles not just in the market of technology platforms but in general in the entire world economy. This is shown by the data presented in Table 2.5.

Among the ten most valuable brands in the world which affect the word economy to the greatest extent, the four leading positions are held by companies offering DTPs, while the sixth position is taken by Amazon. Those brands generate just enormous revenues. In 2018, the total revenues were 714 billion dollars, with profit of 135.5 billion dollars, which means profitability of approximately 19%. Such results show that revenues of the "digital giants" are higher by USD 100 billion than what the Polish economy is able to produce on an annual basis, while the profits alone would be sufficient to cover all the expenditures of the Polish budget.[79]

The technologies implemented by "Big Tech" are without any doubt decisive about the level of development and innovativeness in the world economy. It should be observed that the brands are growing intensively all the time, which can be seen from the fact that in the years 2016–2017, they recorded increase in value of 10% (Apple) up to over 50% (Amazon). In this context, it should be added that the biggest DTPs achieve their unusually strong position at the cost of enterprises from other industries. It is equally relevant that the document entitled "Polityka Rozwoju Sztucznej Inteligencji w Polsce na lata 2019–2027" ("Policy for the Development of Artificial Intelligence in Poland for 2019–2027"), which is at present a draft for social consultation, stressed that

> during several recent decades, with lightning speed, a new economic reality unfolded, where the key role is no longer played by raw materials, workforce or even financial capital but by knowledge or intangible assets. For example, oil companies and car manufacturers disappeared from the leading positions on the list of the most valuable companies in the world, replaced by corporations operating digital platforms, whose major assets are invisible but affect the assessment of the value of each of them.[80]

This is correct and shows a quickly increasing role of DTPs in today's economy.

Here, however, it must be noted that ever more important roles are played in the global DTP market by brand different from "Big Five." They are primarily companies with registered offices in China, including Alibaba, Tencet and the like. As shown by the data presented in Graph 2.1, they have already begun to hold ranks just below "Big Tech" in terms of capitalisation. In addition, an intensive growth in the share of Chinese brands in the capitalisation can be seen. In 2018, the share was already 40%, while it was 48% for American companies, but with a decrease by 15% compared to 2017.[81] The data show that even though US companies continue to dominate in the global DTP market, they may nevertheless gradually face an increasingly growing competition from Chinese brands.

It Is necessary still to stress that the global market of DTPs is not made up of commercial solutions only but also of those which use a great contribution from the public sphere and entities operating there. Good examples are European technology platforms and Polish technology platforms (ETPs and PTPs, respectively).[82] They will be discussed in detail in the next section. It should be noted that what is conducive to promoting such platforms is the policy carried out in many countries. This is also true for Poland. In this area, it is possible to invoke provisions of the Future Industry Platform Foundation ("Fundacja Platforma Przemysłu Przyszłości") Act[83] (the foundation will be further also referred to as the FIPF). Those provisions envisage the establishment of the Foundation to support digital transformation of enterprises, which is to be performed with reference to processes or products which use cutting-edge achievements from the areas of ICT technology, artificial intelligence, automation or human-machine communication. The main tasks of the FIPF include: to increase entrepreneurs' awareness how to use modern digital technologies, to support purchases of innovative technological solutions or data sharing systems and to initiate international cooperation for promoting the use of digital technology. Between 2019 and 2018, over PLN 236 million is to be earmarked for the activities carried out by the Foundation.[84] These activities will also include initiatives for supporting the development of DTPs.

Furthermore, what should be mentioned is the Programme entitled "From Paper Poland to Digital Poland," were plenty activities have been specified for the development of DTPs in the public sphere. These activities are to be performed in five basic areas, concerning, among others, the development of digital competences in the public sector, provision of secure and convenient access to online public services and acceleration of the development of modern telecommunications infrastructure. The performance of the Programme involves, for example, continued modernisation and increasing the functionality of digital public platforms, such as PUE ZUS or ePUAP.[85]

Finally, it should be noticed that intensive growth of DTPs makes it necessary to introduce new regulations or amendments to laws. This follows from the increasingly higher impact of the platforms on various enterprises and consumers, and consequently also on entire markets and economies. Significantly, the impact does not have to be positive; very often, it also has adverse consequences. These include unfair trade practices, such as:

- imposition by a DTP unfair conditions on users regarding mainly access to databases;
- unilateral introduction by a DTP of amendments to conditions of access to digital market or even effective prevention of such access, which also includes access to significant commercial data;
- playing a double role by platforms by facilitating access to market for other entities and simultaneously competing with them, which may lead to excessive promotion of the platforms' products or services;
- application of unfair equality clauses within the operation of DTPs;
- a lack of transparency regarding tariffs applied by platforms, the extent to which they use users' data or search results, which may entail losses for suppliers.[86]

In response to such type of problems, Regulation (EU) 2019/1150 of the European Parliament and of the Council of 20 June 2019 on promoting fairness and transparency for business users of online intermediation services was adopted and published in 2019.[87] The regulation applies to about 7,000 enterprises operating online, including primarily digital sales platforms, application stores, social media services and shopping comparison websites.[88] The key provisions include statements about fair treatment of all users of a DTP by formulating terms and conditions of using the platforms, taking into account requirements for, among others, plain and intelligible language, ready accessibility at all stages of commercial relations with a supplier or consideration of the effect of the terms and conditions on the control of intellectual property rights vested in users.[89] Similarly important are also provisions about vendors of DTP services which are obliged to inform users about the extent of access to personal data[90] and to ensure an internal system for handling users' complaints.[91]

The said regulation demonstrates that the situation on the global market of DTP is very dynamic and constantly changes. Transformations concern not only amendments to law but also types and character of offered systems, technologies, applications or online tools. Although such systems or technologies are developed by many diverse enterprises, the decisive impact on the global DTP market is exerted by the so-called "Big Five," or Google, Amazon, Facebook, Apple and Microsoft. In the coming years, the situation will completely change, in connection with the constant strengthening of the position of the corporations on the digital market, which offer more and more platforms and functionalities operating within them and additionally get involved in other segments of the market. It is worth pointing out that these companies show increasingly higher activity in the financial market, offering their users access to personal accounts through online communication platforms (WhatsApp for Facebook or Messenger by Microsoft).[92] However, the growing role of Chinese brand should not be overlooked. The global DTP market is first and foremost the five biggest players, or "Big Tech." It is important that the market is more and more bringing about a situation which may be referred to as *platform economy* or *online platform economy.*[93] This shows the constantly growing dependence of the world economy on DTPs.

Additionally, in the years to come, the global DTP market may undergo a far-reaching evolution. Even now, a strong tendency may be observed for DTPs to be based on an approach where designing is of utmost importance. Such an approach, based on the combination of business strategy and design thinking, makes it possible, first of all, to effectively build and develop business ecosystems as well as wide-ranging implementation of innovations, better understanding of customers' needs, placing an emphasis of cooperation, continuing experimentation and achievement of high flexibility level.[94]

2.5 Fields of Application and Achieved Benefits

DTPs may be employed in many diverse areas in which enterprises and the economy function. There seems to be simply an unlimited number of such areas now. This follows from the fact that ever newer DTPs appear all the time in the market, therefore the potential scope of their application in business practice continues to grow. Based on the typologies of DTPs presented in the previous section, it may be stated that the platforms are applicable in all business processes performed both inside an enterprise (production, internal transport, storage, information and document flow, human resource management, including training) as well as in the external environment (relations with stakeholders, cooperation within supply chains, sharing data and documents, procurement, sales of products and services on various markets, operation of distribution channels). According to A. Kosieradzka and K. Rostek, the key uses of contemporary digital platforms include operational management (access to knowledge, initiating and intensifying collaboration with other enterprises and scientific or consulting institutions, intermediation in technology sharing) and inter-organisational management (benchmarking of groups of companies, identification of training needs and organisation of relevant training courses and programmes, organisational learning).[95] In addition, DTPs perform activities, among others, in the area of education (e-learning platforms) and entertainment or in the public sector (PTP).

With regard to the operation of enterprises, R. Kapur indicates in particular that digital platforms allow for creating digital jobs, and thus digital organisations. In addition, such platforms may relate to such areas as: communication, cooperation, inter-organisational ties, information management strategies (collecting, analysing and monitoring information and data), roles and duties of organisation members, training and certification, crisis management, policy regarding innovations and increasing operational flexibility and efficiency, recruitment of employees.[96]

U. Dolata conducted an analysis of the most important fields of application of DTPs in relation to the functioning of the "digital giants," or Apple, Amazon, Facebook, Google and Microsoft. The areas are presented in Table 2.6.

The fields of application of the biggest DTPs in the world as presented above naturally do not exhaust all the areas. A greater number of those may be given, for example, for Google or Facebook platforms, they are marketing and advertising. The list of uses of DTPs in Table 2.6 aims to demonstrate in how many aspects of human activity and the business sphere such platforms may be used.

Table 2.6 Fields of application of DTPs using opportunities offered by the biggest technological companies in the world

Platforms	*Fields of application*	*Elements and functionalities of platforms*
Apple	• Media, entertainment	• App Store, iTunes Store, music streaming
	• Mobile technologies	• iPhone, iPad, iPod, iOS operating system, Safari Mobile web browser
	• Software and corporate equipment	• Apple-IBM systems
	• Cloud computing	• iCloud
	• Smart solutions	• Internet of Things (Apple Car)
	• Artificial intelligence	• Turi Create
Amazon	• Digital sales	• Amazon.com, Zappos.com
	• Media, entertainment	• Lovefilm.com, AmazonGames.com, Prime Instant Video
	• Mobile technologies	• Kindle (e-book reader), Fire Phone
	• Cloud computing	• Amazon Web Services
Facebook	• Media, entertainment	• Instagram (photography)
	• Communication	• WhatsApp
	• Software, virtual reality	• Oculus VR
Google	• Media, entertainment	• YouTube, Google Books, Google+ social portal, Picasa (photography)
	• Application stores	• Google Play
	• Mobile technologies	• Browsers Chrome and Chromecast, Android operating system
	• Smart solutions	• Internet of Things (smart home and car)
Microsoft	• Media, entertainment	• LinkedIn social network, Xbox console
	• Communication	• Outlook, Skype
	• Mobile technologies	• Nokia, Bing

Source: U. Dolata, *op. cit.*, pp. 12, 14.

What shows a very wide applicability of DTPs is the practice of implementing ETPs and PTPs, as mentioned above (in the EU – since 2003, in Poland – since 2004). These platforms are

> a great joint project of the European Commission, the industry, scientific and financial institutions, decision-making groups and the society to prepare development strategies for sectors of the economy important for Europe and technologies of the future. The initiatives are aimed to concentrate the efforts of key European partners to perform these strategies in the form of large scientific and technological projects. Technology platforms are expected to play a major role in the activation of research ideas and financial resources at the European level. One of the main tasks of the platforms is to be establishment of effective public and private partnership for the implementation of the developed strategies.[97]

Both European and Polish technology platforms form associations of "practically all the key innovative firms in Poland in priority sectors for the economy,"[98] making

it possible for them to take joint actions to perform innovative projects, including also in the area of implementing DTPs.

At present, in the territory of Poland, several dozen technology platforms are operating and their functioning covers many diverse fields. The following areas should be listed:

- new technologies having impact on radical transformation of sectors – nanoelectronics, hydrogen fuel and fuel cells;
- new technologies for manufacturing products and services – wireless and mobile technology, innovative medications;
- sustainable development – biotechnology, water supply;
- strategic sectors of the economy – aeronautics;
- traditional industrial sectors in the context of their development, modernisation and structuring – steel.[99]

Table 2.7 lists PTPs operating in the territory of Poland. There are 30 of them altogether.

Polish technology platforms are implemented within several fundamental areas, including energy, transport or biotechnology. It might be thought that it is just those areas that have been regarded in Poland as the most important from the perspective of using digital technologies and platforms, development factors for the economy. It should be noted that in the activities concerning PTPs, a very large number of entities participate including enterprises, scientific and research institutes or higher education institutions. It is a fact that all the PTPs may be classified as DTPs as they exploit digital technologies on a large scale, enabling them to establish cooperation between platform participants and to implement innovative solutions.

It should be added that ETPs and PTPs strongly support activities which contribute to (sustainable) development of the economy of the European Union. In this context, they should be associated with Europe 2020 Strategy,[100] where three mutually reinforcing priorities were put forward. In principle, each of them may be related to the system of building ETPs and PTPs because they describe kinds of growth:

- smart growth – developing an economy based on knowledge and innovation;
- sustainable growth – promoting a more resource efficient, greener and more competitive economy;
- inclusive growth – fostering a high-employment economy delivering social and territorial cohesion.[101]

Within ETPs and PTPs, it is crucially important to support any projects which are innovative in nature. Within the projects, the most important thing is to promote specific organisational solutions, systems or tools, including IT systems or tools, which aim to improve effectiveness and efficiency of the operation of enterprises conducting activity in various sectors as well as to reinforce cooperation between diverse entities. The effect is achievement of sustainable growth objectives referred to in Europe 2020 Strategy – owing to ETPs and PTPs, technologies may be

Table 2.7 Types of PTP operating in Poland

Thematic area	*Types of PTPs*	*Coordinators*	*Aims of activity*
Security	Work Safety in Przemyśl	Central Institute for Labour Protection – National Research Institute (CIOP PIB)	To increase work safety by implementing modern technologies
	Internal Security	University of Białystok	Automated voice recognition and text processing technologies
	Security Systems	Military University of Technology	Promotion of new technologies for security
Biotechnology, agriculture, medicine	Biotechnology	Jagiellonian Centre of Innovation (JCI)	Development of bioprocesses, production of biomaterials
	Innovative Medicine	Pomeranian Medical Academy in Szczecin	Supporting innovations in the production of new medicines
	Forest and Wood Sector	Wood Technology Institute (ITD)	Increase competitiveness and effectiveness of the sector
	Environment	Institute for Ecology of Industrial Areas (IETU)	Supporting projects for the protection of natural environment
	Food	University of Warmia and Mazury in Olsztyn	Development of new technologies for food production
Energy	Biofuels and Biocomponents	Automotive Industry Institute (PIMot)	Introduction of biofuels in Poland
	Nuclear Technologies	National Centre for Nuclear Research (NCBJ)	Performance of projects in the area of nuclear energy
	Hydrogen and Fuel Cells	Industrial Chemistry Institute (ICP)	Promoting hydrogen technology
	Sustainable Energy Systems and Pure Carbon Energy	Institute of Heat Technology at Warsaw University of Technology	Development of energy and fuel sector
Metals	Non-ferrous Metals	Institute of Non-ferrous Metals	Performance of research projects in the industry of non-ferrous metals
	Founding	Founding Institute	Development of founding technologies
	Steel	Institute of Ferrous Metallurgy	Development of steel industry
IT technologies	Photonics	PCO S.A.	Development of the photonics sector
	Opto– and Nanoelectronics	Central Technical Organisation (NOT)	Performance of research and projects in the areas of opto – and nanotechnology

(*Continued*)

Table 2.7 (Continued)

Thematic area	*Types of PTPs*	*Coordinators*	*Aims of activity*
	IT Technologies	Polish Chamber of IT Technology and Telecommunications	Implementation of innovative IT technologies
	Mobile Technology and Wireless Communication	MOST Foundation	Development of mobile and wireless technologies
Transport	Smart Transport Systems	Motor Transport Institute (ITS)	Development of smart transport Systems
	Aviation	WSK "PZL – Rzeszów"	Construction of new generation engines
	Space Technologies	Space Research Centre of the Polish Academy of Sciences (CBK PAN)	Development of new technologies for space activities
	Road Transport	Road and Bridge Research Institute (IBDiM)	Construction of electric cars and cars powered by alternative fuels
	Track Transport	Warsaw University of Technology	Production of new track vehicles
	Water Transport	Maritime Advanced Research Centre (CTO)	Development of water transport infrastructure
Advanced materials	Construction	ASM Market Research and Analysis Centre	Development of the construction sector
	Production Processes	Wrocław University of Science and Technology	Development of cutting-edge machines and devices
	Textile Industry	Łódź University of Technology	Development of the textile sector
	Advanced Materials	Institute of High-Pressure Physics of the Polish Academy of Sciences (Unipress, IWC PAN)	Supporting innovative solutions in the automotive, aviation and defence industry
	Sustainable Chemistry	Polish Chamber of Chemical Industry	Development of technology of chemical materials

Source: A. Siemaszko, M. Snarska-Świderska, "Polskie Platformy Technologiczne," [in:] A. Bąkowski, M. Mażewska, eds., *Ośrodki innowacji i przedsiębiorczości w Polsce. Raport 2012*, Polska Agencja Rozwoju Przedsiębiorczości, Warsaw 2012, pp. 169–172; B. Szumiec-Presch, *Utworzono nowe polskie platformy technologiczne*, http://laboratoria.net/aktualnosci/_item,3691,print,1.html [accessed 28 November 2019]; http://7pr.kpk.gov.pl/ppt/ppt.html-id=815.htm [accessed 29 November 2019].

implemented which allow for generating and using knowledge effectively, reducing resources necessary to perform production processes and also to create new jobs in sectors in which innovations are generated on a large scale.

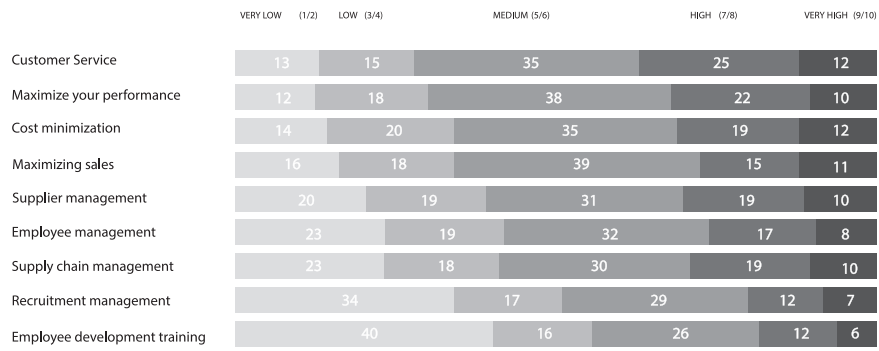
An example may be a European technology platform "Smart Grids" (ETP SmartGrids). Its major aim is to develop and disseminate a technology to make

it possible to supply electricity or, more broadly, to provide energy services, to consumers, using digital technology. In this respect, tools are tested and introduced within SmartGrids allowing for bi-directional energy flows as well as integration of dispersed sources, including those based on renewable resources. Due to this, it is possible to generate large savings, to ensure greater operating effectiveness of electricity systems (they are more resistant to failures) as well as to promote technologies which reduce greenhouse gas emissions (photovoltaic panels, small wind turbines or small hydroelectric power plants). This way, sustainable growth objectives are achieved, including those concerning environmental protection or innovativeness, effectiveness and competitiveness of enterprises.[102]

Describing fields of application of DTPs, it is also worth presenting data about to what extent such platforms are used within each sphere of enterprises' operation. Relevant data come from, among other sources, a survey performed in 2013 by Amarach Research and Deloitte on a sample of 201 decision-makers working in the IT sector in Poland (Graph 2.2).

In Polish companies, needs for using modern technologies, including DTPs, are satisfied the most in such areas as customer service (high and very high satisfaction level was declared by 37% of respondents), efficiency (32%), costs (31%) and vendor management (29%), while they are satisfied the least in employee training (low or very low satisfaction level was indicated by 56% of respondents), recruitment management (51%) or supply chain management (41%). The data show that digital technologies in Poland are used mainly to perform sales, procurement or customer service processes, while these technologies, therefore also DTPs, are needed most for human resources management.

The wide range of using DTPs in the modern economy follows mostly from the fact that they generate many benefits. In one regulation of the European Commission and of the Council, it is stressed that



Graph 2.2 Level of using digital technologies to meet needs of Polish enterprises according to a 2013 survey by Amarach Research and Deloitte

Source: Cyfrowa przyszłość Polski…, *op. cit*., p. 46.

> [o]nline intermediation services are key enablers of entrepreneurship and new business models, trade and innovation, which can also improve consumer welfare and which are increasingly used by both the private and public sectors. They offer access to new markets and commercial opportunities allowing undertakings to exploit the benefits of the internal market. They allow consumers in the Union to exploit those benefits, in particular by increasing their choice of goods and services, as well as by contributing to offering competitive pricing online, but they also raise challenges that need to be addressed in order to ensure legal certainty. […] Online intermediation services can be crucial for the commercial success of undertakings who use such services to reach consumers.[103]

Thus, DTPs, create grounds not only for growth of enterprises, offering them access to new markets, but also contribute to improvement of consumers' welfare by, for example, allowing them to purchase specific products or services at competitive prices.

Considering that the use of a DTP in many cases is associated with performing in enterprises system transformation, benefits generated due to the platforms largely result just from such transformation. It is mostly connected with:

- transformation of business processes which became completely digitised, making it possible to manage human resources more effectively, make better decisions, intensify cooperation with various entities and increase employee participation;
- redefinition of business models in which the major role begins to be played by development of digital products, extending activity to more and more markets in the world and also building new distribution channels shared by many entities;
- increasing effectiveness of customer service by gaining deeper insights on consumers, including their needs for products and services.[104]

E. J. Altman and M. L. Tushman indicated two main aspects of using DTPs. First, they allow for a considerable growth of interdependence among entities operating on the market, which includes all kinds of relationships, such as B2B or B2C. Second, the platforms, because of their openness, may be modernised and updated all the time, which in turn cause them, on the one hand, to group more and more programmers and users, contributing to the construction of business ecosystems, and on the other, to be continuously adjusted to ever changing market requirements or customers' needs. Thus, their operation is constantly optimised so that they are modern and be able to compete effectively with other IT systems or tools. This provides users with many benefits, including access to cutting-edge technologies.[105]

R. Telles broadly referred to the potential benefits that may be associated with the use of online platforms, including in the context of the above-mentioned sharing economy. According to him, the use of DTPs leads to the development of the

so-called *digital matching firms*. What this means is that organisations using DTPs are able all the time to make its offer flexible and update it to meet the needs of the market and customers, so the above "matching" should be understood as referring to the needs or to entering the world of digital economy. The related benefits, according to Telles, are as follows:

- offering lower prices to consumers, which is possible by using digital platforms connecting directly suppliers, producers and purchases, thus eliminating unnecessary middlemen (studies show that Uber rides, which involve the use of a relevant platform by drivers and their customers, are usually cheaper than traditional taxis, and it is similar with lodgings offered by the Airbnb platform);
- providing flexible employment schedules for enterprises, which follows from the fact that digital platforms operate all the time rather than during fixed hours;
- generating consumer demand for completely new products or services, which in turn may provide enterprises with opportunities for accessing untapped markets (which implies an increase in overall consumption, having a strong impact on the entire economy);
- opportunity for enterprises to leverage any underutilised resources;
- promoting a positive image of enterprises in the market as using DTPs shows that they take an innovative approach to business processes as well as that they care very much of their customers' needs;
- increasing trust between suppliers and producers on the one hand and consumers on the other, which may result, among others, from rating systems which are in place in many DTPs.[106]

E. G. Anderson, G. G. Parker and B. Tan focused mainly on that benefit of DTPs that is a greater cooperation and taking advantage of network effects in two-sided markets. Such effects, in their opinion, are achieved by establishing broad, long-term relations among companies, which creates possibilities for their intensification of research and development (R&D) activity.[107] In turn, E. Brosseau and T. Penard mentioned the following benefits: facilitating coordination of production and marketing of goods and information, which is possible, such as in the case of eBay, Amazon or Google, due to the construction of platforms assembled from components integrated strictly in accordance with specific, also non-standard, consumer needs; providing a wide access to all kinds of information; more effective customer service; effective management of the entire supply chain.[108]

The report by Aleo and Deloitte Indicates three major benefits that may be achieved by enterprises due to using DTPs in a B2B market. These benefits are as follows: the possibility of expanding activity and scope of cooperation with further business partners (DTPs provide access to customers or suppliers located in principle anywhere in the world), which in turn, in connection with opening the activity to the world, forces enterprises to demonstrate higher competitiveness in terms of quality and prices; an increase in effectiveness due to using the most

recent IT solutions (e.g. cloud services, making it possible to perform transactions efficiently); and also the possibility of using quantitative leverage allowing suppliers taking part in many transactions on the market to be able to offer highly competitive prices.[109]

B. Gregor, A. Łaszkiewicz, M. Stawiszyński described benefits following from the use of DTPs in the context of functioning virtual commercial exchange platforms. Among these benefits, they indicated mainly generating specific values, both tangible and intangible, for participants of such platforms and providing opportunities for initiating and intensifying cooperation between each link in the value chain.[110] In turn, A. Kosieradzka and K. Rostek, discussing communication and service platforms, stated that they make it possible to intensify cooperation among companies, including also in the area of good practices and knowledge promotion as well as to increase the level of their productivity and competitiveness.[111]

Many surveys have been conducted about benefits which may be gained by enterprises as a result of using DTPs. One of these was conducted in May 2017 among a thousand of US firms and was about the impact of innovative technologies, including digital platforms (mainly Facebook) on small businesses in terms of development or sales and about how entrepreneurs use these technologies. In the first place, it should be noticed that in the United States, the decisive majority of firms, at least according to the findings of the survey, use DTPs. The percentage of such companies is 84% (as regards information platforms) and 80% (as regards platforms to show products and services). Furthermore, 79% of firms use various digital tools to communicate with stakeholders, while 75% of them use platforms strictly for sales processes.[112] Such platforms, according to respondents, contribute to:

- attracting new customers (70% of responses);
- a general development of the company (67%);
- effective performance of processes connected with hiring employees (62%);
- increase in the level of sales (56%);
- opportunities for expanding activity, as a result offering products in entirely new markets (this also means internationalisation of activity) – 52%;
- growth of employment following from the firm's growth (42%);
- building a business in a comprehensive manner (32%).[113]

DTPs may therefore bring both to companies and consumers many different benefits. The most important of these seem intensification of relations, cooperation and connections between various market participants. Such intensification leads to increasingly broader globalisation of the contemporary economy and also makes it possible to increase quality and efficiency of performed processes, offer innovative products and services, create completely new business models strongly oriented to digitalisation and use highly competitive strategies. Significantly, such benefits translate to the whole economy, therefore positive influence of DTPs on the economy may be also observed.

