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The Digital Chasm between an Idea and Its Implementation in Industry 4.0—The Case Study of a Polish Service Company

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Abstract: Digitization in Industry 4.0 is a key trend in a modern company's development. However, business practice shows that digitization can be associated not only with the prospect of development but with numerous limitations that a company may struggle with. The goal of this manuscript is to verify the existence and identify of the management gaps that lead to formation of digitization problems in companies under the conditions of Industry 4.0. Management gap is understood here as a set of discontinuities, identified within management functions, which result in specific problems in the implementation of digitization projects. In general, this aspect is omitted in the literature on the subject, which focuses on benefits of implementing Industry 4.0 technology. The chosen goal of the manuscript is part of the research trend related to the identification of general digitization problems and to a company's development, taking into account the use of technological solutions, as well as to the scope of research on the problems of implementing ICT projects. The development of an enterprise is understood as the ability to improve an organization both in the face of internal challenges and the environmental with maintaining innovation potential. The research structure is based on the construction of a conceptual model of management gaps and its empirical verification. In the theoretical part, the chosen research method is analysis of literature from the last 20 years and in the practical part analysis of a business case supplemented with an in-depth interview conducted among the management of the analyzed company. In the theoretical part, the article defines basic concepts related to Industry 4.0 and digitization of companies. It presents the place and role of digitization and its impact on the blurring of boundaries of traditional management layers. Based on these considerations, a conceptual model is developed defining management gaps within which problems of digitization of enterprises are indicated. The practical part of the article presents an empirical verification of the existence of the formulated management gaps on the basis of a business case analysis. The case study describes a mass, geographically dispersed implementation of the application for 34,000 users, which is the result of the implementation of the digitization strategy. Conclusions were formulated in the last part of the manuscript. On the theoretical ground, the analysis confirms that the process of digitization in an enterprise under the conditions of Industry 4.0 is related to blurring the boundaries of operational, tactical and strategic management. The premises of the said blur are identifiable and appear in each of the above-mentioned layers. On the practical ground, the existence of reasons for blurring the boundaries of management is related to the need to adapt the organization to the new operating conditions related to Industry 4.0. The strategic activities should be targeted at determining the directions of company improvement, which should precede the efforts to implement advanced solutions in the field of Industry 4.0. This approach allows providing a sustainable company development with the possibility of creating short-term effects and maintaining a long-term growth perspective.

Keywords: digitalization; ICT projects; Industry 4.0

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1. Introduction

The Fourth Industrial Revolution made digital technology the main stimulus of changes that take place around the world. These changes are not limited to industry modernization but take place at a large-scale in the economy and society. The explosion of modern technologies breaks the previously established boundaries, penetrating into traditional industries and areas of human life that had previously been unavailable to technical solutions. New technical solutions and software are developed almost every day, and the development process itself is no longer owned by professional entities or specialists only. Countless applications, platforms and systems are created in open development environments by assembling codes from ready-made blocks. Some of these technological ideas create breakthroughs; others do not go beyond the threshold of a promising idea. It is similar in companies—ubiquitous changes induce people to undertake numerous activities aimed at implementing technologies, and only some of them will actually be implemented with the expected effect. These aspirations are reflected in company digitization, which is becoming one of the main directions of transformation. Digitization under the conditions of Industry 4.0 is the subject of scientific research [1–11]. When attempting to systematize the available research, it can be stated that it focuses on two areas: a broad theoretical approach and a narrow practical approach. In the first case, it concerns the indication of potential directions for the development of digitization in companies, introducing innovative ideas or new technologies in the field of Industry 4.0, without going into details related to their implementation [1,9,12–15]. In the second case, it focuses on descriptions of applications of specific technological solutions (e.g., IoT, big data, robotization, autonomous systems) in companies or selected sectors, showing the advantages of undertaken actions [16–20]. This created a gap between a theoretical scientific discourse devoted to potential benefits of application of technology and a detailed description of specialized applications. Additionally, Piccarozzi et al. pointed out that most of the literature on Industry 4.0 focuses on the positive aspects of implementation, whereas the area related to problems and methods of solving them is basically ignored [21] (p. 18). The results of The Standish Group's research indicate that in the operational field a very large number of problems can still be found (depending on the research conducted—approx. 70–50% of projects are unsuccessful) [22–24]. In technological implementations, run by specialized companies, which largely relate to technologies that are characteristic of Industry 4.0, the implementation time is frequently exceeded due to delay in making key decisions [24]. In the strategic area, implementation problems are manifested by a fundamental lack of progress in the transformation strategy implementation, e.g., it is indicated that "digitization has stalled" [25]. Therefore, a question arises—if the development prospects are so high, then why are companies not able to run projects successfully? What types of limitations do they face?