2.6 Development Prospects Based on Artificial Intelligence

DTPs, because of being highly innovative, may also base their operation also on AI (artificial intelligence) technology. What should be noted is a gradual increase in the number of platforms where that technology has become to play a more and more important role.[114] According to a report by Accenture, the most important trends associated with digitalisation of the contemporary economy include first and foremost the dissemination of these AI technologies which, crucially, have an increasingly greater influence on the life of the society.[115]

The implementation of these technologies is accompanied by the willingness to adapt to DTPs, both those operating now and those being created anew. Such trends have been noticed in Poland, among other places, and also in the political circles. This is shown, among others, by the said project of "Policy for the Development of Artificial Intelligence in Poland for 2019–2027" and provisions of the Act on the Industry of the Future Platform Foundation,[116] as well as the document published by the Ministry of Digital Affairs entitled "Assumptions for the AI Strategy in Poland." In the document, it was stated that during the coming years, it would be necessary to build Polish Artificial Intelligence Platform (PPSI) on the basis of already existing resources stored in computation centres. Such platform is to be earmarked, among other things, for supporting activities taken by Polish enterprises to develop innovative products. This way, the platform will have not only scientific but also commercial character, providing grounds for the development of AI technology in Polish companies. It is very important because, as follows from the above document, Poland has so much computing power that its quantity is among the greatest in the world but this potential is not properly exploited.[117]

It is worth noting that within the operation of the Polish Artificial Intelligence Platform, some mechanisms of state aid for innovative firms are envisaged. What is also important is that the Platform is to be made up of many diverse functionalities and elements, thus bringing together many programming circles (for this, the Platform is to use SDK, or software development kit, to develop applications on the respective digital platform), and also is to be based on solutions applied in the biggest DTPs in the world (cloud computing, TensorFlow, which is an open-source software library). The Platform, however, is to make the AI technology developed in Poland independent, in terms of organisation or costs, from the biggest suppliers of computing power, such as Amazon, Microsoft or Google. Furthermore, it should be added that the Polish Artificial Intelligence Platform will get access to the Polish Data Integration Hub (KWID), which will enable it to use the resources found there. This is shown in Figure 2.4.

Based on Figure 2.4, it should be noted that the Polish Artificial Intelligence Platform (PPSI) is to generate profit mainly as a result of the possibility of integrating, analysing and using practically, also by innovative firms, the data which are collected now in the KWID. The data, even though their scope is large, are not applied properly now and only when the PPSI project is implemented will it be possible to change this state of affairs. The discussed project shows that artificial intelligence technologies may be applicable in platform systems and in that regard

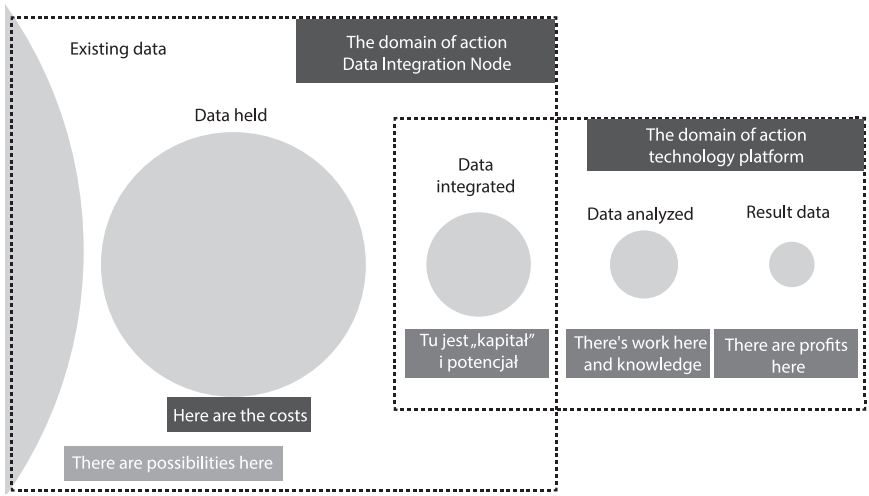


Figure 2.4 Planned architecture of the Polish Artificial Intelligence Platform with the use of the Polish Data Integration Hub

Source: Author's own work based on *Założenia do strategii AI w Polsce…*, *op. cit*., p. 33.

they appear to be very promising, at least in the context of the project of developing the PPSI.

The discussed document additionally draws attention to potential applications of AI technology in priority branches of the Polish economy. This is worth mentioning because in the course of the discussion, quite a few present uses of artificial intelligence within various digital platforms were listed. Due to this, we can have a general idea about the areas of companies' operation and of the entire economy where AI technologies may be used. The areas with specific examples are presented in Table 2.8.

Artificial intelligence has been already used on a large scale in many different areas in which the state and the economy function. This is applicable, for example, to logistics, which uses AI-based platforms which contribute to optimisation of logistics processes or commerce and marketing, where artificial intelligence is deployed, among other things, for effective positioning of customers and construction of marketing messages. What should be mentioned here is the Google platform, which uses, for example, RankBrain, an AI-based algorithm for generating in the search engine such results which will be strictly adjusted to users' needs.[118] The Netflix platform, providing access to a great number of films and serials, operates in a similar manner, using AI technology for recognising user preferences.[119]

Considering the constantly increasing use of artificial intelligence in DTPs, it must be noticed that these prospects look very promising. At present, work is being done on development or ongoing expansion of further platforms in which artificial intelligence will be used on a broad scale. This refers, for instance, to medical platforms making it possible to detect neoplastic diseases at early stages of growth.

Table 2.8 Fields of application of artificial intelligence within digital technology platforms

Area	*Examples of uses*	*Examples of DTPs*
Public administration	• Interactive service of citizens	• Platform used in North Carolina (US)
	• Optimisation of responses to crisis	• Platform operating in Cincinnati (US)
Cybersecurity	• Identification of future attacks, searching for gaps in systems, development of scenarios of online attacks	• Platforms by Cylance or Darktrace
Commerce and marketing	• Positioning customers and their needs	• Amazon
	• Designing and selecting products and services in accordance with customers' needs	• Travelling platform Wayblazer offering advice about interesting places to visit (advice is customised using data entered by users) • Trendage clothing platform
	• Construction of effective marketing messages	• Independent marketer Al Albert
Logistics	• Optimisation of the performance of various logistics processes	• Sensetra platform by CargoSense • Transmetrics cloud platform • Platform by Flexport
	• Traffic control in cities	• EcoStruxure platform by Schneider Electric
Industry	• Increase operating effectiveness of supply chains	• XTM platform by Infirera
	• Effective designing of industrial plants	• Autodesk software
	• Prevention of disturbances during production processes	• Platform by Seebo
Smart buildings	• Controlling smart home devices, optimisation of energy usage	• Google Nest Hub platform
	• Designing office buildings	• Autodesk software
	• Optimisation of office space utilisation	• CogniPoint platform by PointGrab

Source: Założenia do strategii AI w Polsce…, *op. cit.*, pp. 44–46.

In Poland, for example, the SARAH platform has been developed and it will be expanded by adding new functionalities in the coming years. In this context, it is worth adding that whereas the market for bioinformatics solutions was valued at approximately USD 7 billion in 2018, its value in 2023 is expected to increase to about USD 13.5 billion.[120]

It seems that the broadest prospects lie in the use of AI as part of the functioning of DTP in the form of machine learning (automatic self-improvement of machines with the help of acquired knowledge and experience), artificial neural networks (computer models of the brain which can analyse data and make inferences) or expert systems (which replace experts in the respective field). So, for example, the

platform of the Jupyter Notebook project is based on machine learning, making it possible to perform various computations with variables and to visualise output results of mathematical operations, therefore it is designed for data analysis.[121]

It should be stressed that the use of artificial intelligence within DTPs brings measurable benefits. For this reason, AI technologies will be used to an increasingly greater extent to increase the operating effectiveness of the platforms.[122] In this context, M. Ciesielski, referring to the example of Amazon, emphasised that that platform had just entered the area of finance but in this respect

> this applies primarily to those customers who have already made purchases on the company's platform and are willing to accept new offers generated with the application of artificial intelligence. It is more than 310 million customers, including 100 million participants of the Prime programme, which generates about one third of the giant's revenues. So far, though, Amazon Pay payment services have been used by 33 million people in 170 countries. But in five years, in the United States alone, the number of users may go up to 70 million, because as many as 65% of customers participating in the Prime programme, according to a survey by consulting firm Bain, would accept using their bank account on Amazon and the same declaration was made by 43% of the remaining customers of the corporation.[123]

The data show that the application of artificial intelligence within DTPs is definitely justified, which will undoubtedly contribute to a situation where the technologies will be intensively developed on the platforms in the years to come. Prospects in that area go very far, which follows from the fact that artificial intelligence brings plenty benefits (for example, optimisation of business processes, cost reduction) and is more and more commonly used in the contemporary economy.

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3 Innovative Changes to Business Models

3.1 Business Model – Theoretical Approach

The term of key importance for the discussion in this monograph is "business model." It is therefore necessary to examine it in depth to isolate its most important aspects from the point of view of innovativeness and the use of digital communication platforms.

First, the very term "model" should be defined. One of the basic definitions was formulated by J. Zieleniewski. The author stressed the fact that a model is a theory which allows for acquiring knowledge about the environment and also for using reasoning in which values of particular variables are changed to verify the impact of such operations on the remaining variables. In a model, it is important to manipulate diverse variables which are part of it. This way, a model becomes useful for the application of specific theoretical solutions to practical matters.[1]

According to B. Glinkowska, a model may be examined from two basic perspectives – structural and functional. Adopting the first perspective, the model is a construct with the use of which a certain object is represented, either real or abstract one. Therefore, such an approach stresses that a model has an instrumental function, demonstrating an object by revealing its specific characteristics. The functional perspective, in turn, emphasises that a model is a construct which in the course of cognitive operations and experiments replaces a specific real object.[2]

Z. Martyniak distinguishes three possible senses of the term "model." First, it may be perceived as a theory consisting of a set of statements which may be found to be true. In this meaning, a model may be not as much as a theory but also a supplement to or simplification of a theory. In the second sense, a model is a specific pattern, therefore a represented object. Finally, in the third sense, a model turns out to be a representation, so it should be treated as a representing object.[3]

In the scientific literature, a much greater number of definitions of a model can be found. There is no need to discuss all of them here. For example, it might be just mentioned that R. L. Ackoff thought that a model is a representation of a certain state, object or event, taking into consideration relevant characteristics of the reality; according to T. Gospodarek, a model is a coherent or complete system of arguments or logical sequences regarding a specific object or event; still, according to E. V. Krick, a model should be construed as something which allows for describing

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the character or behaviour of the respective original, so representing something, with the use of numbers, symbols, schematic diagrams and graphs.[4]

As far as a "business model" is concerned, it should be stressed that so far a great number of definitions of the term have been formulated and in general none of them can be regarded as fully comprehensive.[5] This is so because each author focuses on selected elements of a business model, in addition offering a different classification of such models.[6] In connection with this, it is worth presenting only some of the proposed scientific definitions of a business model. First of all, however, it should be noted that the term "business model" goes back to the 1950s.[7] It was then discussed mainly in reference to the *razor and blades model*, in which companies sell their own products at low prices, often at a loss, while the basic income is generated from selling goods and services complementary to the product.[8]

One definition of a business model comes from T. Doligalski. The author suggested that such a model is an image of a specific organisation captured at the respective moment which to a large extent pertains to activities aimed to create economic value and to internal mechanisms of the organisation's operation. This way, a business model may be treated as the essence of an enterprise and, first of all, as those aspects of its operation which are crucial for its strength.[9] A. Jabłoński stated that a business model should be regarded as a representation of a structure of relations which may be discerned in the respective organisation and its environment, with the proviso that it is a representation at a specific place, time and business space. According to that author, such a model is inextricably connected with factors which influence the satisfaction of the needs of customers, business partners or social organisations, which in turn condition the achievement of competitive advantage, making the most adequate decisions and unrestricted growth of the organisation.[10] According to B. Nogalski, a business model is a general conception of conducting business activity, which takes into consideration diverse aspects related to it. Primary importance among these must be attached to the value offered to the customer as well relations with partners, innovativeness or resources available to the organisation.[11] In turn, K. Obłój concluded that a business model is a concept relating primarily to the achievement of a dominant competitive advantage by an enterprise, its utilisation of its own resources and skills as well as configuration of a value chain.[12]

Definitions of a business model proposed by other researchers than the Polish authors can be seen to take a different or more developed approach to issues related to the essence of the model. This is shown, for example, by the definition proposed by A. Osterwalder, Y. Pigneur and C. L. Tucci. The authors underlined that a business model is a conceptual tool which makes it possible to present the business logic of a firm, including the way in which profit is generated from the created value. Such a model contains all the components of a firm and relationships observed between them.[13] According to A. Afuah and C. L. Tucci, a business model is the method of increasing resources adopted by a firm to offer its customers better value of products and services than its competitors and to achieve profit doing so.[14] A. A. Thompson and A. J. Strickland resolved that a business model refers primarily to streams of revenues, also future ones, as well as to the structure of

costs incurred by a firm or the level of margin. In most general terms, the authors noticed that a business model amounts to relations between a firm's revenues, costs and profits.[15] In turn, E. Fielt stressed the fact that a business model should be regarded as the logic of an organisation's operation primarily in terms of how it creates customer value.[16]

M. Morris, M. Schindehutte and J. Allen indicated that it is possible to sort out the basic approaches to a business model. Having analysed thirty definitions, the authors concluded that a business model may be viewed from the economic, operational or strategic perspectives, with each of them involving a unique set of decision variables affecting the business model's construction. In the economic perspective, a business model describes how the firm generates profits or how it makes money and sustains its profit stream over time. In this perspective, the decision variables include revenue sources, cost structures, margin level or company valuation methods. The second, operational, perspective assumes that a business model refers to all the internal processes making it possible for the firm to create value. In this approach, the key decision variables include production and administrative processes, resource flows or service provision methods. Finally, in the strategic perspective, a business model pertains to all the aspects of the firm's operation related to its growth, market positioning and cooperation with other entities. This perspective also considers the firm's vision and values. Furthermore, according to the authors, using any business model, regardless of the perspective, should lead to the achievement of a sustainable competitive advantage.[17]

According to S. Slavik and R. Bednar, business models should be described in two perspectives – purely economic (*economic business model*) as well as in that which combines the financial aspects with creating value (*economic and value business model*).[18] Examples of defining a business models from these two points of view are presented in Table 3.1.

An interesting approach to the essence of a business model was proposed by S. M. Shafer, H. J. Smith and J. C. Linder. In particular, the authors described the term, taking into account key words used in its numerous definitions. These key words were put in four groups. They relate to the following aspects:

- strategic choices – in this respect, a business model is about customers, strategy, mission, revenues or competitors;
- creating value – resources, assets or processes;
- capturing value – financial issues concerning the relation between costs and profits;
- value network – relationships with customers and suppliers, product, service and information flows.[19]

In turn, A. Osterwalder and Y. Pigneur distinguished many elements making up a business model. They are presented by the authors within four areas of business activity. Such elements within the infrastructure are key resources, activities and partners, and for customers – customer segments (potential recipients of the organisation's offer), relationships with them as well as distribution channels

Table 3.1 Example definitions of ***economic business model*** and ***economic and value business mode***

Definition authors	*Business model*
Economic business model	
H. Chesbrough	Framework to link new ideas and technologies to economic outcomes
D. Debelak	Instrument by which a business is able to generate profits
A. Ganbardella, A. McGahan	Mechanism for transformation of ideas to revenues
J. Mullins, R. Komisar	Basis of economic activity in all its aspects regarding cash flows
T. Wheelen, D. Hunger	Method for making money in business activity, in which specific characteristics of the company are of key importance
Economic and value business model	
J. Magretta	Description of how an enterprise is able to earn money, who its customers are and how to deliver specific value to them
M. Rappa	Method of doing business by which a company can generate revenue and create value
D. J. Teece	Tool for defining methods of generating value to the customer
D. Watson	Description of a company's operations, including all of its processes and functions which result in value for the organisation and customers

Source: S. Slavik, R. Bednar, *op. cit.*, pp. 20–21.

(communication with customers and ways of delivering them value propositions), with respect to the offer – value proposition (a bundle of products and services bringing specific value to customers), and with respect to financial position – revenue streams and cost structure.[20]

As shown by the definitions presented above, a business model is a term which may be understood very broadly. In addition, it is possible to distinguish various theories of business models which, significantly, are considered to be part of business management theory. An example may be the economic theory of the firm and business model approach to financial reporting. This invokes the said economic business models. Here a business model is examined from the point of view of three aspects associated with the activity conducted by the organisation. They are as follows:

– financial reporting should be a kind of test on practical execution of a specific business model;
– historical cost may be the most reliable measurement when the business model is to contribute to the development of new assets or services;
– fair value may be the most effective measure when the business model involves buying and selling some assets using changes in market prices.[21]

One of the approaches within business management theories which is used more and more frequently by companies is a tool for business model generation known as the Business Model Canvas. It is a template which shows how to do business to

generate concrete real benefits. The concept is based on a logical juxtaposition of elements making up a business model so as to present a full picture and to facilitate planning processes and assessment of changes to the model.[22]

According to the author of this concept, A. Osterwalder, the basic task of a business model is to describe the rationale of how an organisation creates, delivers and captures value.[23] The rationale refers to customers, finance, infrastructure or offer. And the business model should be presented on one sheet of paper ("Canvas") to simplify its construction as far as possible and, at the same time, show its essence in an innovative manner. It is just for this reason that the concept is increasingly more used in business practice.[24] A template according to the concept of Business Model Canvas is presented in Figure 3.1.

The Business Model Canvas is made up of nine building blocks which are strongly interconnected. The point of departure are customer segments and the related value proposition.

Summing up, it should be emphasised that a business model is defined in many aspects, also as a concept for conducting business activity, an image of the organisation's operation or the way to achieve competitive advantage based on generating profits and creating value. Such a model may be explained using business management theories (the economic theory of the firm and reporting, the Business Model Canvas), and furthermore even a business model itself may be regarded as a separate theory.[25] All of this show its high complexity and great relevance to the functioning of today's organisations.

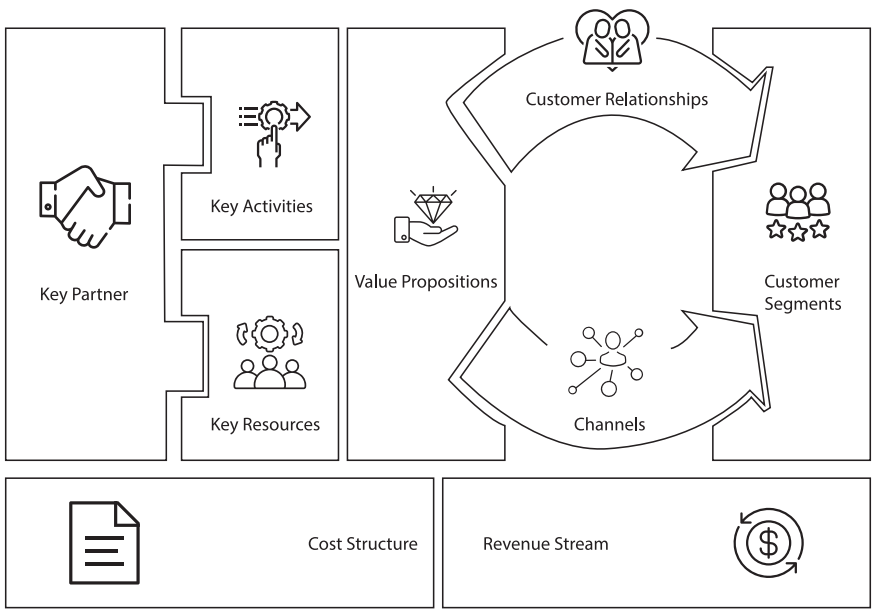

Figure 3.1 A template according to the concept of Business Model Canvas

Source: author's own work based on J. Bis, *op. cit.*, p. 59.

3.2 The Essence of Innovative Organisation

The implementation and use of digital technology platforms (DTPs) are possible mainly due to the existence of innovative organisations. For this reason, aspects related to the functioning of such organisations should be also discussed.

First, the terms *innovation* and *innovativeness* (or *pursuit of innovation*) should be explained as they may help understand the essence of an innovative organisation. The term *innovation* (the word comes from Latin, innovatio means "renewal," while *novus* stands for "novelty"[26]) and it should be underlined that the term was used for the first time in scientific literature by Joseph Schumpeter in 1911 in *The Theory of Economic Development*.[27] He observed that innovations are any organisational or technological changes which may be recognised as manifestations of the first use of the respective product or method of production.[28] Additionally, Schumpeter listed five cases in which it is possible to talk about innovations:

- introduction of a new commodity or a new quality of the commodity which has already been available on the market;
- introduction of a new method of production, or one not yet used in a specific branch of industry;
- opening of a new market, or a market into which the particular branch of industry has not previously entered (whether or not this market has existed before);
- acquisition of a new source of supply of raw materials or half-manufactured goods, irrespective of whether this source has already existed or not;
- introduction of the new organisation of the respective industry, such as, for example, the creation of a monopoly position or the breaking up of a monopoly position.[29]

At present the term innovation has become crucial because of the ever-growing degree of competitiveness in any market and in any economy and continuously changing needs and preferences of customers, which in turn makes it necessary for entities conducting business activity to seek any sources of advantage. One of such sources is innovation,[30] which is at present defined in many different ways. In this respect, the approach by C. Freeman is very important, which, although formulated still in the 1980s, is still regarded as correct. He defined an innovation as "the first commercial transaction involving the new product, process system or device."[31] M. Haffer believes that innovation refers to all the changes which at a given time and in a given location are perceived as vehicles of novelty, whether they pertain to physical or non-physical goods.[32] M. C. Schippers, M. A. West and J. F. Dawson said that innovation means the intentional application within an organisation of processes, products, procedures or ideas which follow from creative attitudes and are new to that organisation and its members and which are designed to bring measurable benefits.[33] In turn, according to M. E. Porter, examples of innovation should include a new product design, implementation of a new production process, application of a new marketing approach or conducting training in a new way.[34]

Even though the two terms are related, *innovativeness* should be distinguished from *innovation*. This is because the latter refers primarily to processes of implementing innovations and showing an organisation's ability and willingness to adopt or develop new products, solutions and technologies.[35] Innovativeness, in management sciences, is also perceived as all new organisational systems and creative changes which lead to generating value both for intelligent organisations and for any of their stakeholders.[36] Therefore, whereas innovation should be regarded as the use of innovative solutions, innovativeness is the ability or property of an organisation or specific persons leading to the implementation of such solutions.

Based on the above definitions, an innovative organisation (firm) is one which implements some innovations and is characterised by innovativeness. In addition, according to E. Stawasz, an entity may be regarded as an innovative organisation only when it has applied at least one innovation during last three years.[37] Importantly, while within the EU methodology it is assumed that an organisation may be considered to be innovative even if it implements an innovation affecting only the organisation itself, the OECD's Oslo Manual stresses that such an innovation should be at least on a national scale.[38]

The above perspective amounts to the simplest, general approach to the issues of the essence of innovative organisation. Therefore, other approaches to the topic may be referred to. A. Sosnowska, S. Łobejko and A. Kłopotek stressed that an innovative organisation is an intelligent unit which continually generates and implements innovations, thus showing modernity and competitiveness, and also any actions taken by it as well as its management structure are subordinated to the performance of tasks connected with innovativeness. Consequently, an innovative organisation is one which during its operation attaches considerable, and frequently even critical importance to demonstrating its innovativeness.[39]

It should be observed that in the scientific literature, an innovative organisation is defined in many different ways. For example, it should be mentioned that it is presented, among others, as an organisation which is[40]:

- intelligent – during its operation, it carries out, on a large scale, activities promoting new management and development models, including improvement of employees' competences and their continual learning as well as strengthening cooperation in working teams[41];
- learning – in such an organisation, continual growth of employees is promoted and they are engaged to perform activities aiming at innovativeness[42];
- agile – such an organisation is characterised by being capable of adjusting quickly to the changing conditions and responding effectively to transformations in the environment, so the organisation is fast and flexible; in addition, such an organisation places a great emphasis on a synthesis of various technologies, deployment of key competences and high product quality, achieved, among others, as a result of innovativeness[43];
- virtual – it is a form of cooperation of enterprises aiming to achieve specific objectives, including those connected with the implementation of some innovative projects and ideas.[44]

A variety of expressions describing an innovative organisation shows without any doubt the complexity of aspects of such an organisation's operation. At this point, it is worth presenting the fundamental characteristics of an innovative organisation. According to A. Sosnowska, S. Łobejko and A. Kłopotek, they include:

- capability for generating new solutions, resulting from great creativity of employees;
- keeping a sufficiently expanded team of innovators;
- skills of exploiting the innovative potential of an organisation to maintain or increase its competitiveness in the market;
- ability to predict future as part of thinking long-term;
- flexibility with respect to adjustment to ever changing conditions in the environment;
- maintaining contacts with customers on an ongoing basis, which aims to get to know their present and future needs;
- continual collection of information necessary to make the right decisions.[45]

L. Białoń, in turn, pointed out that an innovative organisation is characterised mainly by reporting the need for innovative ideas, including findings of research and development work, or for licences. Such an organisation perceives the connection between presenting itself to be innovative and achieving competitive advantage therefore its activity in the area of implementing innovations continually increases, which thus contributes to generating new values and making the entire economy more modern. An innovative organisation is also distinguished by its capability for developing new (technological, organisational, market) knowledge and related skills as well as accumulation of intellectual capital of those employees who are highly qualified, competent, active and creative. Furthermore, it should be noted that an innovative organisation creates completely new standards of behaviour, both in terms of internal relations and contacts with other market participants. These standards include promotion of broad cooperation with any stakeholders in the area of development and implementation of innovations.[46]

Only if the respective organisation has the properties described above can it be regarded as innovative. It must be pointed out then that not only generating innovative ideas but also demonstrating skills of exploiting innovative potential of innovators, who are employees of the organisation, and developing positive relationships with customers – all of the above make the organisation to operate in the atmosphere of innovativeness and thus is able to build competitive advantage in the market. What should be regarded as innovative activity, according to Statistics Poland (GUS), is the operation of such an organisation which includes

> all scientific, technological, organisational, financial and commercial activities which lead or are intended to lead to implementing innovations. Some of the activities are innovative in nature while other ones are not novelties but are necessary to implement innovations. Innovative activity also includes research and development (R&D) activity which is not directly connected with development of a specific innovation.[47]

With respect to the operation of innovative organisations, various models of conducting business activity may be discussed. At present, however, the *open innovation model* is most often selected as one which may contribute to the greatest extent to the success of innovative activity. The model is the opposite of the traditional closed approach, which prevailed still in the second half of the 20th century and whose fundamental feature was implementation of innovations only at the level of an enterprise.[48] In the open model, it is postulated that various organisations should establish cooperation as broad as possible with other entities to develop and apply innovations. This may involve sharing knowledge, selling licences or acquiring specific solutions from other organisations. Just due to that, according to W. H. Chesbrough, it is possible to create appropriate conditions for an organisation's growth. The open innovation model allows for using any development opportunities which are opening up and draw knowledge collected by other organisations, which forms grounds for implementing ever more effective and functional innovations as well as for minimising risk and reducing costs of implementing innovations.[49]

At present, what is promoted for the operation of innovative organisations is openness in innovation management. Such openness is characteristic not only for the open innovation conception as described above but also for the so-called *triple helix theory*, developed by H. Etzkowitz. Its major assumptions are presented in Figure 3.2.