The goal of this manuscript is to verify the existence and identify of the management gaps that lead to formation of digitization problems in companies under the conditions of Industry 4.0. Management gap is understood here as a set of discontinuities, identified within the management functions, which result in specific problems of project implementation in the process of digitization of the enterprise. The article poses two main research questions:

Q1. Is it possible to indicate and identify premises indicating the blurring of operational, tactical and strategic management boundaries in the process of digitization of an enterprise under the conditions of Industry 4.0?

Q2. Is it possible in the company to identify management gaps that affect the problems of project implementation under the conditions of Industry 4.0?

The main strength of the proposed approach is the analysis of problems related to the digitization of an enterprise under Industry 4.0 conditions, the description of which is a definite minority in the scientific literature, as pointed out by M. Piccarozzini et al. [21]. Another aspect is the comprehensiveness of the approach, which translates into searching for the sources of problems in the entire enterprise, in all management layers. Most of the scientific studies focus only on the operational layer, limiting itself to identifying project

implementation problems that may only result from problems of other management layers [22–25] or to general problems of digitization, not located in the enterprise management system [26–31]. The article attempts to answer the question about the relationship between these problems and the adopted way of managing an enterprise, broken down into individual management layers. This approach therefore goes beyond the management of digitization in the enterprise, falling within the scope of general management—operational, tactical and strategic. An additional distinguishing area is the interest in a service enterprise, which is not characteristic of the Industry 4.0 concept, where most scientific studies focus on production companies. Meanwhile, service companies play a significant role in Industry 4.0, especially in the case of countries such as Poland, where the service sector significantly prevails over the production sector. This problem was noticed by the Polish government in 2019 which made efforts to build clusters dedicated to supporting service enterprises, as well as launched scientific initiatives focused on services in Industry 4.0.

The article is conceptual and empirical in nature. The analysis is carried out in accordance with the research structure presented in Figure 1.

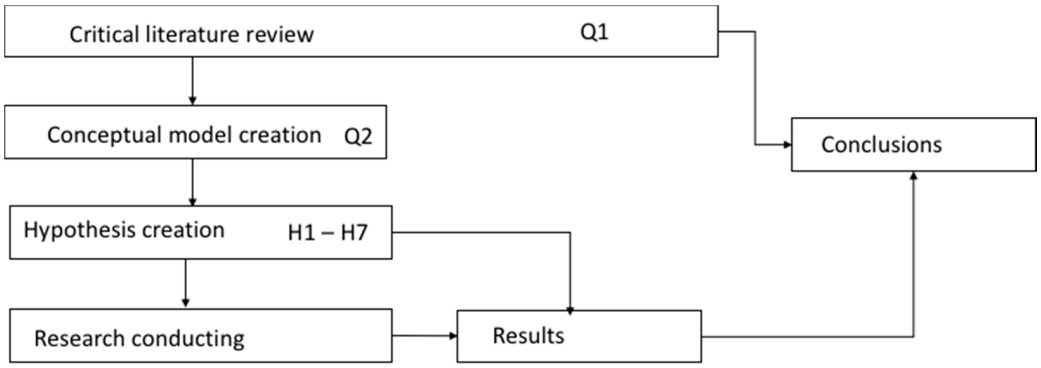

Figure 1. Research structure. Source: own study.

According to the diagram presented in Figure 1, in the first part of the article, a theoretical model is constructed, which is then empirically verified. This verification is primarily of a qualitative nature and consists in confirming or rejecting selected elements of the proposed model. Statistical analysis of the presented phenomena is beyond the scope of this work and may become the next stage of the research.

In the theoretical part, the chosen research methods are the analysis of literature from the last 20 years. On the basis of the aforementioned analysis, the answer to the research question Q1 was provided by a constructed conceptual model which at the theoretical level provides an answer to the question Q2. In the practical part, the analysis of a business case supplemented with an in-depth interview conducted among the management of the analyzed company was used, which allowed to verify the hypotheses H1–H7. The last part of the article presents detailed results which were confronted with a literature review on the implementation of similar research. On the basis of the discussions, general conclusions are developed.

2. Theoretical Background—The Evolution of Approach to Digitization of Company

The meaning of the term digitalization has evolved over the years, with the technological development of the industry and economy. Digitalization originated during the Third Industrial Revolution in the 1870s. At first, the term of digitalization referred to the conversion of an analogue form into a digital one, e.g., [32] (p. 6), [33] (p. 126), [34] (p. 2). An example of this can be digitalization of a collection of documents. In this sense, digitalization does not bring any additional changes to the object itself, other than conversion to a digital form [35]. The origin of this definition is related to the theory of sample data systems, developed in the mid-20th century. From a technical point of view, in the case of a signal, the transformation consists in changing its continuous analogue form into a discrete

sequence of bits, which is associated with cutting out noise and other elements that are insignificant for the perception [36] (p. 7). In the case of process transformation on business grounds—digitalization involves standardization of business processes and is associated with cost reduction and ensuring operational excellence [37] (p. 1). In the 1980s, the use of digitalization was limited to single projects as part of a company's operating activities. Company digitization management is associated with the development of the first methods of strategic planning of IT systems by IBM in 1982 [38]. These methods, however, can be used assuming a significant separation between the sphere of enterprise management and the management of the technological area. In addition, the concept is based on the traditional method of planning and control. The development of IT technology—TCP/IP protocols, network and network devices, disks and matrices resulted in advances in automation that involved implementing technology and software to achieve a procedural result with little or no human interference [34]. The basis for approaching automation developed much earlier. During the First Industrial Revolution in the 18th century, there seemed to be a modernization of textile production using a steam engine, and as part of the Second Industrial Revolution, a 19th-century electric production line. However, automation has been implemented for the first time on such a broad scale, involving re-engineering of an entire enterprise. The approach to automation based on process design has become so deeply entrenched that it is also used in many companies today. However, the changing environmental conditions disturb the design process, which translates into a decrease in the effectiveness of this type of activity. In this sense, automation is a broader concept than digitization, because it involves the need to standardize activities before implementation and may apply not only to non-material but also hardware forms. The use of hardware solutions for automation of work is associated with another concept—robotic process automation (RPA), which is defined as "an umbrella term for tools that operate on the user interface of other computer systems in the way a human would do" [39] (p. 269). Automation and robotization are defined as "company development tools", which goes well beyond delivering effects at the operational level. At the strategic level, robotization allows reducing employment and increasing overall efficiency and, consequently, profitability. However, at the operational level, robotization leads to elimination of human errors, reduction of process implementation time and increased efficiency e.g., [40] (p. 62). IT strategy planning migrated towards business areas. The work on joint methods of technological development management of a company started, which culminated in the development of the model of joint adaptation of business and IT strategies, known as the "triangle model" [41] and the Strategic-Alignment-Model (SAM) [42]. These concepts, however, refer to the conditions of relatively separate integration. This means that the area of interaction between structures and technologies is limited to certain specific organizational elements. These concepts do not take into account the meta-modeling approach, which, however, was characteristic for the period in which the main area of cooperation was the combination of IT and telecommunications solutions that allowed the creation of ICT. In the nineties of the twentieth century, there was also a separation of the concept of digitization and digitization, which began to be described as a broader concept, as reasoning was transferred to the ground of social sciences. Digitization is defined as the structuring of many different areas of social life around the digital communication infrastructure [34,43–45]. In the business sphere, digitization is defined as the ability to transform existing products or services into digital forms, which allows them to have an advantage over a tangible product e.g., [46,47]. In the beginning of the 21st century, the progressing development of telecommunications technology and the closer cooperation with IT led to the increased number of integration projects based on Information and Communication Technology. Digitization is the application of ICT in an enterprise or an increase in its use by an organization, industry, country, etc. e.g., [43] During this time, the number of projects rose and reports about many failures to run them started appearing cf. [48]. According to research by Jasińska and Szapiro, the scope of problems with implementing ICT technology is high, and general difficulties with projects arise not within their structure, but on the verge with

the organization of the company [48]. Associating the concept of digitization only with the implementation of technology and looking for the reasons for its failures in the way of project management significantly limited the scope of understanding its meaning to the tool layer. In this sense, digitization is associated with the development of certain abilities and skills that would allow adapting technology in an organization, economy or society, which can be measured, for example, by the Digital Economy and Society Index (DESI) used in the European Union [49]. Digitization is associated with changes within an organization itself and its business model, which is conditioned by the increasing use of digital technologies used to improve both the efficiency and scope of business [50]. Gartner points out that digitization is the use of digital technologies to change the business model and provide new possibilities to generate income and value, which is connected with the transition process from traditional form to "digital business" [35]. The implementation of technology that entails changes in the business model is associated with a company's deep transformation, redefinition of its processes and organizational structures, changes of the established rules of operation, changes at the resource and human levels, not excluding changes at the level of culture and values. Taking this complexity into account, digitization is defined as a company's digital transformation. Ross defines the concept of digital transformation as a phenomenon of transformation of the economy by using new digital models [37]. In this context, the understanding of digitization moves from the company area to the broad economic area. So far, this perspective has been ignored by the creators of concepts related to the implementation of digitization activities in enterprises.