The discussed theory assumes that the key role in implementing innovations is played by cooperation which should be established between three kinds of entities: business, scientific units (universities, research and development institutes) and public administration bodies. This is because such collaboration may bring about synergy and network effect, reinforce mutual relationships between various innovative organisations and provide them with appropriate conditions for generating new ideas, which may be effected by promoting and implementing relevant policy at the national or local government level (public administration) and allowing for participation in research projects (scientific units).[50] However, public

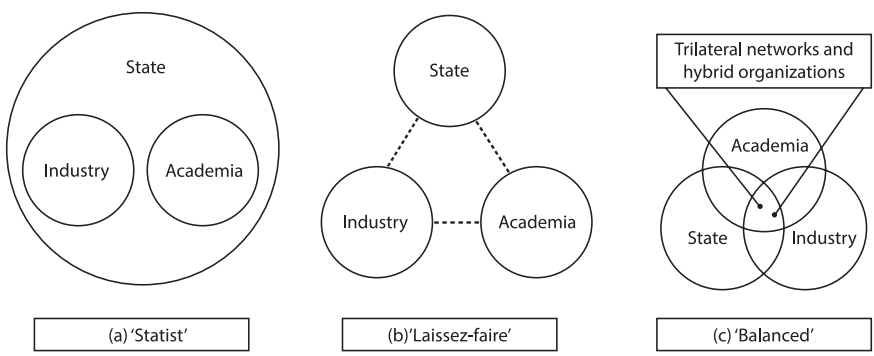

Figure 3.2 Triple Helix Theory

Source: author's own work based on M. Ranga, H. Etzkowitz, "Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society," *Industry & Higher Education* 2013, vol. 27, no. 3, p. 239.

administration has the most important role in the practical implementation of the triple helix theory as it is supposed to take actions to develop relationships and intensify contacts between all the three spheres – state, science and industry.[51]

To sum it up, it should be stressed that an innovative organisation is one which is able to efficiently create and implement various ideas, solutions, concepts or management methods. Doing this, the organisation shows its high flexibility. Its innovativeness has impact on its achievement of competitive edge on the market.

3.3 Concept and Model of Digital Business

At present, in the age of ubiquitous computers and the widespread Internet, the concept of *digital business*, whose name somewhat recalls *e-business*, is more and more frequently promoted. In the most general terms, digital business is a method for performing or transforming business processes to use for them diverse online technologies. Such processes include not only procurement, production, sales, marketing or distribution but also the research and development sphere. It should be emphasised that one of such processes is e-commerce, or performing purchasing or selling transactions online.[52]

Digital business is currently regarded as one of the models of doing business in the market. In this respect, C. Zott, R. Amit and L. Massa observed that it is possible now to talk about three basic perspectives (models) for conducting business activity, including digital business. These perspectives are as follows:

- the entire enterprise – this perspective involves performance of a strategy focused on creating value and achieving competitive advantage;
- technological enterprises – this concerns management of innovations and technologies;
- online businesses – this covers ways of using the Internet in organisations, exploiting IT systems and conducting business activity.[53]

Even though all the perspectives may be adopted for digital business, the latter two match this type of business most closely. This is so because organisations doing this kind of business demonstrate, due to the use of various technologies, a high level of innovativeness, and also operate on the basis of e-business and information systems. A digital business model, then, is closely connected, in turn, with an innovative way of an organisation's operation, and on the other, with using diverse technologies, also Internet ones.

M. Cigain and U. Riss believe that digital business is a model for doing business in which IT technologies predominate. Furthermore, the researchers distinguish two possible variations of the model. The first, *digital business model*, refers to the situation where digital technology dominates in the area of creating value. This way, technology has impact on the whole business model, including the range of products and services offered by the organisation and its creation of value for the

customer. The second, *digitally enabled business model*, includes models in which at least one component functions on the basis of digital technologies.[54]

In a digital business model, at present, a special role is assigned to tools referred to by the acronym SMAC. This is derived from: *social* media, *mobile* technologies data *analytics* and *cloud* computing.[55] It is SMAC that is considered to be a group of factors which has contributed to the greatest extent to the growth of digital business. And considering that, in principle, for each of the components of SMAC, DTPs are of key importance, it is such platforms that should be regarded as the basis of digital business.

A digital business model is characterised by several basic aspects. According to E. Brousseau and T. Penard, one of those is that the models are based on activities which are modular in nature. This is about offering to customers basic functions and packages of extra services they may use, but, importantly, each of the services referred to as modules usually does not generate any value. It may create value only if integrated with other elements of the model. In addition, in digital business, frequently customers themselves take part in generating knowledge and acquiring information, so it is customers that are assigned a special role in the performance of business processes.[56]

It should be underlined that the digital business model now, as any other business model, is being built on the basis of specific business strategies. Here digital business strategies (DBS) become crucial.[57] For them, using digital resources to generate new value becomes highly important, but such strategies typically amount to some kind of combination or integration of IT activities and business strategies.[58] Digital strategies are distinguished by including digital technologies and digitalisation processes as means of implementing specific changes or improvements within an organisation in order to generate new value.[59] In this context, S. Łobejko stressed that

> to achieve success in the contemporary digital world, a company should have a digitalisation strategy, combining digital technologies with information and knowledge resources and physical assets. Digitalisation modifies deeply the strategic approach to competition, conducting business activity and efficiency in various industries. It delivers new ways of creating value for the company, consumer and the whole economy. The impact of digitalisation is felt not only by technological firms but also remaining ones, irrespective of sector or industry.[60]

A digital strategy is much more advanced than a traditional IT strategy because of many diverse factors. First of all, it should be noted that a digital strategy covers digitalisation of products, services and information, and it performed not only in the course of traditional business processes and functions, but also contributes to a considerable expansion of the activity carried out by an organisation. It may be called then a "transfunctional strategy," but it is typically based on intensive data

and information sharing effected mainly through digital platforms. If follows from this that digital business and the related implementation of digital strategies would be impossible without these platforms.[61]

Digital business may be conducted on the basis of many different models. According to M. Kardas, these models include:

- *manufacturing model* – use of the Internet by organisations to initiate direct relationships with customers;
- *brokerage model* – in this model, organisations create virtual markets for performing purchase and sale transactions with brokers usually collecting commission for arranging these transactions;
- *merchant model* – sale of products or services through the Internet or together with traditional distribution channels (for example brick and mortar facilities);
- *infomediary model* – collecting, processing data of customers and manufacturers' offers by organisations which provide the information for a fee;
- *advertising model* – generating revenues by improving the attractiveness of websites;
- *affiliate model* – reaching broad masses of customers by establishing cooperation with affiliated partners who add links to the organisation's portal on their websites;
- *subscription model* – providing a periodical access to digital services in exchange for payment;
- *utility model* – it is a model similar to the subscription model, with the difference that the amount of fees for using digital services depends on their actual use (for example, a fee for some quantity of downloaded data);
- *community model* – using voluntary workers to perform marketing activities.[62]

An attempt to distinguish the most important digital business models used the most frequently in the market was also made by H. R. Varian. Their descriptions are given in Table 3.2, but it must be added that they refer mainly to the business models involving distribution of digital content which can be sent over the web (music, films, books, games).

H. R. Varian provided a classification of digital business models with different ways of marketing, selling and distributing digital products. In such models, it is possible for an organisation not only to perform these processes on its own but also with the aid and support of business partners or even state administration (public support) or customers themselves (e.g. the "ransom" model).

Summing up, it should be said that digital business, understood as performing business processes based on various technologies, mainly online ones, may be implemented within many different models. The ones described above do not exhaust the related topics, and furthermore it is important that changes to the models are made aiming to increase their innovativeness. Such changes take place mostly owing to the operation of DTPs. Issues connected with the changes will be discussed in the next section of this work.

Table 3.2 Types of digital business models according to H. R. Varian

Model name	*Description*
The original cheaper than a copy	Sales of digital products considerably cheaper than in regular distribution by, for example, adding them as extra items to newspapers and magazines
A copy more expensive than the original	Use of technological of legal protections by manufacturers
Physical complements	Various additional items supplied with digital content, for example a T-shirt or a code for free music downloads to promote a CD
Information complements	Providing users who have been given digital content for free with additional components or services (for example access to new functionalities) for a fee
Subscriptions	Regular delivery of specific content in exchange for a fee
Personalised version	Adding to purchased content original exceptional items
Advertise yourself	A digital product delivered free of charge is an advertisement for the same product in physical form available for a fee
Advertise other things	Broadcasting advertisements related to digital content, for example on an Internet portal
Licences	Collective fees for groups of users
Ransom	Potential users bid for content which is provided if the total amount of the bids is sufficiently high, for example, Stephen King offered instalments of his book *The Plant* and then indicated he would continue posting instalments after receiving payments of a specified amount
Public provision	Co-financing the publication of digital content by public institutions or the European Union
Prizes, awards and commissions	For example, commissions from public institutions

Source: H.R. Varian, "Copying and Copyrights," *Journal of Economic Perspectives* 2005, vol. 19, no. 2, pp. 134–136.

3.4 Innovative Changes to the Business Model Based on a Digital Technology Platform

Business models are subject to continual transformations and, which is especially important for the thematic area of the work, DTPs have a great impact on them. First, it is necessary to stress, as mentioned by C. M. Olszak, that nowadays, to increase their innovativeness and competitiveness, many organisations draw up digital strategies. Such strategies become the point of departure for innovative business models which are based on digital resources. In addition, such models typically go beyond the traditional view of the role of IT in a company's activity; instead, they demonstrate implementation of a *resource-based view* and are strictly connected with generating value for the company and its stakeholders. This way, the major reason for implementing modern business models, also those based on DTPs, are limitations of the traditional models, the development of technologies and a greater awareness of these among business users.[63]

Innovative changes to business models are introduced to a great extent due to establishment and growth of DTPs. In this context, it needs to be noticed that, as for example in the media industry, there has been a gradual convergence of many different tools and channels to create large integrated platforms. The changes were also connected with the appearance of new communication channels, including those based on mobile technology. In addition, such channels made it possible to develop new business models.[64]

The changes described above may be traced by analysing stages in the development of the SMAC technology. This is discussed in Table 3.3.

The development of SMAC technologies, which affect considerably the creation of innovative digital business models, would not have been possible without DTPs. This is because these technologies have been accompanied by the emergence of such platforms, ensuring, among other things, exploitation of networked effect or convergence as well as a greater scope of offered services and functionalities. It may be concluded then that owing to DTPs, the approach which prevails in the contemporary business models is based on promoting cooperation and partnership between various entities to achieve specific business objectives.

Such an approach assumes a gradual replacement of hierarchical and vertically integrated management structures or supply chains in favour of network

Table 3.3 Stages in the development of the SMAC technology and the related role of DTPs

Type of technology	*SMAC 1.0*	*SMAC 2.0*	*SMAC 3.0*
Social media	Creating conditions for faster communication between acquaintances	Development of DTPs oriented to communication among all people and creation of new marketing channels	Integration of platforms with CRM (*customer relationship management)* systems to increase the level of cooperation with consumers
Mobile technologies	Development of BYOD (*bring your own device*) concept, or use of private mobile devices by employees for the needs of an organisation	Increase in mobility of employees because of using increasingly greater number of devices	Cooperation of employees from various organisations within digital technology platforms
Big data	Description of present trends with the aid of a great amount of data	Setting future trends based on complex DTPs designed for data analysis	Integration of many different tools, including DTPs, to make data analysis more efficient
Cloud computing	Cloud testing	Development of cloud uses	Uploading more and more amount of data in a cloud, development of cloud management

Source: SMAC 3.0: digital is here. Enterprise IT trends and investments, Ernst & Young LLP, Kolkata 2015, pp. 14–25.

organisations which show a divergent level of formalisation of relationships between various entities. Such organisations operated very frequently on a global scale, which is possible due to latest technologies, including also those involving DTPs. Modern business models, however, focus not only on increasing collaboration between organisations but also on reinforcing interactions with customers. In such models, it is not just a company itself but also the customer that generates specific values for the company. They might concern the customer's comments or recommendations about what should be done by the organisation to effectively meet consumers' needs and requirements to a greater extent than so far. This is what recommendation and opinion systems, commonly used in many DTPs, are for. In this context, W. Rudny stated that "analysis of business models of many companies that have achieved a spectacular market success shows a reconstruction of the models with the use of digital technologies for mutual communication with customers and joint creation of values."[65]

E. Brousseau and T. Penard noticed that the contemporary business models which are digital in nature, do not entail changes only in the digital sphere. The authors indicated that the changes should be perceived as "intermodal" or such that are visible in various areas of a company's operation. The changes then concern not only digital content but also physical products and services and the related infrastructure. What is more, digital business models to a large extent "are crossed" with traditional models, which thus bring about implementation and use of new marketing strategies also in the industries not directly associated with the digital market. This shows a great complexity of changes caused in modern business models, also on the basis of the functioning of DTPs.[66]

The aim of innovative changes within the present business model based on the platforms is mainly to ensure quality and timeliness of services at the highest possible level so that diverse expectations of customers are met and, simultaneously, the platforms receive satisfactory, increasingly higher profits. In such a model, the aim is to make customers autonomous so that they are able to have influence on the shape of the respective product or service, thus generating value for the platform or the organisations creating it. What is also very significant is personalisation of the offer addressed to customers (the platforms make it possible to configure products and services, not just use ready-made packages), algorithimisation and automation of product and service sales (many choices about the shape of products and services are made automatically by various platforms based on various algorithms, which makes it easier for customers to purchase goods) as well as providing customers, within specific platforms, with access to content in the widest possible scope rather than to selected works or book files only (e.g. *video on demand* services). In turn, what should be mentioned is the development of *curated computing* model, based on which the App Store platform operates. Such a platform contains digital content selected strictly on the basis of consumers' needs, which makes it possible to prevent the problem of consumers having an excessive amount of such content and being unable to choose items which would match their preferences as closely as possible. Both models, *video on demand* and *curated computing*, in spite of differences, are responses to more and more rapidly changing consumer needs.[67]

In connection with increasingly strongly progressing digitalisation and implementation of recent technologies or management methods, organisations applying traditional business models (referred to as "incumbent") start to be gradually driven out by entities using innovative business models. This situation is described in terms of a phenomenon known as *uberisation* (from Uber, a company which has introduced a simply revolutionary way of offering transport services based on a DTP). This phenomenon causes the dissemination of modern business models, i.e. those which lead to supplanting patterns and methods of functioning on the market which have worked well to date. These new models are referred to as *hyper-disruptive business models.*[68] A description of the most important of them is found in Table 3.4.

The innovativeness of the business models described above results not only from the fact that all of them use advanced technologies, including frequently

Table 3.4 The most important hyper-disruptive business models

Model name	*Description*	*Examples of platforms using the model*
Access over Ownership	Using products and services without the need to purchase them	Panek CarSharing and Zipcar platforms for car rental for minutes
Experience	Persuading users to purchase products and services for higher prices due to positive experience of previous purchases on the respective platform	Apple, Tesla (platform of the manufacturer of electric cars)
Freemium Model (free + premium)	A product or service are available free of charge but fees must be paid for using additional, expanded functionalities	Dropbox (data storage), Skype, Spotify (access to music)
Free Model	Free access to products and services in exchange for being forced to view advertisements and send data about the user's preferences and behaviour in the digital market	Facebook, Google
Hyper market	E-commerce companies	Amazon, Zalando
Market place	Operation of a platform designed for performing purchase and sale transactions by other entities	Alibaba, eBay
On demand	Offering products and services instantly as soon as demand for them arises	Netflix, Uber
Subscription model	Fixed fee for using a product or service	Kindle (platform for reading e-books), Netflix
The ecosystem	Creating a closed ecosystem, which causes users to be in a way forced to get other products and services available on the respective platform	Apple, Google
The pyramid	Offering products and services by different organisations from those which manage the respective platform	E-stores, such as Amazon

Source: J. Pieriegud, *op. cit.*, p. 19.

artificial intelligence. Such innovativeness also follows from a novel approach to responding to consumers' needs and requirements. Many business models and DTPs concentrate on providing customers with access to the widest possible range of products and services, including those offered by different companies from the entities managing the respective platform (Amazon, eBay), on offering goods which may well be expensive but match closely consumers' preferences (Experience model), on starting to provide a service instantly when it is demanded (video on demand) and even on free access to various services (Google, Skype).

In this respect, it may be observed that the concept of *sharing economy*, which amounts to a practical application of the Access over Ownership model, is becoming more and more popular, also in the Polish society. The above concept makes it possible to borrow or rent a good without making a purchase to own it. This is also an innovative approach to implementing business models as it is based on increasingly widespread belief in the society that the resources available in the environment are being depleted and cannot be replaced therefore people should take care of them without consuming them needlessly. Consequently, platforms for sharing goods between users are becoming more and more popular, for example BlaBlaCar (sharing a car), Airbnb (sharing accommodation) or EatWith (cooking meals).[69] It should be added that the operation of such type of platforms as well as the Market Place model are both manifestations of *economics of intermediation*, in which a platform serves as an intermediary between users who want to make a purchase or sale or exchange goods.[70]

At present, DTPs have much more uses than those described above. As a result of this, further business models are being developed. According to W. Szpringer, the most innovative of those, except for models earmarked for e-commerce or for sharing technologies or software with users, include the following:

- *crowd financing* – in the model, a platform is used to search for sources of financing as well as collaborators and new customers and markets (for example, Kickstarter);
- *micro-manufacturing* – the model makes it possible to design and manufacture goods using tools available online (Ponoko, MakerBot Industries);
- *innovation marketplaces* – in this model, various organisations have the opportunity to purchase technologies (InnoCentive, NineSigma).[71]

Therefore, innovative business models based on DTPs also make it possible to transfer technologies between various organisations or even to arrange manufacturing processes. Owing to these models, enterprises active in diverse industries are provided with opportunities to initiate and intensify activity.

Innovative transformations of business models based on the operation of DTPs also include the development of the said ecosystems. This is the aim of, among others, the PFI model which is being more and more commonly used. This model allows organisations to plan and perform innovative activities, including to make a decision how to implement them, that is either on their own or in cooperation with another enterprise. If cooperation is chosen, then an ecosystem is gradually created,

having in its centre a digital platform which is characterised by interoperability and the possibility of expanding it all the time.[72]

The innovativeness of business models which exploit the possibilities offered by DTPs is also connected with issues concerning leadership 4.0. Such leadership must fully respond to the challenges posed before organisations by digitalisation. This way, every manager, apart from traditional competences, must also have be able to use new digital media effectively in the course of ongoing activity, also for communicating with employees and for adjusting the leadership strategies to the digital reality, which means creating an atmosphere conducive to creativity and innovativeness or promotion of cooperative network. A response to such challenges is the VOPA leadership model, in which the key importance is attached to networking (German: ***Vernetzung),*** openness (***Offenheit***), employee participation (***P****artizipation*) and agility (***A****gilität*).[73] This is presented in Figure 3.3.

To sum up the above discussion, it is worth observing that at present numerous changes are taking place in business models. They are caused to a large extent by digitalisation and technological progress, including the growth of DTPs. Such platforms greatly contribute to promoting modern business models, in which innovation plays a key role. There are plenty such models, for example *hyper-disruptive business models* or *innovation marketplaces*, which aim to promote modern technologies. Current changes which concern business models based on DTPs relate mostly to promoting modern technologies and digital tools or even various behaviours of consumers (platforms such as Uber or those involving sharing economy), increasing the number of entities that cooperate with one another while being centred around these models and platforms (due to network effect and synergy, they are able to implement innovations more effectively and faster) as well as establishing

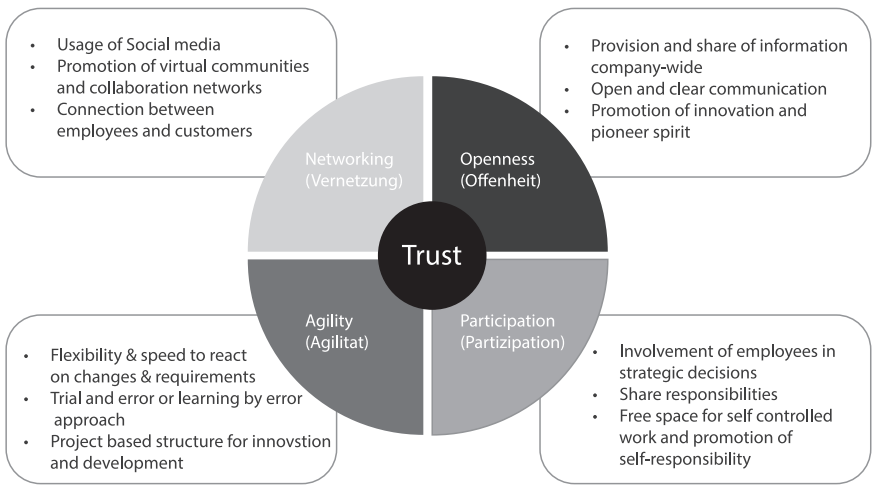

Figure 3.3 VOPA leadership model

Source: author's own work based on U. S. Foerster-Metz, K. Marquardt, N. Golowko, A. Kompalla, C. Hell, *op. cit.*, p. 7.

the broadest cooperation with customers by the organisations (they participate, for example, in product designing activities). Such changes are possible first of all due to the functionalities provided by DTPs.

3.5 Impact of Changes in Business Models on the Competitiveness of Companies

The nature and type of business models used by organisations affects significantly their competitiveness. The latter term refers for the most part to enterprises' capability to remain on the respective market and to grow its own activity, which also includes standing up to other entities operating on the market. The capability allows for continual development of an organisation, for achieving profits and for gaining advantage over the remaining enterprises. It is not irrelevant either that due to competitiveness, a company is able to deliver goods to customers in accordance with their needs in terms of time, quality or location.[74]

In view of the above discussion, the term "competitive advantage" is highly important as well. In the scientific literature, this term is defined primarily in terms of greater attractiveness of the respective company's offer compared to competitors.[75] In other approaches, it is stressed that competitive advantage lies in the overall distinctiveness of a company from its competitors or anything that a company does better from other entities active on the same market.[76]

With regard to competitiveness of an organisation, what is of great importance is digitalisation and the related processes of more and more wide-ranging use of new technologies and DTPs in the activity of companies. As noted by S. Łobejko,

> the progressing digitalisation exerts an increasingly stronger influence on the traditional business relations, offering new business models making it possible to capture values at each stage of the value chain and to gain competitive advantage. Companies which achieve success in the face of competition have their business models, operation and internal culture based on the idea of digitalisation. Intending to develop, they must invest in new technologies allowing for digitisation of business activity, changing the business model as well as ways and methods of competing on the market.[77]

In the scientific literature, it is indicated that the achievement of competitive advantage may be expressed by various kinds of actions, successes or financial indicators. In this respect, two approaches may be distinguished. In the first, the advantage is thought to be demonstrated by a company's greater efficiency compared to competing organisations. In turn, the efficiency is connected with better financial indicators, the company's high profitability or relatively low costs of doing business. The second approach places emphasis on analysing competitive advantage from the perspective of its sources or determinants. These relate in particular to technologies used by the company, resources held by it, capabilities of operating on a competitive market or finally cost leadership.[78] It is a fact that innovative changes to business models may be considered within both of the presented approaches.

After all, such changes contribute to minimisation of costs, which consequently improves the company's financial standing and leads to an increase in its profitability (the first approach), and furthermore, they are inextricably connected with innovative activities and with effective use of available resources (the second approach), which, according to S. Łobejko, results from completely new combinations of information, human capital and technological potential.[79]

According to A. Afuah and C. L. Tucci, a business model has become the most important determinant of an organisation's efficiency. This is because it is exactly due to such a model a firm is able to build and then use its resources to offer its customers better value than its competitors and to achieve higher profits. A business model allows for defining methods for making money, both now and in the future. It is a factor which has an impact on a firm's competitiveness.[80]

It must be emphasised that each business model, even a traditional one, may be a source of competitive advantage. It is so since, according to H. Chesbrough, all business models have similar functions, including, apart from generating value for customer or describing cost structure and profit potential, the formulation of the competitive strategy by which the firm will gain competitive advantage.[81]

When such models, however, are built in an innovative manner, advantages that may be gained by enterprises are much greater. This happens because, among other things, any innovations help identify various opportunities that appear in the firm's environment, which by itself provides grounds for taking advantage of any chances for increasing growth. This is especially important when an organisation operates in conditions, many of which are not conducive to its growth, for example legal restrictions (regulated activity), contracting raw material supplies or social pressures.[82]

According to W. Szpringer, innovative business models, including innovative changes introduced to them, become the source of gaining competitive advantage. They do so because they greatly accelerate and facilitate the performance of business processes and, in addition, they provide the opportunity to offer a relatively large quantity of goods on many diverse markets (internationalisation of activity). Since within innovative business models, modern technologies, including DTPs, are used, they make it possible to communicate with customers faster, deploy various distribution channels and create new values. Such opportunities, and many others, follow from the use of DTPs in innovative business models. An example that can be given here is *innovation marketplaces*, due to which modern technologies which are sources of competitive advantage are transferred between companies.[83]

According to J. Bis,

> innovative business models contribute to increasing companies' profitability. Products and services may be copied by rivals very quickly, whereas a business model is much harder to reproduce by competitors because it consists of all relevant activities performed in a specific manner.[84]

This is undoubtedly true. Many among business models developed in recent years are characterised by originality, because of the scope of applied solutions and technologies, and competitors could not copy them although they have tried

many times; such attempts have not been entirely successful. What may be of key importance in such cases is implementation of protection for the respective model, which may be based on a system of copyrights or trademarks.[85]

An example may be the model used within the Uber platform, which offers transport services to customers. In the model, which is an element of sharing economy or on demand system, a DTP is used due to which customers may look for drivers offering transport services. The innovation or even a revolutionary nature of the model follows from the fact that it is not used within any taxi corporation or firm, therefore it is completely independent of them. The model makes it possible to order rides on vehicles which are suitable for customers at a given time (for example, higher standard vehicles – UberSELECT). What is more, customers may select drivers on the basis of opinions written about them by other users and they pay for a ride not by taximeter rates but depending on the length of the actual route (measured by GPS receivers). It is also worth pointing out that Uber initiates cooperation only with strictly selected group of drivers (the must have vehicles not older than the set age limit and conduct business activity in the scope of transporting people) and furthermore offers fast resolution of complaints (they may be reported via an app or email) as well as automatic cashless payments for rides. Even though there have appeared competitors against the Uber platform (in Europe, it is in particular Estonian start-up Taxify) but still Uber definitely dominates on the market of passenger transport. This follows from the highly innovative business model applied by the company, including mainly the use of an appropriate digital platform for associating service providers with consumers.[86]

Such innovative model of operation is imitated by many other enterprises, not only those operating on the market of passenger transport, for example the Airbnb platform on the real property market). This way the phenomenon of "uberisation" takes place, whose essence is that various companies and platforms managed by them are not service providers but only deliver an app which allows for contacting business people with their customers. So, in the process of generating value, what is mostly used are resources controlled by users of the platforms. What is important, such a model leads to price reductions because intermediaries are eliminated (Uber does not cooperate with taxi corporations). Furthermore, the model allows for being active in many different areas of activity, also with regard to the government sector. For several years, Uber has made available to the authorities of Boston company data about routes ridden by customers of the platform, which contributes to, among other things, more effective public transport management (planning routes). In turn, San Francisco uses data received from the Airbnb platform about the frequency and location of accommodation where customers of the platform stay. This helps, among other things, in the expansion of the hotel infrastructure.[87]

Many studies have shown that innovativeness is one of the most important factors for achieving competitive advantage. Thus, for instance, according to analyses carried out in 2005 by the Economist Intelligence Unit agency, more than half of the four thousand surveyed managers thought that implementing innovations is more important than launching new products or services to achieve a competitive advantage in the market.[88] Then, based on studies conducted in 2014 on a group of

117 enterprises operating in Poland, it was concluded that one of the fundamental determinants of competitiveness is introduction of product, process or organisational innovations (such option was selected by 51.2% of respondents).[89]

Changes to business modes towards innovativeness result in a gradual development of the so-called mature innovative business model. With its aid, a considerable competitive advantage in the market may be achieved, which follows from the following properties of the model:

- consolidated vision and action strategy;
- efficiency of performed business processes;
- continual activity aiming to develop products and services based on innovative solutions;
- having an established circle of stakeholders contributing to the implementation of improvements;
- higher profits than costs, which allows for performing innovative activity;
- use of solutions in the area of effective protection of intellectual property.[90]

Summing up this section, it should be concluded that changes in business models which take place mainly because of increasingly broader use of DTPs make an enterprise more competitive and provide it with greater opportunities for achieving competitive advantage. This is mainly because of using modern methods of building and developing business, based on, among others, sharing economy and reaching for resources controlled by platform users rather than service providers. Changes to business models leading towards innovativeness bring about cost minimisation, faster provision of services and their improved quality as well as offering entirely new products, which strongly contributes to an increased competitiveness of enterprises. It is worth adding that at present, it is desired that each enterprise should aim to develop a mature innovative business model, in which innovative activity is conducted all the time and there is an established vision of how to operate on the market, based on new ideas and concepts.

3.6 Development Prospects for Digital Business Models

In the coming years, there will be a further, intensive development of digital business models. This will be entailed by the continually progressing digitalisation but also following from many benefits possible to receive due to such models. As stated by S. Łobejko,

> digitalisation makes it possible to develop new business models, generating unique customer experience, offering new products and services and also exploiting a firm's resources much more efficiently due to new combinations of information, human capital and technological resources of the firm.[91]

In turn, T. Koch and J. Windsperger found that in the age of digitalisation, competitive advantage may be achieved only after actively shaping the digital

environment and co-creating value by firms operating in such environment within a network.[92] Here it should be stressed that digital technologies change the way firms operate, as a result of which they become more and more interconnected by the common digital infrastructure.[93] It follows from this that only increasingly wider engagement of firms in digital business models may make the successful in the current market.

What may be conducive to the development of such models is the promotion of diverse concepts doing business. These include network systems but aspects of their operation will be discussed below. What may be mentioned here are *open data* technologies, including *open government data* (OGD), which aim to make various types of information resources public (except for sensitive data) so that every Internet user could use them freely, for example in their professional or educational activity.[94] These technologies provide opportunities for promoting knowledge, which by itself may lead to the development of innovative business models based on digital solutions. They are jointly known as *open data business models*.[95]

Such models are already being developed. They are used by several types of firms: *aggregators* (they collect data from various sources and combine them), *developers* (authors of applications and programs which use open data or OGD who also develop these programs all the time), *enablers* (entities selling to customers applications or programs which are designed to use only open data or OGD), *enrichers* (they use these technologies to increase a firm's efficiency or sales of products) and *suppliers* (data providers).[96] It should be noticed that in principle in all the models based on open data or open government data, it becomes necessary to ensure broad cooperation between these types of entities. Only then will it be possible to achieve the effect of synergy.

It should be stressed that in several years, or perhaps in a period between ten and twenty years, a particularly intensive development of some digital business models is predicted. R. Ćwiertniak concentrated on discussing four of such models. They are described in Table 3.5.

The growth of digital business models in subsequent years, as shown from issues presented in Table 3.5, can therefore proceed by emphasising the activities connected with building long-term close relationships with customers. In principle, each of the presented models assumes such activities, but there might be different ways of achieving the related objectives. In the market are conversations business model, firms encourage customers to participate in designing specific business solutions, while in the one-off experience business model or beyond advertising business model, companies make efforts to communicate with customers on the largest possible scale, informing them of various types of aspects of the activity conducted by the company.

Importantly, all the business models presented in Table 3.5 are based on digital technologies. This means that the future of digital business models is inextricably linked with DTPs. It should be also highlighted that digital business models may become for many firms a remedy for problems relating to their operation in view of digitalisation. This is because a model going beyond contemporary advertising methods may create conditions for building DTPs and using them for communication with customers so as to sustain their interest in printed books. It may be an

Table 3.5 Description of the most prospective digital business models according to R. Ćwiertniak

Model name	*Areas for model application*	*Model elements*
Low-budget innovation business model	• Production of fast-moving consumer goods, manufactured locally, targeted at less demanding customers	• Wide-scale promotion of products already recognisable in the market, also with the use of digital technologies • Concentration on cost efficiency and maintenance of good relationships with customers • Efficient marketing and quality management
Markets are conversations business model	• Advisory, consulting and financial industry	• Use of digital platforms to acquire knowledge and customers' ideas about performance of various projects • Supported by social media used for communication with customers • Real-time testing of solutions proposed by customers using Internet technologies
One-off experience business model	• Social media industry	• Use of DTPs to communicate with online and traditional sellers and customers • Forming teams with the participation of organisers of cultural or entertainment events • Placing emphasis on offering unique experience to customers, including a semblance of luxury
Beyond advertising business model	• Publishing industry, facing the problem of decreased interest in press and books	• Operation of online platforms, making it possible to build relationships and mutual trust between the publisher and readers • Delivering knowledge commissioned by customers in the form of online presentation of surveys • Communication with public organisations

Source: R. Ćwiertniak, "Rola potencjału innowacyjnego w modelach biznesowych nowoczesnych organizacji," *Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie* 2015, no. 1, p. 53.

effective response to the challenges caused by strong tendencies to read e-books instead of traditional publications.

In the next years, digital business models should develop on increasingly wider scale based on various kinds of networks. In this respect, concepts in the area of sharing economy should be mentioned. Such concepts are based to a large extent on modern technologies, therefore promoting and using them in practice requires exploitation of digital solutions, also such as DTPs. Here one concept may be invoked referred to as *compass for navigating sharing economy business models*. Such a compass allow for generating over one hundred combinations of business models, so it aims, similarly to the Business Model Canvas, to construct

the architecture of such models but it is also useful for designing, determining or describing aspects associated with revenue streams and cost structure, strategies of cooperation with customers or vendors and value creation sources.[97] A model of such a compass is presented in Figure 3.4.

As can be seen in Figure 3.4, the *Sharing Business Model Compass* (compass for navigating sharing economy business models) takes into consideration many diverse elements for creating and developing business models. They are connected with the functioning of DTPs, too, since one of the main elements of the compass is *platform type*. Apart from that, there is an element called *technology*. It should be explained that decisions made in the areas located near the centre of the compass move the business model for the most part closer to the sharing economy, whereas

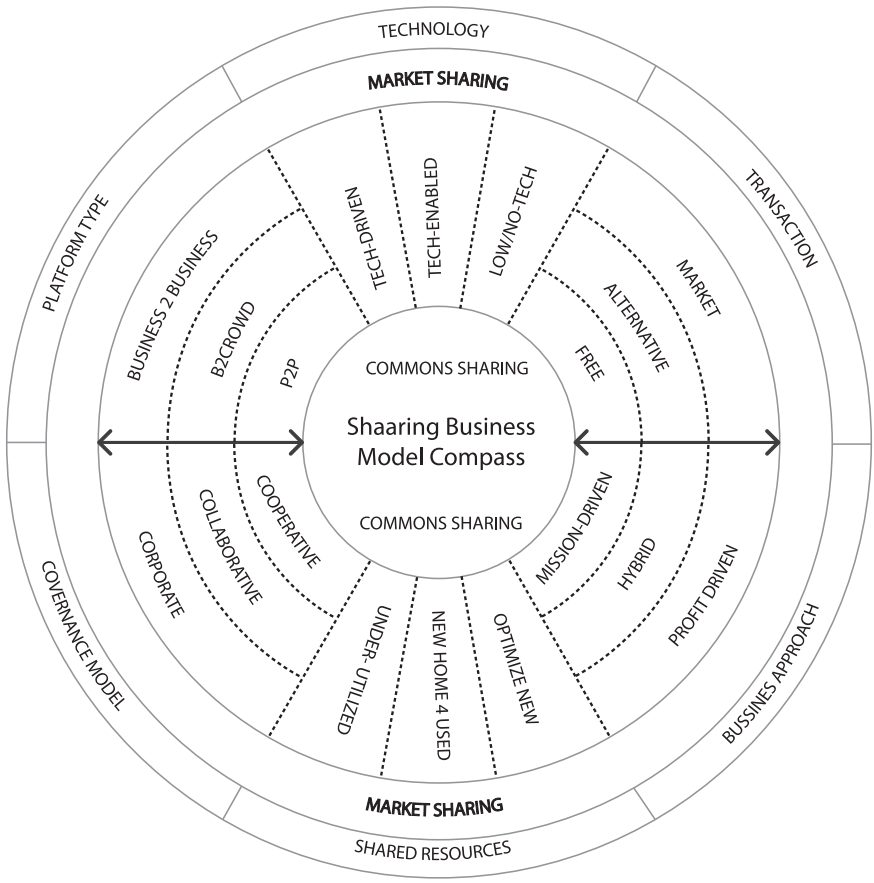

Figure 3.4 Sharing Business Model Compass

Source: author's own work based on P. Munoz, B. Cohen, *op. cit.*, p. 128.

those which refer to areas closer to the edges of the compass lead to the creation and development of market-oriented business models.[98]

It should be added that models Invoking the concept of sharing may be classified as social business models. The creation of such models is one of the key trends in the ways of conducting business activity and it seems that it will still fulfil increasingly greater role in the coming years. Social business models focus on broad participation of social partners and on generation of specific values for the society not limited to the firm or its direct stakeholders. The mission of such models may be, for example, promotion of knowledge. Interestingly, some of them operate as non-profit organisations, therefore their basic mission is not to generate profit but to offer specific value to the society, including also providing grounds for development of other business models. One of them is the South Korea Knowledge Portal, which is being built and developed with the active participation of the government. This solution belongs to ODG. In Poland, works on the SyNat project have been in progress for several years, a "universal, open, repository platform for hosting and communication of networked resources of knowledge for science, education and open society of knowledge," which according to the proposals and postulates should function as a social business model. Importantly, SyNat will be based on an online platform. It should be stressed that social business model may operate in digital form, taking advantage of functionalities available due to DTPs.[99]

In the context of network development, business models which are more and more often promoted are the so-called creative business models, which may become more common in practical business activity in the near future. They concentrate on generating completely new business solutions and formulating proposals about how to create value for the firm and any of its stakeholders based on resources accessible in the digital environment.[100]

Among creative business models, many prospects are associated with the so-called *triple layered business model Canvas* (TLBMC). That concept supplements and develops the Business Model Canvas. As the name implies, it has three layers of "canvas" which refer to activities performed to ensure both horizontal and vertical coherence. This is shown in Figure 3.5.

In the triple business model, apart from economic aspects, two more dimensions (layers) were added: *environmental* (issues connected with the protection of natural environment, including for example neutralisation of the adverse impact of business activity on the environment or development of pro-ecological innovations) and *social* (the perspective of stakeholders – broad organisational, resource or technological support for business partners, including suppliers, impact of products on customers and initiating wide-ranging cooperation with them). Such a broad approach to the architecture of a business model makes it possible to discover issues not sufficiently recognised so far and concerning the possibility of improving the firm's effectiveness by taking maximum advantage of opportunities and neutralising threats appearing in the natural environment or in the social sphere. In addition, *horizontal coherence* makes it possible to determine the scope of activities in the economic, environmental and social layers which will be consistent with the whole

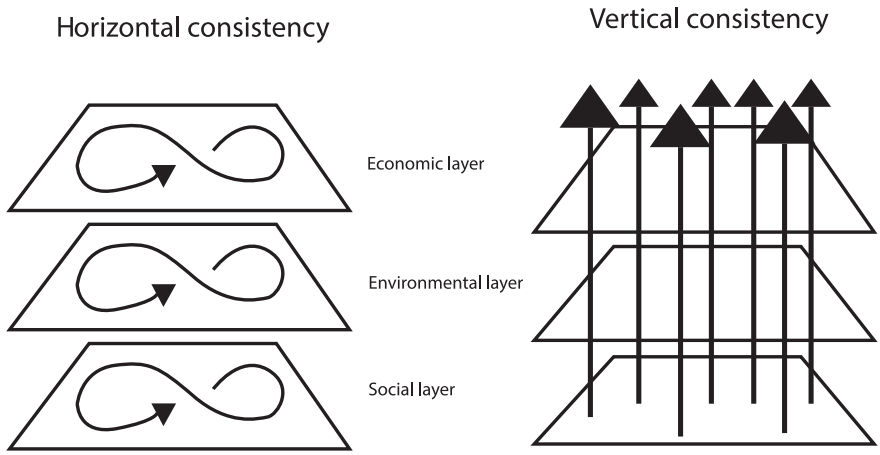

Figure 3.5 The Triple Layered Business Model Canvas architecture

Source: author's own work based on A. Joyce, R.L. Paquin, "The Triple Layered Business Model Canvas. A Tool to Design More Sustainable Business Models," *Journal of Cleaner Production* 2016, no. 135, p. 1482.

business model, while *vertical coherence* provides grounds for performing the activities in cooperation with various entities, including customers.[101] The examples of TLBMC and the concept of Sharing Business Model Compass show how the development of digital business models may look like in the next few years. The development will take place, to a large extent, by improving already used models by adding further elements, such as environmental or social, which may, to a greater extent than so far, ensure coherence of business activities with new digital technologies, including DTPs.

Summing up, it appears that in the coming years, the development of digital business models, which will be certainly intensive, will take place as a result of updating the already existing concepts of doing business. This is because at present, tools are promoted such as the *Sharing Business Model Compass* or the *Triple Layered Business Model Canvas*, which make it possible, considering various dimensions or layers of conducting business activity, to construct modern business models, including digital ones. It does not mean that new models will not be created at all but that they will be based to some extent on the already available solutions. In this context, it is significant that such models will not have commercial character only but also social (see the Polish SyNat platform). It should be added that the development of digital business models in the near future will certainly occur on the basis of DTPs. After all, these platforms provide opportunities for establishing relationships with any stakeholders, which includes initiating cooperation with customers to design products or even build modern IT systems as well as for collecting knowledge and developing new innovative ideas. Without them, in principle, no digital business model may operate effectively.

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4 Findings of Empirical Research

4.1 Research Methodology

In surveys conducted for this monograph, three research methods have been used. The first of these, or content analysis of the literature on the subject matter, was performed during preliminary studies as well as attempts to confirm several research hypotheses. The first method involved analysis of publications about the concept of technological determinism, assigning a critical role to technical and technological issues and related transformations in shaping the modern society and the economy as well as showing the impact of digital technology platforms (DTPs) on companies' business activities.

The second method is CATI or computer-assisted telephone interviews. It is a modification of the classic method of quantitative research – direct standardised interviews. Standardised structured interviews originate from the neo-positivistic research paradigm, although the interpretative paradigm and the critical postmodernistic paradigm also contributed to their development. In this research paradigm, known as quantitative, the aim is to discover the truth about the world using methods which are systematic, standardised, based on facts, synthesising, non-subjective and cumulative.[1] The origin of this established research method can be traced back to the surveys conducted by Arthur Bowley and William Benett-Hurst in Great Britain in 1912 to get to know the living conditions of the working class in the towns of Stanley and Reading. However, the most important contribution to the development of the method is thought to have been made by George Gallup, who in 1940, during the population census, conducted surveys on a five-percent sample of American population.[2]

In contrast to the classic standardised interviews, computer-assisted telephone interviews have many methodological characteristics which make them particularly useful in this research project. First, CATI is a technique standardised to a very high degree and making it possible to enter only pre-defined data with regard to their form and content. Second, telephone surveys allow for ongoing supervision of interviewers who collect data and continuous monitoring of sample size and respondents' answers. Third, the CATI technique ensures the opportunity to make surveys in the sector of enterprises which are representative because of the availability of the entire sampling frame, elimination of the clustering of

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entities around locations geographically close to each other and because of possible (as the database was in electronic form) sampling procedures. Furthermore, CATI surveys may be combined with online surveys as well as with qualitative techniques, including projection tests. CATI is a technique which requires lower financial and organisational expenditures than the classic structured F2F (face to face) interview. The CATI technique makes it possible to modify the research tools even after the field research phase has started. Questions, or even blocks of questions, may be then added or modified. **The most important advantage and at the same time a description of this research method is the fact that on the basis of a correctly selected sample, satisfying appropriate requirements, it is possible to generalise the findings to the population.**

The quantitative data collected during computer-assisted telephone interviews (CATI) were subjected to quantitative analysis in accordance with the classic paradigm of such surveys. A tabular analysis was carried out, taking into account bivariate tables and then inductive tests of inter-group differences were used.

The survey using CATI was conducted on 18–28 February 2019. Standardised structured interviews included questions in strictly defined order and unchangeable wording, generally closed (see Appendix 1). In the survey, a modern version of the method presented above was used. The face-to-face conversation of interviewer and respondent was replaced by a telephone interview, and the traditional printed questionnaire – by a computer.

The sample was selected at random. The interviews were conducted with representatives of managerial staff having knowledge on the operation of DTPs and how they are used by the company. The sampling frame in the survey was a group of beneficiaries of the Innovative Economy Operational Programme performed by the Polish Agency for Enterprise Development (PARP), who received co-financing under the programme for the implementation and development of DTPs. The total number of beneficiaries was N=320. To ensure the possibility of generalising the collected findings on the tested population, a minimum research sample was calculated before starting the survey.

Calculations were performed on the basis of the following formula:

$$n = \frac{1}{\left[\left(\frac{4d^2}{u_\alpha^2}\right) + \frac{1}{N}\right]},$$

where:

d – maximum estimation error expressed as a fraction, is potentially contained in the range from 0 to 1. In general, estimation error is determined arbitrarily at acceptable levels as accepted in research and analytical practice of social sciences – from 0.03 to 0.1. For example, an error assumed at the level of 0.08 means that we accept that specific distribution results obtained in the survey when estimating whether they are representative for the population may contain an error up to ±8 percentage points. The value of coefficient d assumed as acceptable in the survey was 5% (at the level of 0.05);

u_α^2 – confidence level or interval. Commonly accepted in social sciences at the level of 95%. The value means that there is a merely five percent (100%–95% = 5%) probability of committing the so-called Type I error, or rejecting a result which is in fact true. At a 95% confidence level, the value u_α^2 is 1.96;
N – size of fixed population, which in this survey was equal to the number of companies, therefore it is 320.

Having substituted the above values in the formula, we have received the minimum necessary sample size of n = 122.

Because the survey was conducted on a fixed population, while setting the minimum sample size, a sample size adjustment factor should be applied. It is calculated by applying the following formula:

$$n' = \frac{nN}{N + n + s},$$

where:

n′ – unknown value;
n – originally defined sample size;
N – size of the surveyed population;
s – confidence interval is expressed by the formula, $s = \sqrt{\frac{p(1-p)}{n}}$ with p in the confidence interval set at the most disadvantageous level, therefore safe for the researcher, or 0.5 (it is assumed that the surveyed population is, as far as possible, non-homogeneous, or diversified).

After substituting values in the formula, we get adjusted sample size equal to 88. To ensure the possibility of conducting analyses of collected data and taking advantage of various statistical tests, it was decided to increase the realised sample size to N = 120 (requirements of parametric and non-parametric tests assume the minimum size at the level of 120). A randomisation algorithm embedded in the software for telephone surveys (algorithms embedded in the software for quantitative surveys use the so-called random number generators, whose task is to ensure the same probability of drawing each of the records from the sampling frame; in this survey, this means that each of the 320 beneficiaries of the programme had equal chances of being included in the sample) ensured that each record in the database was equally likely to be found in the sample. While conducting the survey, each of the companies were contacted on the telephone. The interviews with beneficiaries were carried out by a team of qualified interviewers, trained on the subject of the survey. Their task was to reach the right person in a company who would have knowledge on the operation and utilisation of DTPs. Data collection and interviews were strictly supervised *ad hoc* and post hoc, in accordance with the requirements of the Interviewers' Work Quality Programme, which guarantees high quality of obtained results. 120 interviews were conducted, 49

companies refused to participate in the survey, two of them declared that they had not implemented any platforms and with the remaining ones it was impossible to carry out interviews on the arranged dates. A company could be included in the sample if it satisfied one of the following to criteria:

- declared use of DTPs by the company;
- planning to implement DTPs in the company in the near future.

The interviewers conducted interviews with representatives of managerial staff having knowledge on the operation and use of DTPs in the company. The tabular data can be found in Appendix 2.

The third research method is regression analysis. This analysis is for making a quantitative assessment of qualitative data, which is based on assigning specific values to certain categories. Within the method, optimal scaling was used in the form of categorical regression (CATREG), or regression analysis for qualitative variables, to predict values of certain variables. Analytical technique made is possible to disclose correlation coefficients for assessments of the impact of DTPs on the company's operation. Optimal scaling belongs to the family of regression methods. It is a method involving prediction of the value of a selected variable on the basis of values adopted by other variables, also selected by the researcher. What is important is the fact that optimal scaling makes it possible to include in analyses variables at each measurement level: nominal, ordinal, interval and ratio. This is a definite advantage of the method, which makes it impossible to include in analyses nominal variables (because of that, we cannot get to know what role they play). This method may be regarded as the "first choice" in social sciences because variables are generally measured here at the qualitative level. The aim of using the method is to quantify correlations between many independent variables and one dependent variable. It is "regression for qualitative variables," which mainly involves testing overall effect of variables (interaction means "the product" of all variables). The concept of optimal scaling is derived from several sources – correspondence analysis[3] and multidimensional scaling (MDS)[4] – and it is regarded as the successor of these two methods. It is, however, more correct and more statistically rigorous.[5]

One of the main objectives of this monograph is to construct a model of DTPs. Accordingly, the relevant procedure should be discussed here. Constructing a model of a phenomenon involves some kind of mathematisation of hypotheses (in the form of an appropriate equation or a system of equations), therefore presenting them in a parametrised manner in the so-called "statistical space." Such a model presents a simplified but basic and most important connections between studied phenomena. For this purpose, tools of inductive statistics are used, most often regression models.

This model concerns measurement of attitudes to DTPs in companies. The concept of "attitude" is deeply rooted in social sciences, in particular in sociology, but it is also widely used in economy.[6] Scientists agree that an attitude has a three-part structure: *affective* (what is felt), *cognitive* (what is known) and

behavioural (what is done).[7] The concept of attitude served to formulate the question indicating an independent variable:

> *Question 13. To what extent do digital technology platforms affect an increase in quality and intensity of relations established by the company in which you perform your professional duties with any stakeholders, including mainly suppliers, business partners, distributors or customers?*

The question made it possible to measure attitudes to the phenomenon of DTPs. There are following elements here: evaluative elements referring to knowledge and elements referring to the appraisal of the phenomenon ("increase in the quality and intensity"). What is of key importance is correlation of the general assessment of the impact of DTPs on the quality and intensity of the company's operation with the remaining evaluative, cognitive elements (questions 5 and 12 – about affective elements and question 9 – about affective and cognitive elements) and behavioural ones (questions: 1, 4, 8, 10, 11, 14). The impact of socio-demographic variables concerning the company was also studied (questions 22 and 23) as well as the probable impact of the so-called latent variables concerning the very respondent (questions 16, 17, 18, 19, 20). Each indicator may be also classified from another important perspective – aspects of the company's operation (a list of variables taken into account is presented in Table 4.1). It was assumed that a company may be transformed by DTPs in the following dimensions: *human* (evaluation of the phenomenon by people, the extent to which platforms are used, expectations, etc.), *cybersecurity* (new IT challenges related to hardware and software), *economic* (connected with the calculation of actual and potential profits and losses) and *social* (changes in the structure of the company and in the manner, type and intensiveness of its relationships with the environment).

Using the above variables, a model was built, indicating which variables and how strongly affect the independent variable. As mentioned above, CATREG optimal scaling was used for the analysis. Such scaling is a technique which ensures multidimensional data exploration: the acceptable number of predictors is two hundred, although only one independent variable may be predicted. It is also justified, however, to limit the number of variables. In fact, each variable should be assigned to at least ten, and ideally twenty, units of analysis; otherwise, we may experience instability of regression line. This means that in this analysis, where the set is N = 121, at most twelve independent variables may be used, and optimally, not more than six. This is highly important in the context of the selected above (Table 4.1) number of sixteen variables. It means that at least four of them should be eliminated *a priori*. The variables selected for elimination were those which in various systems of variables, tested many times, showed the lowest interaction with other independent variables and the dependent variable.

At this point, ways of interpreting the regression model for qualitative variables should be discussed. Interpretations are similar to an ordinary regression model,[8] although it has more indicators and they are more refined.