Under the conditions of Industry 4.0, which is isolated from the beginning of the second decade of the 21st century, digitization is a key concept around which the mainstream of company transformation is focused. Based on the definition by K. Schwab, Industry 4.0 is a collection of technologies that connect the physical, digital and biological worlds, influencing all disciplines, economies and industries [5]. This definition is very general, but digitization is becoming one of the main strategic goals of most enterprises, even those that have operated in the traditional form so far. Digitization has become one of the main strategic goals of most enterprises, even ones that had operated in a traditional form so far. It is difficult to associate digitization with a company's strategic activities only because it is also reflected in operational activities—transformation programs, implementation of changes, projects related to digitization, robotization, automation and other technology implementation methods, which were reflected in practically all previous achievements in the field of project management. Under the conditions of Industry 4.0, digitization activities gain a new meaning. In the case of robotization, instead of trying to raise the effectiveness of a separated process, such as during the Third Industrial Revolution, autonomous systems that completely eliminate human activities [51] are being built. In this context, robotization is indicated as a factor of introducing changes in the labor market through elimination of jobs [52] (p. 8). In addition to robotics, there is also cobotics, which concerns design, production, research and use of work systems in which one or more operators interact with one or more robots in a common space or at a distance [53] (p. 203). In this case, the main value of using such systems comes from the cooperation between man and machine. Thanks to the cooperation, it is possible to combine the benefits of using robots (strength, endurance, speed, precision, repeatability), and on the other hand, to maintain the most valuable human features, such as flexibility and ability to make decisions [54]. Comparing the meaning of the concepts of automation and robotization, they are basically similar, whereas robotization copies human activities through the use of machines to a greater degree, and automation is more related to the improvement of the process, assuming there is cooperation of a human being with an automaton. Under the conditions of Industry 4.0, as part of company digitization, companies may have many different technological activities, the coordination of which becomes a challenge [25,37]. Additionally, this coordination takes place on a number of levels, from operational management, where the goal is to implement technology, to strategy management, where digitization is a breakthrough change. It is fundamentally difficult to find management concepts that would describe the

manner of the aforementioned coordination. Currently, further deepening of the mutual synergy of IT and business areas can be seen. In line with this approach, in 2013, Bharadwaj et al. developed the "Digital Business Strategy Framework", which is a framework concept of formulating and implementing an organization's strategy by using digital resources to create diversified value generated by breakthrough innovations that are destructive in nature for existing technologies [55]. This concept is particularly valuable in terms of taking into account the evolutionary approach, in which, apart from building new solutions, there is a need to adapt the systems already implemented. Under the conditions of Industry 4.0, creating even a strongly adapted but still relatively separate IT strategy is not enough. In this case, company digitization management, apart from its goal—saturating the company with technology itself—is focused on building business value that results from the use of a bundle of technical solutions in every company area and in every management layer, practically. Currently, when building a company's development strategy, it is necessary to realize that digitization is not only a set of new technologies, but these are new technologies that change the basic rules and business models. Success is achievable if new technologies work with each other and form the essence of business [56] (p. 645). Following this line of thought, in 2010, Mithas and Lucas introduced a new concept of Digital Business Strategy (DBS), which incorporated technological activities into the mainstream of company strategic management [57].

Under the conditions of Industry 4.0, there is a gradual blurring of the boundaries between the business strategy shaping area and the development of IT technology. It can be assumed that not only the way of shaping technological development is subject to changes, but also the management of the enterprise itself within the traditionally established management levels. Maintaining a stable management system in an enterprise that prevents discontinuities may form the basis for its sustainable and sustainable development. It is a multidimensional category relating to maintaining a balance in many aspects of the company's operations, also in the technological aspect

3. Conceptual Model and Hypotheses Development

3.1. The Effect of Company Digitization under the Conditions of Industry 4.0 on the Blurring of the Factual and Decision-Making Horizon in Company Management

Traditionally, management levels are differentiated by defining two dimensions—the time horizon that concerns the time perspective of the decisions made and the factual horizon that marks the area of the organization affected by the decisions. In this context, there is a strategic level that relates to a long-term perspective and a wide range of decisions, tactical—medium-term, the decision-making scope of which includes the medium-level and operational structures, and short-term, with a narrow factual scope. The strategic level is the general decision-making stage that is located at the highest level of the management process structure. The tactical level is the stage at which decisions on how to achieve pre-defined strategic goals are made. The operational level is the stage of implementing the methods that are specified at the tactical level [58] (p. 189).