Table 4.1 Classification of indicators of entrepreneurs' attitudes to the phenomenon of digital technology platforms

Interview question	*Dimension of the company's operation*	*Comments*
Question 1. Does your company use digital technology platforms, which are tools that allow for connecting business partners and provide opportunities for intensifying contacts and performing transactions between them?	Human factor	Variable measurement level: ordinal
Question 4. Please state which kind of digital technology platforms is used or will be used (if there are plans for implementation) in your company? (please select all possible responses)	Structural factor	Variable measurement level: nominal (multi-choice question), converted into ratio variable – counting the number of selections
Question 5. Please state what attitude is taken by the personnel in your company about the implementation and use of digital technology platforms?	Human factor	Variable measurement level: ordinal
Question 8. Please state whether in connection with the implementation of digital technology platforms in the company in which you perform your professional duties any of the following adverse cybersecurity events and threats have occurred directly as a result of using these platforms?	Cybersecurity factor	Variable measurement level: nominal (multi-choice question), converted into ratio variable – counting the number of selections
Question 10. In which areas of your company's operation digital technology platforms are or will be used (if there are plans for their implementation)? (please select all possible responses)	Structural factor	Variable measurement level: nominal (multi-choice question), converted into ratio variable – counting the number of selections
Question 11. Please state what basic benefits are generated due to the use of digital technology platforms in your company?	Economic factor	Variable measurement level: nominal (not subject to, e.g. factor analysis)
Question 12. Do you agree with the statement that digital technology platforms make it possible to create and develop innovative business models?	Structural factor	Variable measurement level: ordinal
Question 14. Has the implementation of digital technology platforms in the company in which you perform your professional duties forced the company to introduce specific changes to its organisational structure or will you be forced to do so?	Structural factor	Variable measurement level: ordinal
Question 22. Please state in what kind of company in terms of headcount size you perform your professional duties?	Structural factor	Variable measurement level: interval

(*Continued*)

Table 4.1 (Continued)

Interview question	*Dimension of the company's operation*	*Comments*
Question 23. Which industry does your company operate in?	Structural factor	Variable measurement level: nominal (not subject to, e.g. factor analysis)
Question 16. Please state your gender.	Human factor	Variable measurement level: nominal (not subject to, e.g. factor analysis)
Question 17. Please state your age.	Human factor	Variable measurement level: interval
Question 18. Please state your education level.	Human factor	Variable measurement level: interval
Question 19. Please state how long you have been employed in the company in which you perform your professional duties now.	Human factor	Variable measurement level: interval
Question 20. Please state how long has the company in which you perform your professional duties been active on the market.	Human factor	Variable measurement level: interval
Question 21. Please state your position in the company in which you perform your professional duties now.	Human factor	Variable measurement level: nominal (not subject to, e.g. factor analysis)

Source: Author's own work.

The following numerical results are subject to interpretations:

1 **Multiple R**, also known as multiple correlation coefficient. It is a positive square root of R-squared (coefficient of multiple determination). It describes collective relationship between the dependent variable and independent variables. It takes values between 0 and 1 and is an indicator of model fit.
2 **R-squared** coefficient is the square of multiple R. It depicts total variability of the dependent variable explained by collective impact of independent variables. It takes values from 0 to 1, may be expressed as a percentage and is a comparable value.
3 **Adjusted R-squared** is calculated on the basis of R-squared, taking into account the number of factors in the regression model: the more factors, the lower adjusted R-squared.
4 A pair of variables – **regression and residual** – shows variation explained by the regression model and the size of variation unexplained (residuals). These values are evaluated visually. The higher the first of the values and the lower the second, the better the selected set of independent variables explains the variation of the dependent variable.

5 The **significance of the regression model** is interpreted in the same manner as in other statistical tests. In social sciences, the commonly accepted risk of committing Type I error is 5% ($p \leq 0.05$).
6 **Beta (β) coefficient** is the so-called standardised regression coefficient (made independent of the scope of a variable, calculated on the basis of *slope*, also known as director/angular coefficient), making it possible to compare various predictors in the regression model and taking values from −1 to +1. Such a range means that values around zero mean weak or no correlation between a predictor and the dependent variable.
7 A significant parameter describing each predictor is significance (interpreted as in item 5).
8 **F statistic** is a total goodness of fit showing the magnitude of variance which is being explained. While creating a model, variables which have the lowest values of this parameter are sequentially eliminated.
9 The correlation matrix, which is made up of zero-order, partial and semi-partial correlations, includes less significant information. **Zero-order correlations** are isolated correlations between an independent variable and the dependent variable. In turn, **partial correlations** take into account the way in which the respective predictor and the dependent variable are correlated with the remaining variables in the model. In contrast, **semi-partial correlations** take into account the interaction of the respective independent variable with the remaining variables in the model but do not take into account the correlation of the dependent variable with other predictors. They take values from −1 to +1.
10 **Importance** is significance of particular variables in the model expressed as a part of the unity (the maximum value is 1), and the higher the importance assigned to the respective predictor, the greater the role it plays in the model. The value of the parameter may be expressed as a percentage.
11 **Tolerance** is a measure of collinearity of variables. It is the inverse of R^2 (tolerance $= 1 - R^2$). It takes values from 0 to 1. The closer is the tolerance of a predictor to the unity, the less it is collinear with the remaining variables in the model. Collinearity should be avoided – the closer that coefficient is to zero, the more is the respective variable excessive and useless in terms of information value. This is because variables in the model should be strongly correlated with the dependent variable and weakly correlated with one another. What is significant for the construction of a model is the phase of data validation – the problem of outliers should be resolved then; the CATREG regression model is very sensitive to outliers.[9]

A model using CATREG is usually built in accordance with the following iterative steps:

1 Adding to the model a set of variables which, in the researcher's opinion, affect the dependent variable (the set is determined already at the stage of preparing the tool for empirical research).
2 Manipulating the order of the variables to achieve the highest result (it is an iterative mechanical operation).

3 Constructing and evaluating the model.
4 Reducing the number of variables by getting rid of the weakest predictor.
5 Constructing a reduced model.
6 Comparing the original and the next (reduced model).
7 Repeating items from 4 to 6 to achieve results which will give the most satisfactory figures.

The process described above is a top-down method, which most frequently gives satisfactory results in substantive terms.[10] The next section presents results of calculations performed within the developed model of DTPs.

It should be stressed that the conducted survey is to some degree limited by the target sample of companies which applied for and received co-financing within the Innovative Economy Operational Programme for investments in the area of the implementation and development of DTPs, which could have caused the management of the surveyed companies to have a positive attitude to the phenomenon. Therefore, to confirm the obtained results, further research should be done to include also the firms which have not received or have not applied for such co-financing. It should be added that the obtained results concern attitudes of managers of Polish firms and because of cultural and social differences and business determinants, the results should not be applied uncritically to other countries.

It is also necessary to distinguish the limitations relating to CATREG optimal scaling. One of such limitations is connected with the admissible number of predictors – independent variables, which is 200 (in the case of survey results obtained using the CATI method, it is an irrelevant condition as the number of predictors rarely exceeds 100). Furthermore, there should be at least ten and at best twenty units of analysis for each variable. Optimal scaling is therefore not recommended in the event of making measurements on small samples. If this condition is not satisfied, the consequence will be an unstable regression line. Another limitation is the inborn defect of all regression methods which is that using such methods you can find that some variables are or are not related but this way one does not gain any knowledge about the causal nature of such relations. In addition, an important reservation is that depending on the type and number of variables in the model, different resulting values are obtained and it is difficult to decide which of the constructed models is optimal – the choice here is made by the researcher himself, taking into account the structure of obtained results.

4.2 Changes to Business Models Based on Technology Platforms

The construction of the above model served to partially verify the major proposition, i.e. to determine the influence exerted by digital technology platforms on changes to business models. In addition, performed analysis made it possible to verify partially the following research hypotheses:

Table 4.2 Summary of general coefficients of the optimal scaling model produced with the top-down method

Multiple R	0.668
R-squared	0.446
Adjusted R-squared	0.218

Source: Author's own work.

Table 4.3 ANOVA variance analysis for the optimal scaling model produced with the top-down method

	The sum of the squares	*The number of degrees of freedom (df)*	*Mean square*	*F*	*Significance*
Regression	53.971	35	1.542	1.955	$p \leq 0.01$
Residual	67.029	85	0.789		
Total	121.000	120			

Source: Author's own work.

H1. Digital technology platforms facilitate the introduction of changes to the operations of companies, especially in the area of management, marketing and sales.

H5. Digital technology platforms are a new factor for companies' competitiveness in the digital economy.

The results of calculations (the best final model) for optimal scaling with a top-down method are presented in Tables 4.2 and 4.3.

The model was built using the nine variables listed in Table 4.4, and their order was determined according to the importance of each variable making up the model.

In the resulting model, there are five variables classified as structural factors, three variables (with lower explanatory power) classified as human factors, and one variable which is an economic factor (this is the strongest of all the variables).

Fitting the optimal scaling model expressed by multiple R was 0.668, which is classified as moderate (significant) correlation but nearly bordering on the so-called strong correlation, which starts at 0.7. The total variability of the dependent variable explained by collective impact of independent variables was as high as 0.218. This means that the model explains as much as 21.8% of variability of attitudes to DTPs in companies. It is a considerable value despite the fact that the model consists of a high number of coefficients. The considerable, although admissible, number of factors in the model (9) lowers the original (R-squared) value of a coefficient. It is worth emphasising that analysis involving an attempt to remove various coefficients from the model in order to reduce their number increases the explanatory power of the model. This way, the nine variables have (at least in the

Table 4.4 Variables used to construct the model

Question 11. Please state what basic benefits are generated due to the use of digital technology platforms in your company?	Economic factor
Question 23. Which industry does your company operate in?	Structural (socio-demographic) factor
Question 14. Has the implementation of digital technology platforms in the company in which you perform your professional duties forced the company to introduce specific changes to its organisational structure or will you be forced to do so?	Structural factor
Question 19. Please state how long you have been employed in the company in which you perform your professional duties now.	Human factor (potential hidden variable affecting opinions)
Question 4. Please state what kind of digital technology platforms are or will be used (if there are plans for their implementation) in your company (please select all possible responses).	Structural factor
Question 12. Do you agree with the statement that digital technology platforms make it possible to create and develop innovative business models?	Structural factor
Question 10. In which areas of your company's operation digital technology platforms are or will be used (if there are plans for their implementation)? (please select all possible responses)	Structural factor
Question 21. Please state your position in the company in which you perform your professional duties now.	Human factor (potential hidden variable affecting opinions)
Question 18. Please state your education level.	Human factor (potential hidden variable affecting opinions)

Source: Author's own work.

mathematical sense) a joint effect, making up a non-separable whole. The model is statistically significant at a level more than satisfactory, i.e. $p \leq 0.01$. A visual assessment of the sum of the squares for regression and residuals in the ANOVA analysis shows that the regression model explains as much as over half (53%) of variability, which proves that it was justified to adopt it.[11] The model components are presented in Table 4.5.

The model should be regarded as valuable, explaining correlatives of positive assessments of DTPs and partly verifies the formulated hypotheses.

The developed model includes three groups of factors: economic, structural and human. Positive attitudes to DTPs are explained, first of all, by the **number of benefits generated in a company by digital technology platforms** (38.6% of the model fit). The technological factor has been called for a long time a company's strategic weapons because its importance follows from the purposeful use to increase value added as a result of changes to production and control processes.[12] Positive attitudes to DTPs to a large extent result from structural factors, especially

Table 4.5 Components of the optimal scaling model produced with the top-down method

Name of the component (predictor)	*Beta coefficient*	*The number of degrees of freedom (df)*	*F*	*Significance*	*Zero-order correlation*	*Partial correlation*	*Semi-partial correlation*	*Importance*	*Tolerance after transformation*	*Tolerance before transformation*
Question 11. Please state what basic benefits are generated due to the use of digital technology platforms in your company?	0.477	12	19.774	0.001	0.361	0.522	0.455	0.386	0.911	0.914
Question 23. Which industry does your company operate in?	0.399	11	12.976	0.001	0.233	0.449	0.373	0.208	0.877	0.965
Question 14. Has the implementation of digital technology platforms in the company in which you perform your professional duties forced the company to introduce specific changes to its organisational structure or will you be forced to do so?	−0.295	3	3.881	0.012	−0.162	−0.351	−0.279	0.107	0.890	0.866

(*Continued*)

Table 4.5 (Continued)

Name of the component (predictor)	*Beta coefficient*	*The number of degrees of freedom (df)*	*F*	*Significance*	*Zero-order correlation*	*Partial correlation*	*Semi-partial correlation*	*Importance*	*Tolerance after transformation*	*Tolerance before transformation*
Question 19. Please state how long you have been employed in the company in which you perform your professional duties now.	0.235	2	3.527	0.034	0.150	0.290	0.225	0.079	0.917	0.828
Question 4. Please state what kind of digital technology platforms are or will be used (if there are plans for their implementation) in your company (please select all possible responses).	0.202	1	1.941	0.167	0.130	0.245	0.188	0.059	0.865	0.847
Question 12. Do you agree with the statement that digital technology platforms make it possible to create and develop innovative business models?	0.209	2	1.675	0.193	0.116	0.265	0.204	0.055	0.955	0.914

Question 10. In which areas of your company's operation digital technology platforms are or will be used (if there are plans for their implementation)? (please select all possible responses)	0.153	1	1.919	0.170	0.135	0.197	0.150	0.046	0.954	0.918
Question 21. Please state your position in the company in which you perform your professional duties now.	0.187	2	3.443	0.036	0.100	0.236	0.181	0.042	0.936	0.828
Question 18. Please state your education level.	−0.114	1	0.981	0.325	−0.066	−0.146	−0.110	0.017	0.934	0.931

Source: Author's own work.

the industry in which the enterprise operates and the intensiveness of transformations in the enterprise's internal structure (this is altogether 47.5%, or nearly a half of the model's components). It should be stressed that it has been commonly perceived for many years that the structural factor is far from being irrelevant. Douglas North, a Nobel prize winning economist, maintained that development takes place more as a result of organisational rather than technological progress.[13] In turn, human factors, therefore factors strictly socio-psychological and demographic features of respondents, are of low importance (in terms of explanatory power), and they are represented by such items as years of employment, position and education (13.8%). This is presented in Figure 4.1.

An alternative model was attempted to be built with the bottom-up method, or by adding further variables through trial and error. However, it turned out to be impossible to complete. An attempt was made to base correlation by the bottom-up method on assumptions derived from the cognitive theory. The major factor was sought among both "hard" elements referring to econographic features of an enterprise, and "soft," referring to features of the respondent in their professional role (education, experience and other socio-psycho-demographic characteristics). Selected groups of factors showed moderately high values with regard to F statistic, correlation and importance but they were statistically insignificant (a high risk of committing Type I error).

It Is possible to base a model also on synthetic indicators – indexes or scales. In such a case, independent variables would be synthetic values derived from two or more direct indicators (interview questions). A direct advantage of this approach is reduction of the number of independent variables, which allows for decreasing the distance between the R-squared and adjusted R-squared coefficients. As a result, a model explaining a greater part of variation of the dependent variable could be potentially

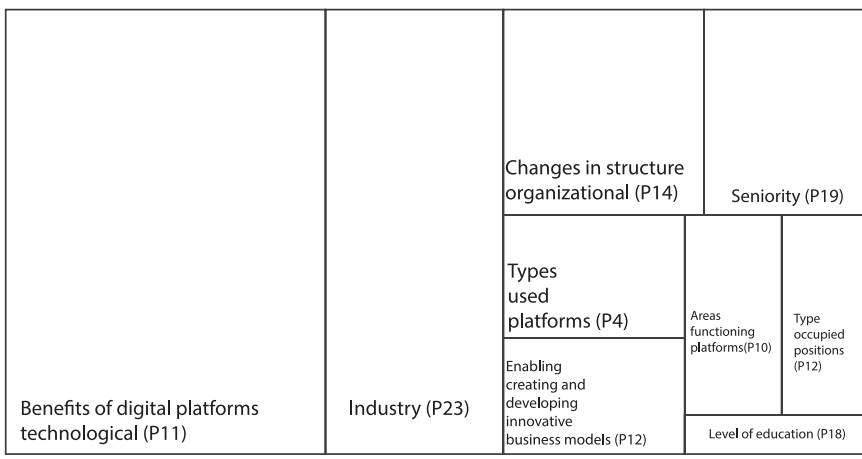

Figure 4.1 Components of the optimal scaling model produced with the top-down method – visual interpretation taking into account the proportional importance of each factor in the model

Source: Author's own work.

generated. An undeniable advantage of such an approach is obtaining transparency by introducing orderliness and structuring factors by putting them into groups.

Data were synthesised by summing them up in a simple arbitrary manner and then averaging sets of indicators. From the methodological point of view, these are the so-called reflexive indicators, therefore not related to one another due to a common cause but in accordance with the research assumptions, classified to a more general category. Five synthetic indexes were distinguished: cybersecurity (represented by one indicator), economic (one indicator), human (eight partial indicators), structural (four indicators) and structural-demographic (two partial indicators). This is presented in Table 4.6.

Table 4.6 Classification of indicators of entrepreneurs' attitudes to the phenomenon of digital technology platforms

Index	*Interview question*	*Comments*
Cybersecurity	Question 8. Please state whether in connection with the implementation of digital technology platforms in the company in which you perform your professional duties any of the following adverse cybersecurity events and threats have occurred directly as a result of using these platforms?	Variable measurement level: nominal (multi-choice question), converted into ratio variable – counting the number of selections
Economic	Question 11. Please state what basic benefits are generated due to the use of digital technology platforms in your company?	Variable measurement level: nominal (not subject to, e.g. factor analysis)
Human	Question 1. Does your company use digital technology platforms, which are tools that allow for connecting business partners and provide opportunities for intensifying contacts and performing transactions between them?	Variable measurement level: ordinal
	Question 5. Please state what attitude is taken by the personnel in your company about the implementation and use of digital technology platforms?	Variable measurement level: ordinal
	Question 16. Please state your gender.	Variable measurement level: nominal (not subject to, e.g. factor analysis)
	Question 17. Please state your age.	Variable measurement level: interval
	Question 18. Please state your education level.	Variable measurement level: interval
	Question 19. Please state how long you have been employed in the company in which you perform your professional duties now.	Variable measurement level: interval

(*Continued*)

Table 4.6 (Continued)

Index	*Interview question*	*Comments*
	Question 20. Please state how long has the company in which you perform your professional duties been active on the market.	Variable measurement level: interval
	Question 21. Please state your position in the company in which you perform your professional duties now.	Variable measurement level: nominal (not subject to, e.g. factor analysis)
Structural	Question 4. Please state what kind of digital technology platforms are or will be used (if there are plans for their implementation) in your company (please select all possible responses).	Variable measurement level: nominal (multi-choice question), converted into ratio variable – counting the number of selections
	Question 10. In which areas of your company's operation digital technology platforms are or will be used (if there are plans for their implementation)? (please select all possible responses)	Variable measurement level: nominal (multi-choice question), converted into ratio variable – counting the number of selections
	Question 12. Do you agree with the statement that digital technology platforms make it possible to create and develop innovative business models?	Variable measurement level: ordinal
	Question 14. Has the implementation of digital technology platforms in the company in which you perform your professional duties forced the company to introduce specific changes to its organisational structure or will you be forced to do so?	Variable measurement level: ordinal
Structural (socio-demographic)	Question 22. Please state in what kind of company in terms of headcount size you perform your professional duties?	Variable measurement level: interval
	Question 23. Which industry does your company operate in?	Variable measurement level: nominal (not subject to, e.g. factor analysis)

Source: Author's own work.

The attempt to construct a model using question no. 13 as the dependent variable and the indexes described above as independent variables generated the following results, presented in Tables 4.7 and 4.8.

In social sciences, results of calculations in inductive statistics which show the value of coefficient p (probability value) above 0.05 are regarded as statistically insignificant. Sometimes, an exception is made to the principle, quoting results of tests which actually exceeded the value of 0.05 but are not higher than 0.1.

Table 4.7 Summary of general coefficients of the optimal scaling model produced with the top-down method

Multiple R	0.361
R-squared	0.131
Adjusted R-squared	0.052

Source: Author's own work.

Table 4.8 ANOVA variance analysis for the optimal scaling model produced with the top-down method

	The sum of the squares	*The number of degrees of freedom (df)*	*Mean square*	*F*	*Significance*
Regression	15.805	10	1.580	1.653	$p \leq 0.1$
Residual	105.195	110	0.956		
Total	121.000	120			

Source: Author's own work.

There is a high risk here (at the level of 10%) of committing Type I error, such a result should be nevertheless at least recorded as a marginal note.

The model based on synthetic indexes explains **to a considerably lower extent than the model built as the first** the variation in question 13. The most relevant explanatory factor over one fourth (25.4%) of the variation of an independent variable is the structural (socio-demographic) factor, which includes the company's size and industry. This may be a reason for exploring the issue further.

During a systematic analysis of variables, a regularity was discovered, confirmed above and already mentioned, at the level of single indicators of inductive statistics using Pearson's chi-squared test. The result is presented in Table 4.9.

In a summary, it should be underlined that the hypothesis of joint impact of characteristics, referred to in the statistical literature as interaction, has been verified. To this end, a regression model for qualitative variables was built using the top-down method. It turned out to be satisfactory in terms of obtained results. Constructing the model with the use of the top-down method, in the first phase, all the variables were included to it, and then those with the lowest tolerance level were systematically eliminated in order to start rejecting, step by step, variables with the lowest goodness of fit expressed by F statistic. The most significant factor, strongly connected with the attitude to DTPs, turned out to be the economic factor, or financial benefits from using the platforms. The assessment of DTPs is also affected by numerous structural elements of the external and internal environment of the company. A small, though significant role is played by characteristics of the respondent – their length of employment, position in the company and education.

In addition, the model was built on the basis of arbitrary indexes (Table 4.10). It turned out to be borderline statistically significant and was excluded from further discussion, but it was decided that the direction of research indicated by it should

Table 4.9 Structural (socio-demographic) index – chi-squared test of correlation significance

Structural (socio-demographic) index	*Question 13. To what extent do digital technology platforms affect an increase in quality and intensity of relations established by the company?*													
	To a very large extent		*To a large extent*		*Neither to a large nor to a small extent*		*To a small extent*		*To a very small extent*		*I have no opinion*		*Total*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
0–25	4	30.8	6	46.2	2	15.4	0	0.0	0	0.0	1	7.7	13	100.0
26–50	10	35.7	11	39.3	3	10.7	2	7.1	0	0.0	2	7.1	28	100.0
51–75	15	36.6	16	39.0	5	12.2	0	0.0	5	12.2	0	0.0	41	100.0
76–100	15	38.5	14	35.9	1	2.6	0	0.0	1	2.6	8	20.5	39	100.0
Kruskal-Wallis test of inter-group comparisons							*Statistically insignificant*							
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient							χ^2 (15, N = 121) = 26.27; $p \leq 0.05$, V = 0.269							

Source: Author's own work.

Table 4.10 Components of the optimal scaling model produced with the top-down method

Name of the component (predictor)	*Beta coefficient*	*The number of degrees of freedom (df)*	*F*	*Significance*	*Zero-order correlation*	*Partial correlation*	*Semi-partial correlation*	*Importance*	*Tolerance after transformation*	*Tolerance before transformation*
Index – structural (socio-demographic) factor	0.261	0.201	1	10.682	0.197	0.274	0.262	0.254	0.547	0.944
Index – structural factor	0.147	0.163	3	0.816	0.488	0.140	0.154	0.145	0.157	0.975
Index – human factor	0.141	0.163	2	0.749	0.475	0.145	0.148	0.139	0.157	0.972
Index – economic factor	0.070	0.207	3	0.114	0.952	0.105	0.072	0.067	0.056	0.932
Index – cybersecurity factor	−0.138	0.159	1	0.756	0.386	−0.078	−0.141	−0.133	0.083	0.928

Source: Author's own work.

continue to be explored (factors connected with the enterprise's structure, such as the industry and the number of employees, as correlatives of attitudes to DTPs).

Further research was done with the use of cross tables. Question 13 was juxtaposed with questions: P2, P4, P5, P9, P10, P11, P16, P17, P18, P19, P20, P21, P22, P23. The cross (two-variable) tables were used to carry out analysis and to support inductive tests of inter-group differences (Tables 4.11–4.14). To find differences and similarities among groups selected during conceptual work, two tests were used: the Kruskal-Wallis test by ranks, also known as non-parametric variance analysis, and the Mann-Whitney U test. The first statistical tool was introduced to scientific practice in the 1950s by William H. Kruskal and W. Allen Wallis.[14] The test makes it possible to determine whether in a large ($k > 2$) group consisting of many elements, there are statistically significant differences between the elements. If the test shows such differences, then the next test is conducted – one introduced by Henry B. Mann and Donald R. Whitney to compare pairs of elements making up the group.[15] The second test allows for stating statistically significant differences between elements or their absence. The tests may be applied when the variables to be tested have been measured at least at the ordinal level and also at the interval or ratio level.

The result of the Kruskal-Wallis test is recorded in the following way:

$$H\left(\chi^2\left([x],\ N=[y]\right)=[z];\ p\leq[\alpha]\right)$$

It is interpreted as follows:

- x is the number of degrees of freedom;
- y is the size of the sample which was tested;
- z is the value of chi-squared test;
- α is the significance level of completed Kruskal-Wallis test.

The result of the Mann-Whitney U test is recorded in the following way:

$$U\left(N=[x]\right)=[y];\ p\leq[\alpha]$$

It is interpreted as follows:

- x is the size of the sample which was tested;
- y is the value of the Mann-Whitney U test;
- α is the significance level of completed test.

In these tests, similarly to other inductive tests, the following two statistical hypotheses are formulated: the null hypothesis (H_0), assuming that the compared groups are identical, and alternative hypothesis (H_1), according to which they are different. A test is found to be statistically significant if $p \leq 0.05$. The tables below present the assessment of changes caused as a result of using DTPs, taking into consideration many variables. Those variables which had been found not to

Table 4.11 Assessment of the impact of DTPs v. the type of platform used in the company

Question 4. Please state which kind of digital technology platforms is used or will be used?	*Question 13. To what extent do digital technology platforms affect an increase in quality and intensity of relations established by the company?*													
	To a very large extent		*To a large extent*		*Neither to a large extent nor to a small extent*		*To a small extent*		*To a very small extent*		*I have no opinion*		*Total*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Communication	37	38.9	36	37.9	9	9.5	2	2.1	3	3.2	8	8.4	95	100.0
Information	28	32.9	36	42.4	7	8.2	2	2.4	4	4.7	8	9.4	85	100.0
Comparison tools, for example for comparing prices or product features	3	25.0	5	41.7	3	25.0	1	8.3	0	0.0	0	0.0	12	100.0
Entertainment	2	22.2	5	55.6	0	0.0	0	0.0	0	0.0	2	22.2	9	100.0
Online markets	13	27.1	18	37.5	8	16.7	2	4.2	3	6.3	4	8.3	48	100.0
All of the above	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
Kruskal-Wallis test of inter-group comparisons	Communication platforms v. degree of impact – *statistically insignificant* Information platforms v. degree of impact – *statistically insignificant* Comparison platforms, for example for comparing prices or product features – *statistically insignificant* Entertainment platforms v. degree of impact – *statistically insignificant* Online markets v. degree of impact – *statistically insignificant* All of the above v. degree of impact – *statistically insignificant*													
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient	Communication platforms v. degree of impact – *statistically insignificant* Information platforms v. degree of impact – *statistically insignificant* Comparison platforms, for example for comparing prices or product features – *statistically insignificant* Entertainment platforms v. degree of impact – *statistically insignificant* Online markets v. degree of impact – *statistically insignificant* All of the above v. degree of impact – *statistically insignificant*													

Source: Author's own work.