As part of the organizational structures, there are clearly distinguished layers of management structures, which fit into the above-mentioned management levels. On the other hand, decision-making and information processes, as well as organizational functions, cut through the afore-mentioned layers, which makes the division blurry [59], (p. 7). Under the conditions of Industry 4.0, the creation of a clear separation of management levels based on the material-time criterion is difficult due to the interpenetration of technological and structural areas. In the case of Industry 4.0, the blurring of the boundaries between management levels intensifies the shortening of technology life cycles, discontinuities of technological trends, and turbulence in the company's environment. The support for decision-making areas by IA and even the transfer of some managerial decisions to machine learning systems combine strategic decision-making areas with the company's operational areas.

Particular strategic management stages are increasingly influenced by other management layers, and some stages coexist, essentially. This is related to the deepening focus on

agile management and prototyping, which consists in breaking with long-term planning, and then executing and correcting plans that had been developed. Another reason is the strong technological specialization as professional knowledge is already required at the initial planning stage. It should be emphasized that strategic management is also the process of strategy redefining in response to changes in the environment or preceding these changes or even triggering them, as well as the correlated implementation process, in which the company's resources and skills are used to achieve the adopted long-term development goals and also to secure the company's existence in potential situations of discontinuity [60] (p. 97). Figure 2 shows a diagram of the course of the company digitization management process, taking into account the following areas—strategic, tactical and operational management

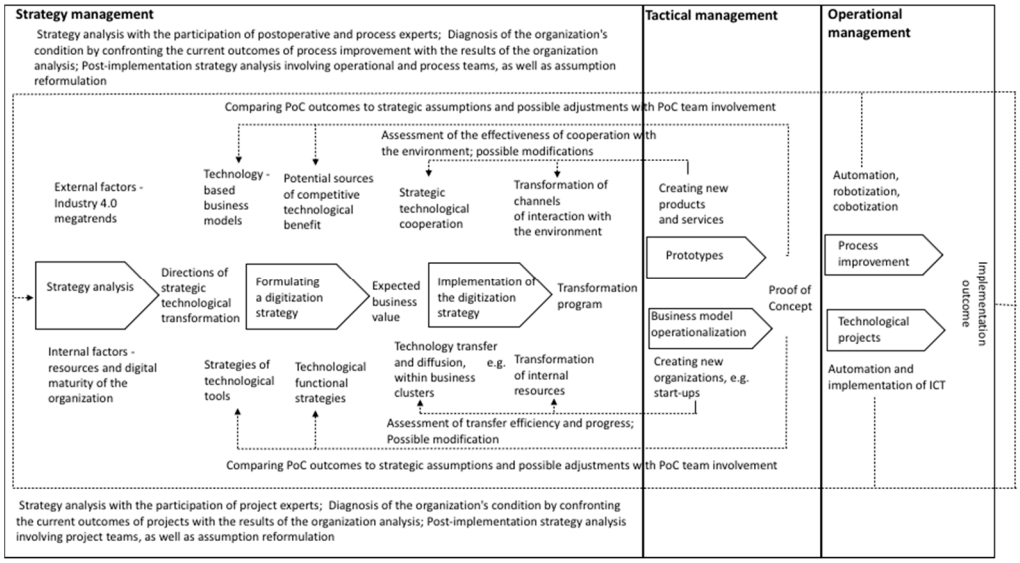

Figure 2. The company digitization management process. Source: own study.

According to the diagram presented in Figure 2, it can be indicated that individual stages of digitization management are an integral element of company management at all its levels. These stages are not autonomous but related to each other. The flow of information between strategic, tactical and operational teams takes place in two directions. Tasks and information are transferred based on decomposition from the highest level to the lower levels, whereas expert knowledge and feedback on the actual implementation progress encountered limitations or ideas resulting from specialist knowledge that are transferred in the opposite direction, which is an important input element of strategic analysis. The boundaries between particular levels of company management are being blurred, which is related to the time and factual horizon blurring, characteristic of traditional separation. This blurring will be characterized at individual stages of the digitization process in the context of individual management layers

3.1.1. Blurring of the Boundaries of Strategic Management

Strategic management includes strategic analysis, strategy formulation and strategy implementation [61] (p. 9). Under the conditions of Industry 4.0, this chronological cycle may be disturbed by the need to supplement the planning process with continuous confrontation with the ever-changing environmental conditions and to gain knowledge about the state of the internal organization in the face of the changing reality. Smuts et al. show that the company's internal structures must be revised to be able to implement an appropriate business strategy, and obtain the expected value [62], (p. 90).