Table 4.12 Assessment of the impact of DTPs v. the attitude of personnel to DTPs

Question 5. Please state what attitude is taken by the personnel in your company about the implementation and use of digital technology platforms?	*Question 13. To what extent do digital technology platforms affect an increase in quality and intensity of relations established by the company?*													
	To a very large extent		*To a large extent*		*Neither to a large nor to a small extent*		*To a small extent*		*To a very small extent*		*I have no opinion*		*Total*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Definitely positive	17	39.5	17	39.5	3	7.0	2	4.7	0	0.0	4	9.3	43	100.0
Rather positive	19	31.7	26	43.3	4	6.7	0	0.0	5	8.3	6	10.0	60	100.0
Neither positive nor negative	4	50.0	1	12.5	3	37.5	0	0.0	0	0.0	0	0.0	8	100.0
Rather negative	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
Definitely negative	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
I have no opinion about that topic	2	25.0	3	37.5	1	12.5	0	0.0	1	12.5	1	12.5	8	100.0
Kruskal-Wallis test of inter-group comparisons							*Statistically insignificant*							
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient							*Statistically insignificant*							

Source: Author's own work.

Table 4.13 Assessment of the impact of DTPs v. the battery of measurements of attitudes to DTPs

Question 9. To what extent do you agree with the following statements:		*Question 13. To what extent do digital technology platforms affect an increase in quality and intensity of relations established by the company?*												
		To a very large extent		*To a large extent*		*Neither to a large extent nor to a small extent*		*To a small extent*		*To a very small extent*		*I have no opinion*		*Total*	
1 The implementation of digital technology platforms generates excessively high costs, inadequate to benefits following from using them.	Definitely agree,	4	57.1	2	28.6	0	0.0	1	14.3	0	0.0	0	0.0	7	100.0
	rather agree,	1	20.0	1	20.0	0	0.0	0	0.0	1	20.0	2	40.0	5	100.0
	rather disagree,	15	30.6	20	40.8	5	10.2	1	2.0	4	8.2	4	8.2	49	100.0
	definitely disagree	24	40.0	24	40.0	6	10.0	0	0.0	1	1.7	5	8.3	60	100.0
2 The current utilisation of digital technology platforms amounts to an excessive financial burden for the company.	Definitely agree,	1	33.3	1	33.3	0	0.0	1	33.3	0	0.0	0	0.0	3	100.0
	rather agree,	2	22.2	5	55.6	0	0.0	0	0.0	0	0.0	2	22.2	9	100.0
	rather disagree,	19	31.1	27	44.3	5	8.2	1	1.6	4	6.6	5	8.2	61	100.0
	definitely disagree	22	45.8	14	29.2	6	12.5	0	0.0	2	4.2	4	8.3	48	100.0
3 Employees think that the use of digital technology platforms is ineffective from the economic perspective.	Definitely agree,	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0
	rather agree,	4	33.3	4	33.3	1	8.3	1	8.3	1	8.3	1	8.3	12	100.0
	rather disagree,	11	30.6	15	41.7	2	5.6	0	0.0	2	5.6	6	16.7	36	100.0
	definitely disagree	28	38.9	28	38.9	8	11.1	1	1.4	3	4.2	4	5.6	72	100.0
4 Stakeholders, such as business partners, suppliers or distributors, think that the use of digital technology platforms is ineffective from the economic perspective.	Definitely agree,	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	1	100.0
	rather agree,	1	50.0	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
	rather disagree,	26	32.9	32	40.5	7	8.9	1	1.3	6	7.6	7	8.9	79	100.0
	definitely disagree	17	43.6	14	35.9	4	10.3	0	0.0	0	0.0	4	10.3	39	100.0

(*Continued*)

Table 4.13 (Continued)

Question 9. To what extent do you agree with the following statements:	*Question 13. To what extent do digital technology platforms affect an increase in quality and intensity of relations established by the company?*						
	To a very large extent	*To a large extent*	*Neither to a large extent nor to a small extent*	*To a small extent*	*To a very small extent*	*I have no opinion*	*Total*
Kruskal-Wallis test of inter-group comparisons	Statement 1 v. degree of impact – *statistically insignificant* Statement 2 v. degree of impact – *statistically insignificant* Statement 3 v. degree of impact – *statistically insignificant* Statement 4 v. degree of impact – *statistically insignificant*						
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient	Statement 1 v. degree of impact – *statistically insignificant* Statement 2 v. degree of impact – χ^2 (15, N = 121) = 28.38; $p \leq 0.05$, V = 0.280 Statement 3 v. degree of impact – *statistically insignificant* Statement 4 v. degree of impact – χ^2 (15, N = 121) = 65.00; $p \leq 0.05$, V = 0.423						

Source: Author's own work.

Table 4.14 Assessment of the impact of DTPs v. fields of application of DTPs in the company

Question 10. In which areas of your company's operation digital technology platforms are or will be used?	*Question 13. To what extent do digital technology platforms affect an increase in quality and intensity of relations established by the company?*													
	To a very large extent		*To a large extent*		*Neither to a large extent nor to a small extent*		*To a small extent*		*To a very small extent*		*I have no opinion*		*Total*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Management, including human resources management	23	33.3	27	39.1	7	10.1	2	2.9	2	2.9	8	11.6	69	100.0
Marketing	40	38.8	40	38.8	8	7.8	2	1.9	5	4.9	8	7.8	103	100.0
Sales	29	30.2	41	42.7	10	10.4	2	2.1	6	6.3	8	8.3	96	100.0
Research and development (R&D)	16	32.7	20	40.8	5	10.2	1	2.0	4	8.2	3	6.1	49	100.0
Procurement	23	38.3	24	40.0	3	5.0	1	1.7	2	3.3	7	11.7	60	100.0
Production	9	27.3	12	36.4	4	12.1	2	6.1	1	3.0	5	15.2	33	100.0
Distribution and transport	11	30.6	15	41.7	4	11.1	2	5.6	1	2.8	3	8.3	36	100.0
Finance	20	28.6	30	42.9	7	10.0	2	2.9	4	5.7	7	10.0	70	100.0
Customer service	40	37.7	40	37.7	9	8.5	2	1.9	5	4.7	10	9.4	103	100.0
All of the above	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	1	100.0

(*Continued*)

Table 4.14 (Continued)

Question 10. In which areas of your company's operation digital technology platforms are or will be used?	*Question 13. To what extent do digital technology platforms affect an increase in quality and intensity of relations established by the company?*													
	To a very large extent		*To a large extent*		*Neither to a large extent nor to a small extent*		*To a small extent*		*To a very small extent*		*I have no opinion*		*Total*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Kruskal-Wallis test of inter-group comparisons	Management, including human resources management v. degree of impact – *statistically insignificant* Marketing v. degree of impact – *statistically insignificant* Sales v. degree of impact – *statistically insignificant* Research and development (R&D) v. degree of impact – *statistically insignificant* Procurement v. degree of impact – *statistically insignificant* Production v. degree of impact – *statistically insignificant* Distribution and transport v. degree of impact – *statistically insignificant* Finance v. degree of impact – *statistically insignificant* Customer service v. degree of impact – *statistically insignificant* All of the above v. degree of impact – *statistically insignificant*													
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient	Management, including human resources management v. degree of impact – *statistically insignificant* Marketing v. degree of impact – *statistically insignificant* Sales v. degree of impact – *statistically insignificant* Research and development (R&D) v. degree of impact – *statistically insignificant* Procurement v. degree of impact – *statistically insignificant* Production v. degree of impact – *statistically insignificant* Distribution and transport v. degree of impact – *statistically insignificant* Finance v. degree of impact – *statistically insignificant* Customer service v. degree of impact – *statistically insignificant* All of the above v. degree of impact – χ^2 (5, N = 121) = 60.00; $p \leq 0.05$, V = 0.704 (because of too small sizes, this is not taken into account in the analysis)													

Source: Author's own work.

differentiate the attitudes to DTPs in a statistically significant manner were disregarded. This refers to declared benefits, education, length of employment, duration of the company's operation, type of occupied position and the industry in which the company operates.

Subsamples are too small to extrapolate from the sample to the population, therefore the presented findings and conclusions are inherently approximate. The structure of responses about the assessment of the degree of impact of DTPs on the increase in the intensiveness of relations established by the company is different only with regard to people who declare that the kind of platforms used by them are online markets. Users of such platforms as a group rate more poorly the positive impact of the technology on the company. The other groups are indistinguishable in terms of distribution of responses, although the low number of samples is not conducive to being certain about it.

Variables P5 and P13 are not autocorrelative. On the one hand, this makes it possible to use in calculations one of the variables as dependent and the other as independent, but on the other, such a situation requires explanation (no obvious correlation). The performed tests show that there is a weak positive connection (e.g. Pearson's R, calculated *ad hoc*, is 0.09) but it is not statistically significant (coefficient p, or probability value, is far above 0.05). That is connected with the size of the sample and numerous categories of items making up each question.

A positive correlation was found between a favourable assessment of the impact on an increase in quality and intensiveness of relations established by the company and the same positive assessment that using the platforms is reasonable for the company's stakeholders (business partners, suppliers, distributors). The correlation is moderate (coefficient 0.42 on H. Cramér's scale) and it is statistically significant. A bit weaker correlation was found between the same independent variable (question 13) and the view that DTPs are not an excessive financial burden for the company. Here Cramér's V coefficient was 0.28 and it is also interpreted as a moderate correlation because it lies between 0.3 and 0.5.

The fields of application of DTPs in a company influence very little a positive or negative assessment of an increase in the quality and intensiveness of relations established by the company. The only distinct variable, which is different from the remaining ones in terms of statistical significance, is the group of people declaring that sales platforms are used or will be used in the future. The sizes, however, do not diverge from the rest, so we should be cautious about the result.

In the course of further research, correlation was set up with inter-group comparisons to find various "special characteristics" of the use of digital platforms from the point of view of various groups of respondents (multi-level description of the surveyed population). Assumptions and directions of exploration were determined by the questions accepted as independent variables.

Question 2. If in question 1 you have selected the response "definitely so" or "rather so", then please state how long digital technology platforms have been used in the company in which you perform your professional duties?

Question 4. *Please state what kind of digital technology platforms are or will be used (if there are plans for their implementation) in your company (please select all possible responses)*

Question 22. Please state in what kind of company in terms of headcount size you perform your professional duties?

At this point, the results which refer strictly to hypotheses H1 and H5 will be presented (in Tables 4.15–4.24). With regard to them, correlation between questions 2 and 6 should be described. The relevant data are presented in Table 4.15.

The marginal distributions in Table 4.15 show the following divergence: the longer a company uses DTPs, the more the employees are willing to participate in training and active in generating new ideas connected with the use of DTPs. At the same time, the following similarities are observed: both groups most often pointed out the following factors: (1) giving consent to any changes resulting from the implementation of DTPs, including changes connected with the organisational structure (85.4% of those using platforms for three years or shorter and 85.2% for those using the longer), (2) great involvement in the performance of tasks (75% from the first group and 85.2% from the second) and (3) being interested in next investments regarding the implementation of DTPs (68.8% and 77.8% respectively) as effects of a positive attitude to performed projects.

In this respect, there are no statistically significant differences between the analysed groups. Both agree nearly in 100% with the statement that DTPs make it possible to create and develop innovative business models. It should be noted that the force of positive conviction that the statement is true is higher for those companies which use platforms longer (more than three years).

Both groups of the surveyed enterprises adopt the same position about a high or very high impact of using DTPs on increase in quality and intensiveness of relations established by the companies. In this case, there are no statistically significant differences between the groups.

There are no significant differences between both groups also with regard to the issue of the necessity to introduce changes in the company's organisational structure as a result of using DTPs. In both groups, a similar percentage of respondents declare that such changes should have been introduced (60.4% of the respondents using platforms for three years or shorter and 53.2% of those using them longer). A cautious interpretation of the results is that people using DTPs for more than three years no longer notice very well the already implemented or potential changes in the organisational structure.

Both groups make similar declarations about the changes which have taken place as a result of the introduction of DTPs. The most frequent of these include creation of a new job/position(s) for persons who will be responsible for the maintenance of the platforms (51.4% – enterprises using platforms for three years or shorter and 63.6% – those using them longer than three years), and transformations in the governance and managerial structure (28.6% and 45.5% respectively). The only statistically significant difference is found in selections about liquidation of existing jobs. In enterprises using platforms for more than three years, there are

Table 4.15 Duration of using digital technology platforms v. involvement of managerial staff

Question 6. What shows the positive attitude of the personnel to the implementation and use of digital technology platforms in your company?	*Question 2. Please state how long digital technology platforms have been used in the company in which you perform your professional duties?*			
	Up to three years		*More than three years*	
	N	*%*	*N*	*%*
Active involvement in the performance of tasks related to the implementation and use of digital technology platforms	36	75.0	46	85.2
Great spontaneous willingness to participate in training in this area	26	54.2	37	68.5
Active generation of new ideas connected with the use of digital technology platforms	33	68.8	42	77.8
Giving consent to any changes resulting from the implementation of digital technology platforms, including changes connected with the organisational structure	41	85.4	46	85.2
Being highly ready for changes concerning one's own professional duties	37	77.1	43	79.6
Being interested in next investments regarding the implementation of digital technology platforms	33	68.8	42	77.8
Mann-Whitney *U* test of inter-group comparisons	Involvement in the performance of tasks v. duration of use – *statistically insignificant* Willingness to participate in training v. duration of use – *statistically insignificant* Active generation of new ideas v. duration of use – *statistically insignificant* Consent to changes v. duration of use – *statistically insignificant* Readiness for changes of own professional duties v. duration of use – *statistically insignificant* Further investments v. duration of use – *statistically insignificant*			
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient	Involvement in the performance of tasks v. duration of use – *statistically insignificant* Willingness to participate in training v. duration of use – *statistically insignificant* Active generation of new ideas v. duration of use – *statistically insignificant* Consent to changes v. duration of use – *statistically insignificant* Readiness for changes of own professional duties v. duration of use – *statistically insignificant* Further investments v. duration of use – *statistically insignificant*			

Source: Author's own work.

Table 4.16 Duration of using digital technology platforms v. development of innovative business models

Question 12. Do you agree with the statement that digital technology platforms make it possible to create and develop innovative business models?	*Question 2. Please state how long digital technology platforms have been used in the company in which you perform your professional duties?*			
	Up to three years		*More than three years*	
	N	*%*	*N*	*%*
Definitely agree	25	43.1	37	59.7
Rather agree	29	50.0	16	25.8
Neither agree nor disagree	4	6.9	8	12.9
Rather disagree	0	0.0	1	1.6
Definitely disagree	0	0.0	0	0.0
Mann-Whitney *U* test of inter-group comparisons	*Statistically insignificant*			
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient	*Statistically insignificant*			

Source: Author's own work.

Table 4.17 Duration of using digital technology platforms v. improvement in the quality of the enterprise's relations

Question 13. To what extent do digital technology platforms affect an increase in quality and intensity of relations established by the company?	*Question 2. Please state how long digital technology platforms have been used in the company in which you perform your professional duties?*			
	Up to 3 years		*More than 3 years*	
	N	*%*	*N*	*%*
To a very large extent	21	36.2	23	37.1
To a large extent	22	37.9	24	38.7
Neither to a large extent nor to a small extent	5	8.6	6	9.7
To a small extent	0	0.0	2	3.2
To a very small extent	3	5.2	3	4.8
I have no opinion about that topic	7	12.1	4	6.5
Mann-Whitney *U* test of inter-group comparisons	*statistically insignificant*			
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient	*statistically insignificant*			

Source: Author's own work.

Table 4.18 Duration of using digital technology platforms v. necessity of organisational changes

Question 14. Has the implementation of digital technology platforms in the company in forced the company to introduce specific changes to its organisational structure or will it be forced to do so?	*Question 2. Please state how long digital technology platforms have been used in the company in which you perform your professional duties?*			
	Up to three years		*More than three years*	
	N	*%*	*N*	*%*
Definitely so	8	13.8	7	11.3
Rather so	27	46.6	26	41.9
Neither agree nor disagree	13	22.4	7	11.3
Rather not	9	15.5	17	27.4
Definitely not	1	1.7	5	8.1
Mann-Whitney *U* test of inter-group comparisons	*Statistically insignificant*			
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient	*Statistically insignificant*			

Source: Author's own work.

Table 4.19 Duration of using digital technology platforms v. organisational changes

Question 15. What are (will be) the changes in the company's organisational structure resulting from the implementation of digital technology platforms?	*Question 2. Please state how long digital technology platforms have been used in the company in which you perform your professional duties?*			
	Up to three years		*More than three years*	
	N	*%*	*N*	*%*
Opening a new branch of the enterprise	0	0.0	0	0.0
Liquidation of an existing branch of the enterprise	0	0.0	1	3.0
Setting up a new department(s) of the enterprise	10	28.6	11	33.3
Liquidation of an existing department/existing departments of the enterprise	0	0.0	2	6.1
Creation of a new job/position(s)	18	51.4	21	63.6
Liquidation of an existing job/position(s)	0	0.0	4	12.1
Transferring specific groups of employees to another department/other departments of the enterprise	1	2.9	4	12.1
Transformations in the governance and managerial structure	10	28.6	15	45.5

(*Continued*)

Table 4.19 (Continued)

Question 15. What are (will be) the changes in the company's organisational structure resulting from the implementation of digital technology platforms?	*Question 2. Please state how long digital technology platforms have been used in the company in which you perform your professional duties?*			
	Up to three years		*More than three years*	
	N	*%*	*N*	*%*
Mann-Whitney *U* test of inter-group comparisons	Opening a new branch of the enterprise v. duration of use – *statistically insignificant* Liquidation of an existing branch of the enterprise v. duration of use – *statistically insignificant* Setting up a new department(s) of the enterprise v. duration of use – *statistically insignificant* Liquidation of an existing department/existing departments of the enterprise v. duration of use – *statistically insignificant* Creation of a new job/position(s) v. duration of use – *statistically insignificant* Liquidation of an existing job/position(s) v. duration of use – $U(N=68)=507.5$; $p \leq 0.05$ Transferring specific groups of employees to another department/other departments of the enterprise v. duration of use – *statistically insignificant* Transformations in the governance and managerial structure v. duration of use – *statistically insignificant*			
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient	Opening a new branch of the enterprise v. duration of use – *statistically insignificant* Liquidation of an existing branch of the enterprise v. duration of use – *statistically insignificant* Setting up a new department(s) of the enterprise v. duration of use – *statistically insignificant* Liquidation of an existing department/existing departments of the enterprise v. duration of use – *statistically insignificant* Creation of a new job/position(s) v. duration of use – *statistically insignificant* Liquidation of an existing job/position(s) v. duration of use – $\chi^2 (1, N=121)=4.50$; $p \leq 0.05$, $V=257$ Transferring specific groups of employees to another department/other departments of the enterprise v. duration of use – *statistically insignificant* Transformations in the governance and managerial structure v. duration of use – *statistically insignificant*			

Source: Author's own work.

Table 4.20 Company size v. benefits from using the platforms

Question 11. Benefits are generated due to the use of digital technology platforms in the company	*Company size*							
	Micro		*Small*		*Medium*		*Large*	
	Rank sum	*Rank*	*Rank sum*	*Rank*	*Rank sum*	*Rank*	*Rank sum*	*Rank*
Growth of profits	75.9	2	100.0	1	100.0	1	100.0	1
Growth of competitiveness	100.0	1	74.8	2	70.9	2	73.6	3
Enlarging the product offering	70.7	3	48.9	4	51.5	4	66.7	4
Increase in market share	41.4	6	45.8	5	33.5	6	35.8	6
Increase in the level of innovativeness	43.1	5	30.5	9	37.4	5	35.8	6
Increase in the number of customers	70.7	3	38.9	6	13.7	11	14.4	9
Improvement of customer service and increased consumer satisfaction level	44.8	4	36.6	7	17.6	10	8.0	12
Increase in the number of markets in which the company is active	8.6	9	31.3	8	28.6	8	28.9	7
Increasing the number of business partners, including those operating on in a virtual environment	—	—	29.8	10	33.0	7	37.8	5
Optimisation of performance of various business processes, including those relating to customer service	12.1	8	74.0	3	63.9	3	87.6	2
Development of digital supply chains	—	—	16.8	11	12.8	13	3.0	13
Increase in the general effectiveness of the company's operations	29.3	7	30.5	9	13.2	12	22.4	8
Increasing flexibility of operations, which shows in the capability for launching new products and services quickly	8.6	9	15.3	12	7.5	14	11.4	11
Opportunity to get involved actively in programmes initiated in the virtual space to expand the range of goods and services or the database of customers	—	—	8.4	13	20.7	9	12.9	10

Source: Author's own work.

Table 4.21 Company size v. creating innovative business models

Question 12. Do you agree with the statement that digital technology platforms make it possible to create and develop innovative business models?	*Company size*							
	Micro		*Small*		*Medium*		*Large*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Definitely agree	10	83.3	18	64.3	15	36.6	19	48.7
Rather agree	1	8.3	5	17.9	24	58.5	15	38.5
Neither agree nor disagree	1	8.3	5	17.9	1	2.4	5	12.8
Rather disagree	0	0.0	0	0.0	1	2.4	0	0.0
Definitely disagree	0	0.0	0	0.0	0	0.0	0	0.0
Kruskal-Wallis test of inter-group comparisons	*Statistically insignificant*							
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient	*Statistically insignificant*							

Source: Author's own work.

Table 4.22 Company size v. company's relationships with the environment

Question 13. To what extent do digital technology platforms affect an increase in quality and intensity of relations established by the company?	*Company size*							
	Micro		*Small*		*Medium*		*Large*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
To a very large extent	4	33.3	10	35.7	15	36.6	15	38.5
To a large extent	5	41.7	11	39.3	16	39.0	14	35.9
Neither to a large extent nor to a small extent	2	16.7	3	10.7	5	12.2	1	2.6
To a small extent	0	0.0	2	7.1	0	0.0	0	0.0
To a very small extent	0	0.0	0	0.0	5	12.2	1	2.6
Kruskal-Wallis test of inter-group comparisons	*Statistically insignificant*							
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient	*Statistically insignificant*							

Source: Author's own work.

Table 4.23 Company size v. changes in the company's organisational structure

Question 14. Has the implementation of digital technology platforms in the company in forced the company to introduce specific changes to its organisational structure or will it be forced to do so?	*Company size*							
	Micro		*Small*		*Medium*		*Large*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Definitely so	3	25.0	3	10.7	5	12.2	4	10.3
Rather so	2	16.7	13	46.4	18	43.9	20	51.3
Neither agree nor disagree	1	8.3	3	10.7	7	17.1	9	23.1
Rather not	4	33.3	6	21.4	11	26.8	5	12.8
Definitely not	2	16.7	3	10.7	0	0.0	1	2.6
Kruskal-Wallis test of inter-group comparisons	*statistically insignificant*							
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient	*statistically insignificant*							

Source: Author's own work.

Table 4.24 Company size v. organisational changes

Question 15. What are (will be) the changes in the company's organisational structure resulting from the implementation of digital technology platforms?	*Company size*							
	Micro		*Small*		*Medium*		*Large*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Opening a new branch of the enterprise	0	0.0	0	0.0	0	0.0	0	0.0
Liquidation of an existing branch of the enterprise	1	20.0	0	0.0	0	0.0	0	0.0
Setting up a new department(s) of the enterprise	3	60.0	9	56.3	6	26.1	3	12.5
Liquidation of an existing department/existing departments of the enterprise	0	0.0	1	6.3	0	0.0	1	4.2
Creation of a new job/position(s)	5	100.0	8	50.0	13	56.5	13	54.2
Liquidation of an existing job/position(s)	1	20.0	1	6.3	0	0.0	2	8.3
Transferring specific groups of employees to another department/other departments of the enterprise	0	0.0	3	18.8	0	0.0	2	8.3
Transformations in the governance and managerial structure	1	20.0	8	50.0	7	30.4	9	37.5

(*Continued*)

Table 4.24 (Continued)

Question 15. What are (will be) the changes in the company's organisational structure resulting from the implementation of digital technology platforms?	*Company size*							
	Micro		*Small*		*Medium*		*Large*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Kruskal-Wallis test of inter-group comparisons	Opening a new branch of the enterprise v. duration of use – *statistically insignificant* Liquidation of an existing branch of the enterprise v. duration of use – *statistically insignificant* Setting up a new department(s) of the enterprise v. duration of use – *statistically insignificant* Liquidation of an existing department/existing departments of the enterprise v. duration of use – *statistically insignificant* Creation of a new job/position(s) v. duration of use – *statistically insignificant* Liquidation of an existing job/position(s) v. duration of use – *statistically insignificant* Transferring specific groups of employees to another department/other departments of the enterprise v. duration of use – *statistically insignificant* Transformations in the governance and managerial structure v. duration of use – *statistically insignificant*							
Pearson's chi-square test of associations between variables and Cramér's V contingency coefficient	Opening a new branch of the enterprise v. duration of use – *statistically insignificant* Liquidation of an existing branch of the enterprise v. duration of use – *statistically insignificant* Setting up a new department(s) of the enterprise v. duration of use – *statistically insignificant* Liquidation of an existing department/existing departments of the enterprise v. duration of use – *statistically insignificant* Creation of a new job/position(s) v. duration of use – *statistically insignificant* Liquidation of an existing job/position(s) v. duration of use – *statistically insignificant* Transferring specific groups of employees to another department/other departments of the enterprise v. duration of use – *statistically insignificant* Transformations in the governance and managerial structure v. duration of use – *statistically insignificant*							

Source: Author's own work.

cases of liquidating jobs as a result of the introduction of new solutions. In the situation, there is also a statistically significant relation between variables but it is not strong.

For all enterprises, regardless of the headcount level, the most important benefits generated due to the use of digital platforms include growth of profits and increase in the competitiveness level. For companies employing up to 49 people, the factors

of increasing the number of customers, improving customer service and raising the customer satisfaction level ranked higher than in the case of medium-sized and large companies. In turn, for companies employing over 250 people, in contrast to the remaining types of enterprises, a higher rank is given to increasing the number of business partners.

Representatives of all enterprises, regardless of the headcount level, nearly completely agree with the statement that DTPs make it possible to create and develop innovative business models.

For all the enterprises, the typical responses are that using DTPs affects "to a very large" or "large extent" an increase in quality and intensity of relations established by the company with other entities operating in the environment. There are no significant differences in this respect among the analysed groups.

For most companies, the implementation of DTPs was connected with the introduction of changes in the organisational structure. For enterprises employing over ten people, selections of changes were more than half (small – 57.1%, medium-sized – 56.1%, large – 61.6%). There are no significant differences between the groups when considering this aspect.

The most frequently introduced changes in the companies' organisational structure should include creation of new jobs, and for those employing up to 49 people – opening new departments. Transformations in the governance and managerial structure were selected by respondents from companies employing over ten employees. However, the populations of the groups are too small to draw conclusions about significant differences between the groups.