Under the conditions of great uncertainty, the measure of the company's ability to digitize is the implementation progress of technological projects. If no progress is visible in

even the simplest projects related to the use of IT tools as part of functional strategies, it is difficult to talk about further deepening the scope of technological implementations. In this situation, the strategy should indicate directions for internal improvement and creation of competences that would be key for digitization. Antoniou and Ansoff indicate two groups of variables that determine the selection of the company's technological strategy: external and internal. External variables include technological progress, technology life cycle, product life cycle, and competition dynamics. Whereas internal variables include the leadership role and the center of power [63] (p. 276). The strategic analysis and then strategy formulation under the conditions of Industry 4.0 take place with the participation of operational, design and process experts who participate in the implementation of tasks on an ongoing basis and can accurately determine the characteristics of the mentioned internal and external variables. They can also relate technological progress to the actual possibilities of the company's adaptation of technology, as well as assess the feasibility of taking directional decisions in this regard. Therefore, they diagnose the organization at an early stage to prevent impossible investment in technology. On a strategic basis, the consequence of the lack of an early diagnosis of potential implementation difficulties that result from the condition of internal organization are countless applications that implement a bold innovative idea or a strategic idea but are used by individual or corporate users to a very small extent. Many mobile users have no reason to download new applications, despite their rising numbers. According to a 2017 comScore MobiLens report, 51% of smartphone users did not download any application [64]. Under the company conditions, unused enterprise applications were not confronted with the actual conditions prevailing at the operational level. The involvement of operational teams' representatives at the highest level of planning is an expression of maintaining the flow of information and knowledge management in real time, which is one of the main postulates of the Fourth Industrial Revolution. Keeping the flow of information in real time makes it possible to use this information in various areas of the company, e.g., CPS systems or the customization process, and therefore not only at the strictly strategic level e.g., [65,66]. Transferring information following the hierarchical approach between teams under the conditions of Industry 4.0 may deform it and lead to delays in any possible reaction. The short life cycle of technology and the incubation period of technological ideas force the company to make sudden returns—at the strategic level, delays and distortions of information can significantly reduce the company's responsiveness as well. Moreover, it should be noted that the technology has become "light" and accessible. Nowadays, there are platforms that do not require programming knowledge to build an application, e.g., Caspio No-code [67]. Practically, any person who knows the basics of algorithm design and its operations can become the creator of a competing application, and compared to the corporate software development cycle, this person's actions may turn out to be much faster and more flexible. The question arises whether a large traditional corporation from the level of strategic management can perceive such a small and agile competitor. Business practice shows that this does not always happen. For example, despite numerous strategic attempts, telecommunications operators have not managed to take over the renewable energy market. Already in the early 2000s of the nineteenth century, these companies aimed at diversification in the field of RES in their strategies. However, the implementation of the strategy consisted in extending the offer to include electricity sales on the basis of a framework agreement with a traditional energy supplier, and the provision of services to prosumers was taken over by young, dynamic start-ups [68,69]. Under the conditions of Industry 4.0, strategic planning in the technological area is shifting more and more towards the operational layer and specialists' engagement who observe the changes taking place and provide the basis for defining development directions and new business models. An example would be the implementation of data prediction systems that could overlook the possibilities of gaining significant competitive advantages through "top-down" planning. Under the conditions of Industry 4.0, the company's technological saturation is basically ubiquitous. The boundaries of the company's cooperation with partners who participate in strategic

planning, and even determine the company's development opportunities, are also open. The lack of key cooperation, for example, when designing a complex technological product, may limit the company's possibility to compete on new markets. This can be seen in the example of device manufacturers which constitute an integrated form of systems of many different suppliers. The Apple company works with nine leading hardware and software vendors, with which it not only runs cooperation programs but invests in their development by creating "Supplier Responsibility" programs [70]. In the case of providers of services that are provided on multi-stakeholder platforms, building strategies goes beyond traditional business boundaries. An example is Uber, which bases its expansion on new partnerships, e.g., by creating UberEats. Thus, the company's external boundaries are blurred in the context of strategic planning. Being a supplier or a key player of a given platform, it would be a purely theoretical activity to formulate a strategy in isolation from partners. Industry 4.0 definitely ends the period when growth could be achieved on one's own, in isolation from the environment.

It is possible to indicate the following premises for the blurring of the strategic management boundary:

- P.1.1 necessity to work with experts from the operational level in strategy planning which leads to the blurring with lower management levels;
- P.1.2 tightening of cooperation with suppliers at the stage of strategy formulation which leads to the blurring of boundaries in contact with the environment;
- P.1.3 need to have complex detailed knowledge to observe changes in the environment which leads to the blurring in terms of implemented analysis techniques;
- P.1.4 need to diagnose the internal organization condition, e.g., its ability to adapt to technology, which requires detailed operational knowledge which leads to the blurring in terms of implemented analysis techniques;
- P.1.4 breaking with the perspective of long-term planning, aiming at quick results which leads to the blurring in terms of planning periods.

The aforementioned list of premises is an answer to research question Q1.

3.1.2. Blurring of the Boundaries of Tactical Management

Tactical management is the process of specifying strategic action plans and transforming them into implementation projects [58] (p. 190). It is a transition layer between building prospects for the future and the present implementation of tasks. Traditionally, the role of this layer is limited to strategic goals decomposition to a lower level and to two-way transfer of information. However, under the conditions of Industry 4.0, this would be insufficient. The tactics of operation in Industry 4.0 are associated with the design of prototypes and the development of the basis for the operationalization of new, strategic business models based on assumptions. The prototype allows verifying business requirements and relating the assumptions that support product development to real conditions prevailing at the place of implementation [71]. The tactical layer is primarily the creation of a plan aimed at confronting reality, which should end with the completed Proof of Concept, reflecting the ideas proposed at the strategic level. Traditional planning of program and prioritization of portfolio and the resulting projects is only the beginning of activities under the conditions of Industry 4.0. Tactical teams must provide knowledge of the real possibilities of transfer and technological absorption at individual company levels as part of making chosen strategic directions real, as well as regulate cooperation with the surroundings. In the context of tactical management, the blurring of the factual and decision-making horizon mainly concerns the process of prototyping and the need for constant confrontation with reality, which leads to defining conclusions that are required for communication at the strategic level. Scurm and other agile methodologies that are widely used in the implementation of technological solutions in the field of Industry 4.0 are in opposition to traditional water-fall planning [72] (p. 125). The tactical layer is an area where these two perspectives meet, which may be the source of numerous discontinuities and management problems. On the other hand, understanding the values underlying the formulation of strategic assumptions

in the tactical area must be at a particularly high level, because changes in the chosen course of action when implementing new technological solutions may be frequent. High flexibility of operation and ease of communication both at the strategic and operational levels is an important element of tactical operations. The tactical layer under the conditions of Industry 4.0 can be compared to a negotiator who is specialized in resolving the conflict of the world of idea and real implementation possibilities.

It is possible to indicate the following premises for the blurring of the tactical management boundary:

- P.2.1 translation of business value into the operational level, which requires detailed knowledge of the strategy and directions of digitization;
- P.2.2 provision of information on operational problems, which requires detailed knowledge about strategy and directions in digitization which leads to the blurring with the lower and higher management levels;
- P.2.3 a wider contribution of operational knowledge in building a tactical level which leads to the blurring of the analysis techniques;
- P.2.4 the need to build prototypes and the ability to inform about the results of prototype implementations which leads to the blurring of traditional information channels;
- P.2.5 mediation as part of ongoing projects which leads to the blurring with the lower and higher mangement levels;

The aforementioned list of premises is an answer to research question Q1.

3.1.3. Blurring of the Boundaries of Operational Management

Operational management covers all activities related to the management of production factors and resources intended for the production of products and services, as well as their delivery to customers [73] (pp. 4–12). Therefore, it mainly concerns process management and project implementation. Under the conditions of Industry 4.0, implementations related to robotization, cobotization and automation of processes, as well as software and systems implementation are carried out in the scope of operational management. Depending on the company profile and the characteristics of its operating activities, other types of projects are implemented. Smart-class systems are implemented—e.g., smart factories in the manufacturing sector, smart-city in cities, smart-building in office buildings and residential houses, IoT systems in dispersed locations of companies, autonomous systems in logistics and CPS environments. To support the implementation of services, robots are used, artificial intelligence systems are implemented, and data lakes in the area of company management and administration are built. Therefore, there are many technological projects, and they appear in different areas of the company. This requires project teams and project managers to adapt their behavior and leadership style. There is currently a debate on the best ways to manage project teams during the Fourth Industrial Revolution. According to research conducted by Marnewick and Marnewick, the best leadership style for Industry 4.0 projects is defined as servant-leadership, according to which the position of the project manager is not due to his formal power and attributes but skills and knowledge [74], (p. 314). This style is in contradiction with the conditions of management in a traditional organization with a functional structure. Therefore, the project manager has to deal not only with design problems but also problems with cooperation with the company. It is a very difficult task, because the problems of Industry 4.0 projects are complex as they are due to the fact that apart from building systems with technological uncertainty, there is also a difficult implementation process in an internal environment that is sometimes unfavorable. A paradox can be observed here that highly developed technology finds its way into an area where low-skilled personnel work. Under these conditions, the use of even the simplest application can cause problems. Problems of human nature which are complex to solve can appear, and this requires managers' involvement and conduct of transformation programs [75–77]. Therefore, these activities are characteristic of higher management layers than the operational one. Understanding the realities at the operational level by teams