Summing up this part of the work, it should be stressed that a model was built using the CATREG regression model for qualitative variables, which made it possible to verify the main proposition and research hypotheses H1 and H5. The model turned out to be statistically significant and explained 21.8% of variation of the dependent variable (P13). The model included nine independent variables. The most significant impact factors for the extent to which DTPs affect an increase in quality and intensity of relations established by the company with stakeholders are:

- the variable concerning benefits generated by using DTPs (P11) – explains 38.6% of the variation of the dependent variable;
- the industry in which the company operates (P23) – explains 20.8% of the variation of the dependent variable;
- current or future changes made necessary by the implementation of DTPs (P14) – explains 10.7% of the variation of the dependent variable.

The model was supplemented with additional meticulous analyses. Many weak but promising trails have been found, but they will need to be confirmed in further research. In this respect, it may be only mentioned that according to representatives of the surveyed companies, a correlative of the dependent variable is the conviction about a multifaceted impact of DTPs on a company (P10 v. P13).

Furthermore, attention should be drawn to the following disclosed co-variances (they are **not too high** but regular and statistically significant; they should be

interpreted with caution, they may be regarded as obvious, common-sensical, autocorrelative):

- the longer a company uses DTPs, the more the employees are willing to participate in training and active in generating new ideas connected with the use of digital technology platforms;
- the longer a DTP is used in a company, the higher the benefits are, also regarding competitiveness (P11);
- in enterprises using platforms for more than three years, there are cases of liquidating jobs as a result of the introduction of new solutions;
- people using DTPs for more than three years no longer notice very well the already implemented or potential changes in the organisational structure (P2).

The general conclusion is that digital technology platforms enable and facilitate the introduction of changes in the operation of companies, including in the spheres of management, marketing or sales (relations with stakeholders) and that they are significant factors affecting the competitiveness of companies. This way, it should be concluded that hypotheses H1 and H5 have been confirmed.

4.3 A Consumer as a Co-Originator of Innovative Changes to Business Models

One of the hypotheses which has been formulated in this monograph concerns co-creation of innovations by the consumer. The literature on the subject matter discusses the related issues in broad terms. It stresses that at present, while many modern business models are in operation, a consumer is not only a recipient but also a creator of innovations. According to K. Karpińska, A. Matel and A. Protasiewicz, this applies to the majority of models based on innovations.[16] It should be noted that modern technologies and DTPs play a great role in this, which is possible mainly due to the use of functionalities available over the Internet.[17]

The concept of active participation of a consumer follows from several fundamental factors. In addition, it should be noticed at once that the concept has evolved with gradual changes in relations initiated by enterprises and their customers. This is because the relations have become more and more intensive, as a result of which customers have no longer been treated only as passive recipients of the companies' offer but also as co-creators of various products, including innovations. This has brought the elimination of the traditional division of the market into enterprises managing value and consumers purchasing goods.[18] The said factors mainly refer to the fact that the main objective of launching new goods on the market is to satisfy consumers' needs, both those openly expressed and hidden. Therefore, each product or service must exactly fulfil the needs so that it can be successful in the market. Considering that, it is important that processes of designing products and services should be performed while taking into account suggestions reported by consumers themselves. Due to this, various goods will be manufactured and offered in connection with these needs, which guarantees high demand for them.

This is applicable especially to innovative products which, because of being novel, may not arouse interest of many customers, therefore it is so important to design them and implement for production with participation of consumers. This way, their engagement increases the chance of appropriate promotion of the respective product is considerably increased and generation of many benefits, both for the manufacturer and the consumer.[19]

A consumer may be involved in the performance of innovative processes within three basic activities. They include:

- initiating development of a new product or service, or seeking appropriate ideas and gradually developing the respective concept – in that area, due to suggestions of consumers, it is possible to verify initial ideas effectively to select one which has the greatest chances of success;
- product development – in that area, technological capabilities are prepared and verified for producing a product, developing a prototype of product or service, conducting market tests and designing activities for launching the product on the market; in these activities, the consumer plays the key role by testing the product or service and possibly indicating what should be improved so that they satisfy market requirements;
- launching the product on the market – this includes performance of the strategy for implementing the respective innovation; in that area, the consumer's role amounts to participation in market research, owing to which it becomes possible to prepare possible modifications to a product or service so that they satisfy to a greater extent the consumer's requirements.[20]

It should be emphasised that effective inclusion of a consumer in processes connected with co-creating innovations would not be possible without changes taking place in contemporary business models, including, to a large extent, with the use of DTPs.[21] One should refer here to the concept developed by K. Nordström and M. Biaström, who noticed that the basic role in creating any kind of innovation belongs to consumers. For this reason, most enterprises operating on the market take advantage of the support offered by consumers while developing innovations. This is done in the course of model configuration of products and services, which is more and more widely promoted in the practice of companies' operation and which a manifestation of changes in business models, which are taking place on a wide scale.[22]

The described configuration would not be possible without digital solutions, including those based on DTPs. This is so since such platforms allow for achievement of network effect, which means that their operation involves a large group of users who offer support with improving the way a DTP works or with generating innovations. DTPs are tools which serve to stimulate the activity of consumers regarding co-creation of innovative solutions, while companies, due to these platforms, may hold dialogue with consumers and acquire access to knowledge possessed by individual users as well as the entire online communities. Members of those communities therefore become a source for new product development.[23]

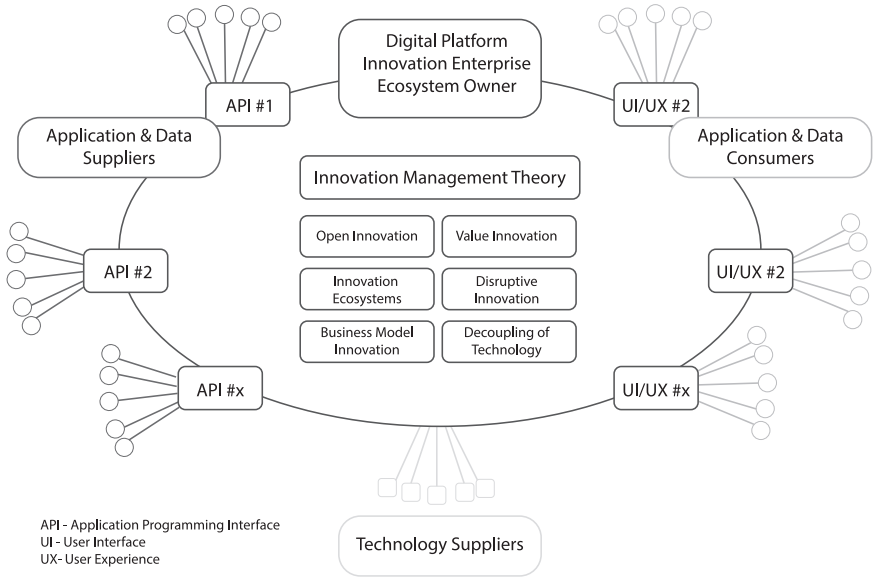

Figure 4.2 Digital technology platform as a tool for companies' cooperation with consumers
Source: Author's own work based on L. Bouwer, *op. cit.*, p. 2.

As already mentioned in Chapter II of the monograph, DTPs operate in the circumstances of a business ecosystem. What is important, it gathers diverse stakeholders, including consumers. This is shown in Figure 4.2.

What is characteristic for a DTP, which operate within a business ecosystem, is creation of networks of various kinds of relations and connections among various entities. This refers to a large extent also consumers who are responsible for generating ideas and sharing their experience while developing innovations. For this purpose, specific interfaces (UI) are used which are accessible through DTPs.

What seems relevant here is the concept of *open innovations*, which include the operation of *open collaborative innovation and digital platforms.* Due to such platforms, it is possible to take advantage of external resources to generate innovations, which is a consequence of the existence of open space for any innovations put forward by users. In the case of these platforms, for example, there are joint open laboratories which make it possible to share experience and ideas.[24] One of the varieties of open innovations are already described here crowdfunding, crowdsourcing and crowdworking platforms, allowing companies to acquire intellectual or time resources coming from users.[25]

An especially important role in making it possible for consumers to take an active part in developing innovations is played by social media, including mostly those which ensure integration of DTPs with CRM systems (they are based on technology SMAC 3.0. – see Section 3.4). It so happens because they provide opportunities for creating various communities which may concentrate on implementing

innovative solutions and considering that contact through platforms is initiated efficiently and without costs, this may lead to the development of innovations in a relatively short period and without the necessity of incurring excessive expenditures. What should be stressed is that at present, innovations are generated not only on specific social portals, including in closed groups using the support of communication apps such as Messenger, but also within topical blogs and microblogs.[26]

Innovative changes in contemporary business models which are oriented to the widest possible use of digital technologies, creation of various kinds of networks or multi-aspectual innovation management, contribute to making the consumer a co-creator of innovations. This is mainly entailed by using DTPs, or for example, crowdfunding platforms or social media, which gather many users, to offer them using their knowledge to generate new ideas and design innovative products, services or processes. What is more, at present, a consumer also becomes a co-author of changes to business models. This is because it should be stressed that the manner in which the modern market and each company work is largely determined by megatrends regarding consumption, which result in individualisation and virtualisation, implying wider engagement of consumers in creating value and developing innovative ideas. Consumers perceive that it is possible to have their needs satisfied effectively mostly due to their activity in the field of designing and implementing products.[27] It is just for this reason that the concept of *sharing economy*, among other ones, is promoted on a wide scale. What is important, such activity follows for the most part from the functionalities offered by DTPs. After all, it is them that make it possible, for example, to create a community of users who concentrate on the idea of developing a certain concept, whose effect may be a specific innovative product or service. It should be underlined that the above successfully confirms hypothesis H3, according to which innovative changes to the business model based on a DTP make it possible to include the consumer in the processes of co-creating innovations.

4.4 Digital Opportunities for Expanding Consumer Experience

It is necessary to stress that digital platforms and brands working on them which concentrate on building positive customer experience (this is a concept referred to as customer experience excellence) are able to achieve market successes and win customers faster than other entities. As can be seen from the survey conducted in 2018 by KPMG on a sample of 5,000 respondents, the brands which implement the above concept generate revenues higher by 9% on average than other enterprises.[28] This demonstrates the great importance of the need to perform a strategy oriented to enhancing customer experience for company management. Good prospects in the area are associated with DTPs.

DTPs undoubtedly lead to increasing customer experience. In this respect, it must be stressed again that a consumer is becoming not only a recipient but also a creator or developer of various goods or innovative projects. This helps build their brand loyalty, additionally increasing their competences, including digital ones, which provides opportunities for continual growth and contributes to personal and

the entire entity's success. It should be noticed that currently, mostly due to DTPs, consumers are becoming prosumers, that is entities that provide companies with a lot of feedback used for example to develop innovative products, upgrade the offer or create a network of mutual connections and relations with stakeholders.[29] Consumer activism is possible mainly due to digital platforms on which various kinds of comment systems and blogs are provided for users to share their comments and suggestions. This phenomenon causes the so-called incorporation of customers, which means gradually blurring the line between the organisation and its internal resources on the one hand and its external environment, including customers, on the other, as a result of which consumers are becoming part of the organisation. It gives them an opportunity to experience in a completely novel way everything connected with shopping or initiating contacts with other people, including active pursuit of personal growth and active participation in the respective market, influencing what is going on there. Due to DTPs, grounds are provided for a new kind of marketing – experience marketing, where the key role is played by what consumers feel, also about using a platform.[30]

Digitalisation, shown by the operation of an ever-higher number of DTPs, leads to a considerable expansion of customer experience within the so-called six pillars. They are discussed in Table 4.25.

It should be stressed that in the digital world, all the above six pillar are applicable but because of the innovatory approach of DTPs to issues connected with the organisation of sales processes, communication or customer service, the experience gained by consumers in terms of these pillars is more wide-ranging than in the case of the traditional relationships between a company and its customers. This can be exemplified by two platforms – Booking.com and Allegro.pl (the latter works

Table 4.25 Six pillars of customer experience

Name of the pillar	*Elements of the pillar*
Integrity	• Trust to brand (platform, organisation) • Degree to which promises made to the consumer are fulfilled • Coherence of actions with declared values and mission
Resolution	• Coping with difficult situations (acting effectively) • Acting immediately • Being able to admit to having made a mistake • Providing the consumer with support
Expectations	• The degree to which customers' needs are satisfied or to which the company went beyond (functionality, service standard, manner of handling complaints) • Appropriate communication about what a customer may expect
Time and effort	• Minimising time and effort needed to do something, for example make a purchase • Removing unnecessary obstacles and difficulties
Personalisation	• Adjusting the offer to individual needs
Empathy	• Understanding the customer's special situation by building a relationship based on positive emotions

Source: [Cyfrowy] klient…, *op. cit.*, p. 9.

in a similar manner to Amazon or eBay). The former causes many new customer experiences mainly in the area of personalisation (matching search results closely to customers' preferences), time and effort and empathy (the platform makes it possible to present real-time information about free rooms or apartments so that the user does not have to contact each facility to make a reservation or advance payment) as well as customers' expectations (the Booking.com platform allows for looking through any offers and making reservations of facilities around the world in a few minutes).[31]

In the case of Allegro.pl, it should be mentioned that the platform puts a strong emphasis on increasing consumers' trust and loyalty to it. It is enough to mention the Allegro Smart! Service, which ensures, in exchange for a relatively low fee, free-of-charge shipment of products worth PLN 40 or more (in Amazon.com, the corresponding service is Amazon Prime; another example is Empik Premium, a service of the Polish Empik bookstore chain, which for a subscription fee offers free-of-charge shipment and also various kinds of special offerings and discounts). Allegro Smart! Creates completely new experience for customers who got used to pay for shipment in each case – this service entirely changed the model, satisfying many needs of customers, here concerning the opportunity to buy products for the lowest price possible. The platform, similarly to Amazon or eBay, generates completely new quality as well with regard to effectiveness of searching (at present, at the level of 96%), use of varied communication channels (social media) or transaction security (buyer protection program, which allows for getting a refund of cash paid in favour of an unfair seller; in addition, there is an option of discussion between the seller and the buyer, in which representatives of the portal participate, and a system for evaluating contracting parties and even various products). This causes Allegro.pl to be perceived as more reliable by its users. It should be also mentioned that the platform provides users with access to simply enormous number of products and is extremely easy and intuitive to use, which in connection with the possibility of using the platform in many different forms, also in a mobile version, makes it create new experience in the area of empathy, personalisation, solving problems or time and effort.[32]

The examples of two platforms described above show that DTPs enlarge customer experience on a wide scale. This happens because of a totally innovative approach of the platforms to issues connected with performing transactions or communication with consumers. Even a few years ago, certainly a relatively small number of people thought that one time it would be possible to make online purchases with minimum costs of delivery. Now many platforms provide such an opportunity. So DTPs create a completely new level of customer service which is not encountered in online relations.

In view of the issues touched on here, it is worth emphasising that at present, a concept which is promoted on an increasingly broader scale is that of *digital experience platforms* (DXP). The main aim of their operation is to ensure consumers using opportunities offered by the digital world appropriate experiences in any processes, including communication, sales or marketing. The essence of the operation of a DXP is the use of any applications, program packages or products that drive

the delivery, coordination and support of consumer experience (such as content management, analytics, personalisation and customer data management systems).[33]

Therefore, the operation of DTPs leads to generating new customer experience, which confirms hypothesis H4. These platforms first of all form grounds for an innovative approach to issues connected with consumer service. This is because the service is performed in a more and more effective manner, delivering experience following from the possibility of being actively involved in new project development and therefore sharing knowledge, evaluating entities and products available in the market, or influencing the attitudes and behaviour of many other consumers (it should be added that it is an element of the so-called *gamification*, which means the application of mechanisms known from games to influence consumers' behaviour and habits)[34] or limiting time and effort needed to do make purchases or perform some activity. What is important, DTPs, due to constantly improved functionalities, considerably increase customers' requirements. Since what seemed remote and even impossible, for example no shipment costs, is already available and regarded as regular standard rather than some special service. This makes customers to demand more and more, and the task of DTPs is to respond effectively to their needs.

4.5 Artificial Intelligence as a Factor Increasing the Autonomy of Digital Platforms

Artificial intelligence is widely used in digital platforms, which was already discussed in this monograph. In this context, it is worth reflecting if AI technologies have an impact on the increased autonomy of DTPs as regards customer service.

Analysing this issue, it should be emphasised that at present efforts are made to make DTPs more and more autonomous. This is about making them have the property of diverse use, which includes controlling certain processes, such as customer services processes, without excessive human interference, that is performing many operations on their own, manifesting both automatic processes and the possibility of responding properly in various situations. An example may be platforms developed for purposes connected with transport, which serve to control autonomous vehicles. These include interior sensing platforms which are able to recognise the location and movement of the bodies of the driver or passengers and respond to changes),[35] or the AdroMote platform, which makes it possible to control vehicle driving robots using a smartphone with the Android system.[36]

Many applications of artificial intelligence on DTPs may be already pointed out which make the platforms manifest increasingly higher level of autonomy during customer service processes. In addition, it should be noted that there is a tendency now to integrate DTPs more and more closely with AI-based technologies, which results in the construction of *artificial intelligence platforms*.[37] In such platforms, emphasis is placed on collecting, analysing and using, on the widest possible scale, any type of information and data which refer to the operation of companies, including the customer service area. This makes it possible to verify the conducted activity and then improve in view of customers' needs. What is of great importance is

data of shopping behaviours of customers and their opinions on services offered by enterprises as well as unsatisfied needs of consumers which, when properly used, make it possible to generate value for customers. It should be added that building new platforms based on AI is not very complicated or time– and cost-consuming now. One of the factors for this is cloud technology, which is accessible in principle to every Internet user.[38]

An example of modern solutions in the area of integration of DTPs with AI may be Amazon platform, which exploits on a wide scale machine learning. In particular, such integration can be seen in AWS (*Amazon Web Service*), a tool which offers programmers access to various solutions and services. Among those, the following are of key importance in the area of automation of customer service processes:

- Amazon SageMaker – the service for building, training and deploying new machine learning models, which can be done relatively easily (programmers take advantage of ready-made algorithms); in the area of customer service, Thomson Reuters used the service to design a natural language processing solution in the form of an application for answering customers' questions; another example is ZipRecruiter platform, which offers to customers the most accurately selected products and services based on analysis of many transaction operations;
- Amazon Polly – converts text to speech in 25 languages of the world (the service is applicable, for example, to communication between an enterprise and a customer, especially in a global market);
- Amazon Rekognition Video – the service allows for analysing video recordings, including, for example, automatic tagging video sections with names of locations or detecting actions which is very important, for instance, for processes aiming to customise an offer to customers' needs;
- Amazon Comprehend – a tool for natural language processing and finding key text elements, including positive or negative sentiment (this is highly important, for example, while analysing comments and opinions written by customers);
- Amazon Transcribe – automatic speech recognition service converting speech to text with language identification (makes it possible to produce transcripts and subtitles);
- Amazon Translate – machine translation of text (useful for communication of enterprises with international customers);
- Amazon Lex – application for building chatbots using conversational interfaces.[39]

Various digital communication applications developed on AWS are becoming more and more autonomous in operation. This is because services and tools available on the platform allow for partial or even complete automation of such processes as communication with customers, advertising products, developing an offer adjusted to a customer's requirements (here it should be mentioned that Netflix platform uses AWS for processes within a system of recommending to customers films in accordance with their preferences)[40] or analysing customers' opinions, comments and requests. It should be added that the AWS platform is available in a

cloud, which eliminates many problems, for example, of websites freezing while customers review offers and making purchases. This undoubtedly accelerates the performance of customer service processes.[41]

Another platform worth mentioning is *Azure Cognitive Service* by Microsoft. Similarly to AWS, it enables a more efficient execution of many processes, including customer service processes. Its services relate to several areas, including:

- making appropriate decisions – in this area, services are available for personalisation of content, including advertising content, and identification of potentially undesirable content found, for example, in comments published by customers (this makes it possible to improve the quality of products and services or increasing effectiveness of formulated advertising messages);
- extracting meaning from text – in this area, the platform allows for detecting key phrases, translating text, adding natural language interpretation to applications, bots or devices connected within the Internet of Things as well as using an immersive reader which makes it possible for users to comprehend text with the aid of sound or visual cues;
- speech – converting speech to text or text to speech, translating speech and also identifying the person speaking;
- image – identifying content in video files, recognition of handwriting, extracting key terms from images, detecting human emotions;
- searching in web resources – automatic completion of phrases, which makes it possible to faster find offers interesting for customers or to more efficiently reach consumers with offers by enterprises, creating non-standards search engines.[42]

The above discussion shows that the use of artificial intelligence makes digital platforms become increasingly more autonomous with regard to customer service processes. This confirms hypothesis H4. Such technologies as machine learning make is possible for AI to gradually increase its capabilities, as a result of which DTPs using artificial intelligence are able, for instance, recognise speech or emotion, which makes communication with customers more efficient, identify key terms and phrases in a text, such as elements of customers' opinions and comments (owing to this, it is possible to respond quickly to negative opinions by changing the manner of customer service) as well as to adjust the offer to customers' preferences. It should be stressed that what can be observed now is an increasingly closer integration of DTPs with AI, which leads to the emergence of *artificial intelligence platforms*. Amazon AWS or Azure Cognitive Service by Microsoft should be regarded as such platforms.

In view of this discussion it may be added that, as noticed in one report by PwC – at present, many diverse platforms operate which are based on artificial intelligence. This is because companies treat them as sources of competitive advantage. This way, they develop their own platforms, which makes the development of AI based on DTPs "fragmented." In turn, it is more and more frequently proposed that one universal platform based on AI should be built to allow for comprehensive

performance of many processes and services, including those concerning customer service. Such a platform could have functionalities based on one central software and place for sharing information with all AI bots as well as systems for data collection and analysis. It is an interesting proposal but putting it into practice is not possible yet because of the strong competition among platforms. The proposal nevertheless shows that at present we are witnessing a fast growth of DTPs based on artificial intelligence.[43]

Notes

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5 D. Mider, *Polacy wobec przemocy politycznej. Politologiczno-socjologiczne studium ocen moralnych*, Dom Wydawniczy "Elipsa ", Warsaw 2017, pp. 206–207.
6 See, e.g.: J.C. Soper, W.B. Walstad, "On Measuring Economic Attitudes," *The Journal of Economic Education* 1983, no. 1494, pp. 4–17.
7 M. Marody, *Sens teoretyczny a sens empiryczny pojęcia postawy. Analiza metodologiczna zasad doboru wskaźników w badaniach nad postawami*, Państwowe Wydawnictwo Naukowe, Warsaw 1976, pp. 6, 12–22.
8 Cf. D. Mider, A. Marcinkowska, *Analiza danych ilościowych dla politologów. Praktyczne wprowadzenie z wykorzystaniem programu GNU PSPP*, ACAD, Warsaw 2013, p. 233 and elsewhere.
9 See: D. Mider, *op. cit.*, pp. 206–207.
10 An alternative would be a bottom-up method which involves adding factors from 1 to n.
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Final Conclusions

In the modern economy, what is becoming crucially important for enterprises is to acquire competitive advantage. To achieve this aim, various actions are taken. Currently they place a heavy emphasis on digitalisation, for which the dissemination of digital technologies is of decisive significance. These technologies began to be used in the 1950s in connection with the increasing importance of processes of planning and monitoring technologies, or shifting the focus onto providing services and collecting and using knowledge in the widest scope possible. Due to the promotion of digital technologies, more and more companies are subject to digital transformation. It may concern any areas of companies' operation and manifest itself in diverse forms, such as social media, e-commerce, mobile Internet or cloud computing.

An integral element of digitalisation is the operation of digital technology platforms (DTPs). The author's original definition of DTPs stresses that they are tools in digital (electronic) form which concern specific services or content, making it possible to initiate and intensify relations between various entities operating on the market, including companies, customers, suppliers or state administration institutions. The characteristic properties of such platforms include their modular structure, enabling their expansion with new components all the time, being strictly based on digital components, hyperconnectivity, the disappearance of spatial and temporal barriers, networking or fully automated information sharing. These platforms make it possible to create innovative business models, or models in which cutting-edge digital technologies, also those based on artificial intelligence, dominate completely. Moreover, are business ecosystems gathering customers, suppliers or research institutions, change relations among entities operating on the market (it is visible to the largest extent in situations where a customer is becoming more and more a company's collaborator, for example getting involved in innovative activities) and in which original solutions and tools are used – this is applicable, for example, to models which do not make it necessary for a customer to purchase the product they will use (*access over ownership*) or those providing free-of-charge access to products and services in exchange for viewing advertisements or providing information about consumer needs (*free model*).

At present, an intensive development of DTPs is unfolding, and the factors conducive to it include: greater digital competences in society, a relatively easy access

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to highly qualified employees as well as a gradual reduction of temporal, spatial or administrative barriers as a result of globalisation. It is worth emphasising that the most valuable brands in the world, with the highest level of capitalisation, include digital platforms, such as Apple, Google, Microsoft, Facebook and Amazon (the so-called "Big Five"). This is why it makes sense to claim that such platforms play a decisive role in the world economy. As a result, more and more innovative (digital) business models are being developed and their prospects look promising, especially in the context of promoting the concept of sharing or expansion of the Business Model Canvas.

The author's own work in this monograph involves attempts to analyse several aspects concerning the importance of DTPs for business models. To this end, a CATREG regression model for qualitative variables was built using the top-down method. The model made it possible to isolate the variables which are the most important for the impact of DTPs on an increase in the quality and intensiveness of relations established by a company with its stakeholders as well as the benefits generated by a company, the industry in which it operates and present or future changes forced by the implementation of DTPs. In addition, it was found that digital platforms entail specific changes to the operation of enterprises and various business models. They include mainly the spheres of management (changes to the organisational structure) as well as marketing and sales (relations with stakeholders, including customers). In the constructed model, it was possible to discern a correlation between using DTPs by enterprises and their growth of competitiveness.

At further stages of the research, based on the relevant literature, it was found that changes in business models resulting from the use of DTPs and concerning innovations, make it possible to include consumers in the processes of co-creating innovations. This is because platforms operating as social and crowdfunding portals or blogs allow for gathering whole communities of users who may participate in the performance of innovative projects. The participation of consumers in generating innovations is beneficial, because it enables the deployment of their frequently hidden potential and knowledge, which additionally contributes to reducing costs incurred by companies in connection with innovative activities. Furthermore, users may distinguish themselves by being active, derive satisfaction and, frequently, achieve professional success (participation in various projects may be a ticket to finding a job in an innovative organisation).

The analysis of the literature also enabled the author to conclude that due to digitalisation and the increasingly wide-ranging use of DTPs, it is possible to improve consumer experience. After all, DTPs create a completely new quality as regards sales processes or customer service. Apart from the fact that they make it possible to increase customers' involvement in the operation of companies, such platforms are the factor which affects the attitudes and purchasing decisions of other consumers, limiting the time and effort needed for purchases or the customisation of an offering.

Based on the author's research, it should be emphasised that the development of DTPs is going on in parallel to the development of artificial intelligence. At present, we may even talk about *artificial intelligence platforms*. Artificial intelligence

leads to an increasing autonomy of DTPs, also in the area of customer service. This is possible, because artificial intelligence, also in the form of machine learning, allows for making communication with customers more efficient (speech recognition or machine translation systems), improving the offering or the manner of customer service (identification of key phrases in customers' opinions and comments) or improving the adjustment of offerings to customers' requirements.

The general conclusion following from the author's own research is that DTPs are now one of the most important growth factors for various enterprises and the entire economy, strengthening the level of competitiveness and implying changes to business models going in the direction of increasing innovativeness. The platforms enable a continuous expansion with new functionalities and integration with multiple modern technologies, including those in the area of artificial intelligence, which creates just unlimited possibilities for the activity of market entities. Owing to such platforms, completely new perspectives are opened with regard to customer service and the enterprise's communication with any of its stakeholders. For this reason, DTPs will continue to develop intensively and more and more expanded and effective solutions in this area will appear in the market.

At this point, it is worth recalling the utilitarian aim of this work, which concerns the identification of critical factors for achieving success in the implementation and utilisation of DTPs. These factors primarily include an appropriate positive attitude of senior and middle-level management as well as other employees of enterprises to issues connected with the implementation of DTPs, which is connected with their having up-to-date knowledge, also about methods of implementing DTPs and benefits that may be achieved through them. Other factors are related to the need to use modern IT systems though which it will be possible to integrate solutions used so far in an enterprise with DTPs as well as with ensuring a high degree of security and thus dispel fears of many stakeholders about using such platforms. In addition, it is not irrelevant that sufficient financial resources must be collected to carry out activities regarding the implementation of DTPs effectively. Such expenditures may be very steep, but benefits from using platforms may relatively quickly bring commensurate returns.

This work does not exhaust the broad range of issues concerning DTPs that may be elaborated on in subsequent studies on this topic. Some of those issues have been suggested – the analyses of correlatives of attitudes to DTPs might be extended to cover factors related to the company structure, the industry in which the company operates or the number of employees. Future research endeavours concerning DTPs might also focus on issues concerning the possibilities of developing business models based on DTPs using AI technologies. This issue has been touched upon in this monograph, but considering the rapid development of artificial intelligence, it may be used to an increasingly greater extent within DTPs.

Appendix 1

Survey Questionnaire

Dear Sirs/Madams,

I would like to ask you to complete a survey about the implementation of digital technology platforms in Polish companies. The survey is entirely anonymous; therefore, I would like to ask you to provide honest and completely truthful responses. Results of the survey will be only used for scientific purposes, for research about the use of digital technology platforms. In addition, if the question does not give another instruction, it is possible to choose only one of the provided responses (to closed-ended questions) or to give a free answer (to open-ended questions).

Thank you very much for your participation in the survey.

Question 1. Does your company use digital technology platforms, which are tools that allow for connecting business partners and provide opportunities for intensifying contacts and performing transactions between them?

a definitely so – please skip question 3.
b rather so – please skip question 3.
c rather not – please skip question 2.
d definitely not – please skip question 2.

Question 2. If in question 1 you have selected the response "definitely so" or "rather so," then please state how long digital technology platforms have been used in the company in which you perform your professional duties?

a 0–12 months
b 13–24 months
c 25–36 months
d 37–48 months
e 49–60 months
f 61–72 months
g 73–84 months
h 85 months and longer

Question 3. If in question 1 you have selected the response "definitely not" or "rather not," then please state when it is planned to implement digital technology platforms in the company in which you perform your professional duties?

a 0–6 months
b 7–12 months
c 13–18 months
d 19–24 months
e 25–30 months
f 31–36 months
g 37 months and longer

Question 4. Please state what kind of digital technology platforms are or will be used (if there are plans for their implementation) in your company (please select all possible responses)

a communication platforms
b information platforms
c comparison platforms (e.g. comparing prices or product features)
d entertainment platforms
e online marketplaces
f all of the above
g other – which ones?

Question 5. Please state what attitude is taken by the personnel in your company about the implementation and use of digital technology platforms?

a definitely positive – please skip question 7.
b rather positive – please skip question 7.
c neither positive nor negative – please skip questions 6 and 7.
d rather negative – please skip question 6.
e definitely negative – please skip question 6.
f I have no opinion about that topic – please skip questions 6 and 7.

Question 6. If in question 5 you have selected the response "definitely positive" or "rather positive," please define what shows the positive attitude of the personnel to the implementation and use of digital technology platforms in the company in which you perform your professional duties? (please mark all possible responses)

a active involvement in the performance of tasks related to the implementation and use of digital technology platforms
b great spontaneous willingness to participate in training in this area
c active generation of new ideas connected with the use of digital technology platforms

d giving consent to any changes resulting from the implementation of digital technology platforms, including changes connected with the organisational structure
e being highly ready for changes concerning one's own professional duties
f being interested in next investments regarding the implementation of digital technology platforms
g other – which ones?

Question 7. If in question 5 you have selected the response "definitely negative" or "rather negative," please define what shows the negative attitude of the personnel to the implementation and use of digital technology platforms in the company in which you perform your professional duties? (please mark all possible responses)

a a lot of resistance connected with the stage of implementation of digital technology platforms resulting from possible changes in the company's organisational and employment structure
b many fears resulting from economic factors (high costs of implementation and possible cost reductions in other areas of the company's operation)
c unwillingness to adjust to changes resulting from the use of digital technology platforms
d opposition to the company's further plans for using different digital technology platforms
e lack of commitment in the performance of tasks resulting from the use of digital technology platforms
f expressing numerous fears about cybersecurity
g other – which ones?

Question 8. Please state whether in connection with the implementation of digital technology platforms in the company in which you perform your professional duties any of the following adverse cybersecurity events and threats have occurred directly as a result of using these platforms? (please select all possible responses)

a failure of computer equipment
b failure of the Internet network resulting from, for example, its overloading with the use of digital technology platform
c leakage of data referring to the enterprise and its employees or business partners
d leakage of data referring to customers
e *phishing*, or sending fraudulent information that seems to come from a reputable source
f *pharming*, or redirecting the user's browser to a malicious website or web server
g loss of financial assets
h online espionage
i other events and threats – which ones?

Question 9. Please take a position on the following statements about economic factors for the implementation and use of digital technology platforms, by putting next to each statement an appropriate number (1 – definitely agree, 2 – rather agree, 3 – rather disagree, 4 – definitely disagree)

The implementation of digital technology platforms generates excessively high costs, inadequate to benefits following from using them
The current utilisation of digital technology platforms amounts to an excessive financial burden for the company
Employees think that the use of digital technology platforms is ineffective from the economic perspective
Stakeholders, such as business partners, suppliers or distributors, think that the use of digital technology platforms is ineffective from the economic perspective

Question 10. In which areas of your company's operation digital technology platforms are or will be used (if there are plans for their implementation)? (please select all possible responses)

a management, including human resources management
b marketing
c sales
d research and development (R&D)
e procurement
f production
g distribution and transport
h finance
i customer service
j all of the above
k other – which ones?

_____

Question 11. Please state what basic benefits are generated due to the use of digital technology platforms in your company? (please select at most 7 responses, marking them with numbers from 1 – the most important benefit to 7 – the least important benefit, leaving blank space for benefits which have not been taken into account)

Type of benefits	*Scope of benefits*
Growth of profits	
Growth of competitiveness	
Enlarging the product offering	

(*Continued*)

(Continued)

Type of benefits	*Scope of benefits*
Increase in market share	
Increase in the degree of innovativeness	
Increase in the number of customers	
Improvement of customer service and increased consumer satisfaction level	
Increase in the number of markets in which the company is active	
Increasing the number of business partners, including those operating on in a virtual environment	
Optimisation of performance of various business processes, including those relating to customer service	
Development of digital supply chains	
Increase in the general effectiveness of the company's operations	
Increasing flexibility of operations, which shows in the capability for launching new products and services quickly	
Opportunity to get involved actively in programmes initiated in the virtual space to expand the range of goods and services or the database of customers	
Other – which ones?	

Question 12. Do you agree with the statement that digital technology platforms make it possible to create and develop innovative business models?

a definitely agree
b rather agree
c neither agree nor disagree
d rather disagree
e definitely disagree
f I have no opinion about this issue

Question 13. To what extent do digital technology platforms affect an increase in quality and intensity of relations established by the company in which you perform your professional duties with any stakeholders, including mainly suppliers, business partners, distributors or customers?

a to a very large extent
b to a large extent
c neither to a large extent nor to a small extent
d to a small extent
e to a very small extent
f I have no opinion about this issue

Question 14. Has the implementation of digital technology platforms in the company in which you perform your professional duties forced the company to introduce specific changes to its organisational structure or will you be forced to do so?

a definitely so
b rather so
c neither agree nor disagree – please skip question 15.
d rather not – please skip question 15.
e definitely not – please skip question 15.
f I have no opinion about this issue – please skip question 15.

Question 15. If in question 14 you have selected the response "definitely so" or "rather so," then please state what are (will be) the changes in the company's organisational structure resulting from the implementation of digital technology platforms? (please select all possible responses)

a opening a new branch of the enterprise
b liquidation of an existing branch of the enterprise
c setting up a new department(s) of the enterprise
d liquidation of an existing department/existing departments of the enterprise
e creation of a new job/position(s)
f liquidation of an existing job/position(s)
g transferring specific groups of employees to another department/other departments of the enterprise
h transformations in the governance and managerial structure
i other – which ones?
……..

Respondent's demographics

Question 16. Please state your gender

a female
b male

Question 17. Please state your age

a 0–19 years
b 20–39 years
c 40–59 years
d 60 years or older

Question 18. Please state your education level

a basic
b lower secondary school
c vocational school
d secondary school

e college
f bachelor's degree
g master's degree

Question 19. Please state how long you have been employed in the company in which you perform your professional duties now.

a 0–12 months
b 13–24 months
c 25–36 months
d 37–48 months
e 49–60 months
f 61–72 months
g 73–84 months
h 85 months and longer

Question 20. Please state how long has the company in which you perform your professional duties been active on the market.

a 0–12 months
b 13–24 months
c 25–36 months
d 37–48 months
e 49–60 months
f 61–72 months
g 73–84 months
h 85 months and longer

Question 21. Please state your position in the company in which you perform your professional duties now.

a senior management personnel (director/president/management board member)
b manager/middle management personnel
c specialist or independent employee
d office worker
e labourer
f other position – please specify:
……..

Question 22. Please state in what kind of company in terms of headcount size you perform your professional duties?

a micro-business (0–9 employees)
b small enterprise (10–49 employees)
c medium-sized enterprise (50–249 employees)
d large company (250 employees and more)

Question 23. Which industry does your company operate in?

a construction
b catering
c education
d electronics
e electricity
f IT
g logistics, including transport and forwarding
h clothing
i industrial
j agriculture
k food
l travel
m insurance
n other industry – which one?
……..

Appendix 2

Tabular Results of Quantitative Data Collected during the CATI Survey

The tables below show marginal distributions of responses to all the survey questions.

Question 1: Are digital technology platforms used in your company?

	Frequency	*Percentage*
Definitely so	93	76.9
Rather so	27	22.3
Rather not	1	0.8
Total	121	100.0

Question 2: Please state how long digital technology platforms have been used in the company in which you perform your professional duties?

	Frequency	*Percentage*
0–12 months	1	0.8
13–24 months	26	21.7
25–36 months	31	25.8
37–48 months	30	25.0
49–60 months	13	10.8
61–72 months	2	1.7
73–84 months	1	0.8
85 months and longer	16	13.3
Total	120	100.0

Question 3. Please state when it is planned to implement digital technology platforms in the company in which you perform your professional duties?

	Frequency	*Percentage*
37 months and longer	1	100.0
Total	1	100.0

Question 4. Please state which kind of digital technology platforms is used or will be used?

	Responses		*Percentage of observations*
	N	*Percentage*	
Communication platforms	95	37.8	78.5
Information platforms	85	33.9	70.2
Comparison platforms, for example for comparing prices or product features	12	4.8	9.9
Entertainment platforms	9	3.6	7.4
Online marketplaces	48	19.1	39.7
All of the above	2	0.8	1.7
Total	251	100.0	207.4

Question 5. Please state what attitude is taken by the personnel in your company about the implementation and use of digital technology platforms?

	Frequency	*Percentage*
Definitely positive	43	35.5
Rather positive	60	49.6
Neither positive nor negative	8	6.6
Rather negative	2	1.7
I have no opinion about this issue	8	6.6
Total	121	100.0

Question 6. Please state what shows the positive attitude of the personnel to the implementation and use of digital technology platforms in the company in which you perform your professional duties?

	Responses		*Percentage of observations*
	N	*Percentage*	
Active involvement in the performance of tasks related to the implementation and use of digital technology platforms	83	17.8	80.6
Great spontaneous willingness to participate in training in this area	63	13.5	61.2
Active generation of new ideas connected with the use of digital technology platforms	76	16.3	73.8
Giving consent to any changes resulting from the implementation of digital technology platforms, including changes connected with the organisational structure	88	18.8	85.4
Being highly ready for changes concerning one's own professional duties	81	17.3	78.6
Being interested in next investments regarding the implementation of digital technology platforms	76	16.3	73.8
Total	467	100.0	453.4

Question 7. Please state what shows the negative attitude of the personnel to the implementation and use of digital technology platforms in the company in which you perform your professional duties?

	Responses		*Percentage of observations*
	N	*Percentage*	
A lot of resistance connected with the stage of implementation of digital technology platforms resulting from possible changes in the company's organisational and employment structure	2	40.0	100.0
Many fears resulting from economic factors (high costs of implementation and possible cost reductions in other areas of the company's operation)	1	20.0	50.0
Expressing numerous fears about cybersecurity	2	40.0	100.0
Total	5	100.0	250.0

Question 8. Please state whether in connection with the implementation of digital technology platforms in the company in which you perform your professional duties any of the following adverse cybersecurity events and threats have occurred directly as a result of using these platforms?

	Responses		*Percentage of observations*
	N	*Percentage*	
Failure of computer equipment	65	36.1	53.7
Failure of the Internet network resulting from, for example, its overloading with the use of digital technology platform	43	23.9	35.5
Leakage of data referring to the enterprise and its employees or business partners	6	3.3	5.0
Leakage of data referring to customers	6	3.3	5.0
Phishing, or sending fraudulent information that seems to come from a reputable source	12	6.7	9.9
Pharming, or redirecting the user's browser to a malicious website or web server	10	5.6	8.3
Loss of financial assets	6	3.3	5.0
Online espionage	3	1.7	2.5
No adverse events took place	28	15.6	23.1
Total	180	100.0	148.8

Question 9a. The implementation of digital technology platforms generates excessively high costs, inadequate to benefits following from using them

	Frequency	*Percentage*
1 – definitely agree	7	5.8
2 – rather agree	5	4.1
3 – rather disagree	49	40.5
4 – definitely disagree	60	49.6
Total	121	100.0

Question 9b. The current utilisation of digital technology platforms amounts to an excessive financial burden for the company

	Frequency	*Percentage*
1 – definitely agree	3	2.5
2 – rather agree	9	7.4
3 – rather disagree	61	50.4
4 – definitely disagree	48	39.7
Total	121	100.0

Question 9c. Employees think that the use of digital technology platforms is ineffective from the economic perspective

	Frequency	*Percentage*
1 – definitely agree	1	0.8
2 – rather agree	12	9.9
3 – rather disagree	36	29.8
4 – definitely disagree	72	59.5
Total	121	100.0

Question 9d. Stakeholders, such as business partners, suppliers or distributors, think that the use of digital technology platforms is ineffective from the economic perspective

	Frequency	*Percentage*
1 – definitely agree	1	0.8
2 – rather agree	2	1.7
3 – rather disagree	79	65.3
4 – definitely disagree	39	32.2
Total	121	100.0

Question 10. In which areas of your company's operation digital technology platforms are or will be used?

	Responses		*Percentage of observations*
	N	*Percentage*	
Management, including human resources management	69	11.1	57.0
Marketing	103	16.5	85.1
Sales	96	15.4	79.3
Research and development (R&D)	49	7.9	40.5
Procurement	60	9.6	49.6
Production	33	5.3	27.3
Distribution and transport	36	5.8	29.8
Finance	70	11.2	57.9
Customer service	106	17.0	87.6
All of the above	1	0.2	0.8
Total	623	100.0	514.9

Question 11a. Please state what basic benefits are generated due to the use of digital technology platforms in your company? – Response I

	Frequency	*Percentage*
Growth of profits	56	46.3
Growth of competitiveness	19	15.7
Enlarging the product offering	13	10.7
Increase in market share	3	2.5
Increase in the degree of innovativeness	6	5.0
Increase in the number of customers	2	1.7
Improvement of customer service and increased consumer satisfaction level	3	2.5
Increase in the number of markets in which the company is active	2	1.7
Increasing the number of business partners, including those operating on in a virtual environment	1	0.8
Optimisation of performance of various business processes, including those relating to customer service	11	9.1
Development of digital supply chains	1	0.8
Increase in the general effectiveness of the company's operations	3	2.5
Opportunity to get involved actively in programmes initiated in the virtual space to expand the range of goods and services or the database of customers	1	0.8
Total	121	100.0

Question 11b. Please state what basic benefits are generated due to the use of digital technology platforms in your company? – Response II

	Frequency	*Percentage*
Growth of profits	15	12.4
Growth of competitiveness	27	22.3
Enlarging the product offering	12	9.9
Increase in market share	9	7.4
Increase in the degree of innovativeness	2	1.7
Increase in the number of customers	9	7.4
Improvement of customer service and increased consumer satisfaction level	5	4.1
Increase in the number of markets in which the company is active	6	5.0
Increasing the number of business partners, including those operating on in a virtual environment	8	6.6
Optimisation of performance of various business processes, including those relating to customer service	16	13.2
Increase in the general effectiveness of the company's operations	6	5.0
Increasing flexibility of operations, which shows in the capability for launching new products and services quickly	2	1.7
Opportunity to get involved actively in programmes initiated in the virtual space to expand the range of goods and services or the database of customers	4	3.3
Total	121	100.0

Question 11c. Please state what basic benefits are generated due to the use of digital technology platforms in your company? – Response III

	Frequency	*Percentage*
Growth of profits	15	12.5
Growth of competitiveness	13	10.8
Enlarging the product offering	15	12.5
Increase in market share	10	8.3
Increase in the degree of innovativeness	9	7.5
Increase in the number of customers	4	3.3
Improvement of customer service and increased consumer satisfaction level	5	4.2
Increase in the number of markets in which the company is active	4	3.3
Increasing the number of business partners, including those operating on in a virtual environment	12	10.0
Optimisation of performance of various business processes, including those relating to customer service	19	15.8
Development of digital supply chains	2	1.7
Increase in the general effectiveness of the company's operations	3	2.5
Increasing flexibility of operations, which shows in the capability for launching new products and services quickly	4	3.3
Opportunity to get involved actively in programmes initiated in the virtual space to expand the range of goods and services or the database of customers	5	4.2
Total	120	100.0

Question 11d. Please state what basic benefits are generated due to the use of digital technology platforms in your company? – Response IV

	Frequency	*Percentage*
Growth of profits	7	6.0
Growth of competitiveness	12	10.3
Enlarging the product offering	12	10.3
Increase in market share	12	10.3
Increase in the degree of innovativeness	13	11.1
Increase in the number of customers	6	5.1
Improvement of customer service and increased consumer satisfaction level	5	4.3
Increase in the number of markets in which the company is active	8	6.8
Increasing the number of business partners, including those operating on in a virtual environment	9	7.7
Optimisation of performance of various business processes, including those relating to customer service	17	14.5
Development of digital supply chains	4	3.4
Increase in the general effectiveness of the company's operations	6	5.1

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	Frequency	*Percentage*
Increasing flexibility of operations, which shows in the capability for launching new products and services quickly	2	1.7
Opportunity to get involved actively in programmes initiated in the virtual space to expand the range of goods and services or the database of customers	4	3.4
Total	117	100.0

Question 11e. Please state what basic benefits are generated due to the use of digital technology platforms in your company? – Response V

	Frequency	*Percentage*
Growth of profits	5	4.4
Growth of competitiveness	9	8.0
Enlarging the product offering	14	12.4
Increase in market share	8	7.1
Increase in the degree of innovativeness	12	10.6
Increase in the number of customers	8	7.1
Improvement of customer service and increased consumer satisfaction level	6	5.3
Increase in the number of markets in which the company is active	11	9.7
Increasing the number of business partners, including those operating on in a virtual environment	7	6.2
Optimisation of performance of various business processes, including those relating to customer service	18	15.9
Development of digital supply chains	5	4.4
Increase in the general effectiveness of the company's operations	4	3.5
Increasing flexibility of operations, which shows in the capability for launching new products and services quickly	4	3.5
Opportunity to get involved actively in programmes initiated in the virtual space to expand the range of goods and services or the database of customers	2	1.8
Total/	113	100.0

Question 11f. Please state what basic benefits are generated due to the use of digital technology platforms in your company? – Response VI

	Frequency	*Percentage*
Growth of profits	2	1.8
Growth of competitiveness	14	12.8
Enlarging the product offering	13	11.9
Increase in market share	8	7.3
Increase in the degree of innovativeness	11	10.1

(*Continued*)

(Continued)

	Frequency	*Percentage*
Increase in the number of customers	7	6.4
Improvement of customer service and increased consumer satisfaction level	8	7.3
Increase in the number of markets in which the company is active	8	7.3
Increasing the number of business partners, including those operating on in a virtual environment	8	7.3
Optimisation of performance of various business processes, including those relating to customer service	12	11.0
Development of digital supply chains	3	2.8
Increase in the general effectiveness of the company's operations	9	8.3
Increasing flexibility of operations, which shows in the capability for launching new products and services quickly	4	3.7
Opportunity to get involved actively in programmes initiated in the virtual space to expand the range of goods and services or the database of customers	2	1.8
Total	109	100.0

Question 11g. Please state what basic benefits are generated due to the use of digital technology platforms in your company? – Response VII

	Frequency	*Percentage*
Growth of profits	5	4.7
Growth of competitiveness	2	1.9
Enlarging the product offering	9	8.5
Increase in market share	19	17.9
Increase in the degree of innovativeness	13	12.3
Increase in the number of customers	2	1.9
Improvement of customer service and increased consumer satisfaction level	4	3.8
Increase in the number of markets in which the company is active	18	17.0
Increasing the number of business partners, including those operating on in a virtual environment	8	7.5
Optimisation of performance of various business processes, including those relating to customer service	10	9.4
Development of digital supply chains	3	2.8
Increase in the general effectiveness of the company's operations	6	5.7
Increasing flexibility of operations, which shows in the capability for launching new products and services quickly	5	4.7
Opportunity to get involved actively in programmes initiated in the virtual space to expand the range of goods and services or the database of customers	2	1.9
Total	106	100.0

Question 12. Do you agree with the statement that digital technology platforms make it possible to create and develop innovative business models?

	Frequency	*Percentage*
Definitely agree	63	52.1
Rather agree	45	37.2
Neither agree nor disagree	12	9.9
Rather disagree	1	0.8
Total	121	100.0

Question 13. To what extent do digital technology platforms affect an increase in quality and intensity of relations established by the company in which you perform your professional duties with any stakeholders, including mainly suppliers, business partners, distributors or customers?

	Frequency	*Percentage*
To a very large extent	44	36.4
To a large extent	47	38.8
Neither to a large extent nor to a small extent	11	9.1
To a small extent	2	1.7
To a very small extent	6	5.0
I have no opinion about this issue	11	9.1
Total	121	100.0

Question 14. Has the implementation of digital technology platforms in the company in which you perform your professional duties forced the company to introduce specific changes to its organisational structure or will you be forced to do so?

	Frequency	*Percentage*
Definitely so	16	13.2
Rather so	53	43.8
Neither agree nor disagree	20	16.5
Rather not	26	21.5
Definitely not	6	5.0
Total	121	100.0

Question 15. Please state what are (will be) the changes in the company's organisational structure resulting from the implementation of digital technology platforms?

	Responses		*Percentage of observations*
	N	*Percentage*	
Liquidation of an existing branch of the enterprise	2	2.0	2.9
Setting up a new department(s) of the enterprise	21	20.8	30.4
Liquidation of an existing department/existing departments of the enterprise	2	2.0	2.9
Creation of a new job/position(s)	40	39.5	58.0

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	Responses		*Percentage of observations*
	N	*Percentage*	
Liquidation of an existing job/position(s)	4	4.0	5.8
Transferring specific groups of employees to another department/other departments of the enterprise	6	5.9	8.7
Transformations in the governance and managerial structure	26	25.7	37.7
Total	101	100.0	146.4

Question 16. Please state your gender

	Frequency	*Percentage*
Female	23	19.0
Male	98	81.0
Total	121	100.0

Question 17. Please state your age

	Frequency	*Percentage*
20–39 years	64	52.9
40–59 years	49	40.5
60 years or older	8	6.6
Total	121	100.0

Question 18. Please state your education level

	Frequency	*Percentage*
Secondary school	17	14.0
College	7	5.8
Bachelor's degree	12	9.9
Master's degree	85	70.2
Total	121	100.0

Question 19. Please state how long you have been employed in the company in which you perform your professional duties now

	Frequency	*Percentage*
0–12 months	3	2.5
13–24 months	7	5.8
25–36 months	10	8.3
37–48 months	22	18.2

(*Continued*)

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	Frequency	*Percentage*
49–60 months	13	10.7
61–72 months	15	12.4
73–84 months	6	5.0
85 months and longer	45	37.2
Total	121	100.0

Question 20. Please state how long has the company in which you perform your professional duties been active on the market

	Frequency	*Percentage*
0–12 months	1	0.8
2–36 months	1	0.8
37–48 months	1	0.8
49–60 months	7	5.8
61–72 months	6	5.0
73–84 months	7	5.8
85 months and longer	98	81.0
Total	121	100.0

Question 21. Please state your position in the company in which you perform your professional duties now

	Frequency	*Percentage*
Senior management personnel	63	52.1
Middle management personnel	33	27.3
Specialist or independent employee	25	20.7
Total	121	100.0

Question 22. Please state in what kind of company in terms of headcount size you perform your professional duties?

	Frequency	*Percentage*
Micro-business (0–9 employees)	13	10.7
Small enterprise (10–49 employees)	28	23.1
Medium-sized enterprise (50–249 employees)	41	33.9
Large company (250 employees and more)	39	32.2
Total	121	100.0

Question 23. Which industry does your company operate in?

	Frequency	*Percentage*
Construction	1	0.8
Education	13	10.7
Electronics	15	12.4
Electricity	1	0.8
IT	26	21.5
Logistics, including transport and forwarding	7	5.8
Clothing	1	0.8
Industrial	25	20.7
Food	2	1.7
Travel	1	0.8
Insurance	1	0.8
Commerce	28	23.1
Total	121	100.0

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