shaping the strategy is an important element of operation. To formulate a strategy, it is necessary to acquire knowledge of the behavior of low-qualified staff, and to find ways to appropriately influence it. In many cases, the desire to create autonomous systems and robotization is associated with staff reduction, which does not have a motivating effect on engagement in projects. The fear of using new solutions is additionally aggravated by the problem of low technological competences and related fears [78–81]. Difficulties that can be encountered in the operational layer, related to the use of implementation products, e.g., applications or devices, can effectively block the digitization progress [25]. The company's development is possible thanks to a proper use of business-improvement technology, which is related not only to finding the right technological paradigms but also to adapting them effectively on the basis of the company [3,6,82]. As a result, there is a need to deal with management issues related to the transformation of the entire organization, and not with the problems of a single implementation project [83,84]. The development of a digitized company, technological saturation and the creation of new values are achieved precisely through implementation activities carried out in the operational layer, whereas the problems faced by work teams may require senior managers' involvement. The distance between the strategic and operational layers, especially in large, traditionally managed corporations, is very large. This distance is not good for projects as it increases the time it takes to make decisions. The problem of delays in decision-making processes was identified as one of the key issues in the Standish Group report [24]. Decisions that appear during project management in the field of Industry 4.0 technology sometimes exceed the capabilities of implementation teams, and the reported problems have their source outside the scope of the projects. Management-related problems occur on many different levels: in the area of data sources, where we struggle with their disorder and low quality; processes that do not meet the requirements of new implementations; organizational structure the growth of which slows down the possibility to make quick decisions; as well as management methods, effective in a corporation but impossible to be used in prototype design. Nevertheless, directional decisions are made at the operational level because the management board has one expectation of the work teams—quick effect of work. Therefore, the teams cannot afford to wait any longer for management decisions or they are not able to effectively pass information. This phenomenon is not a desired effect and design teams should focus primarily on the scope of projects and prevent them from drifting. Thus, the boundary of operational management is blurred in the context of the decision-making horizon. There is a similar situation with knowledge. Apart from low-qualified personnel, high-class specialists, e.g., in the technological area, are involved in the operational activity. Operational management has become a platform for verification of the strategic idea, but also for the verification of work of the management board itself. If the development directions proposed at the strategic level cannot be implemented, and most decisions are made in working teams, the management board may lose the staff's reputation and respect. Therefore, it is even more important to properly diagnose the areas in which, apart from operational teams, higher management representatives should work.

It is possible to indicate the following premises for the blurring of the operational management boundary:

- P.3.1 need to make decisions that belong to the higher management level by tradition which leads to the blurring of with the higher management level;
- P.3.2 need to motivate lower staff in the face of reluctance to engage in projects related to the large-scale digitization project which leads to the blurring with the higher management level;
- P.3.3 employment of experts with knowledge in the field of Industry 4.0 that often exceeds senior management's knowledge which leads to the blurring of informational channels and the methods of managing knowledge on specific management levels;
- P.3.4 adding additional scopes of implementation works related to solving the company's large-scale problems in project teams to new projects which leads to the blurring with the higher management level;

- P.3.5 implementation of a new style of work based on cooperation which leads to the blurring with the higher management level.

The aforementioned list of premises is an answer to research question Q1.

3.2. Management Gap—Conceptual Model

Due to the blurring of the boundaries of individual management layers, there may be numerous discontinuities in the company. While maintaining the traditional approach, which is related to a certain autonomization of the strategic, tactical and operational areas, gaps can be expected. These gaps are filled by management problems that are generated at the point where the company's development strategy and the implementation of ICT projects meet. To separate the aforementioned management gaps, premises of blurring the boundaries of management layers on the company were grouped and described in points 3.1.1–3.1.3. Thus, management gaps were distinguished, divided into groups related to the scope, budget, time, decision making, knowledge management, organizational culture and motivation. These groups have been considered in terms of potential problems they may generate and are presented together with the description in Table 1.

Table 1. Management gaps in the company's digitization process under the conditions of Industry 4.0.

Gap (Gn)	Premises (P)	Potential Problems (GnPRn)
1. Scope gap (Gs)	P.3.4; P.1.4, P.1.1, P.1.2	1. GsPR1. Lowering the effectiveness of the digitization strategy implementation 2. GsPR2 Adding additional scopes of work to the scope of projects 3. GsPR3 Project scope drifting 4. GsPR4 Solving company problems in project teams 5. GsPR5 Diagnosis of the company's condition through project implementation
2. Time gap (Gt)	P.1.4	1. GtPR1. The prospect of quick effects at the expense of searching for optimal solutions 2. GtPR2 Project delay 3. GtPR3 "Endless" projects
3. Decision gap (Gd)	P.3.1	1. GdPR1 Making large-scale decisions concerning the entire company in project teams, which is dictated by the need to solve large-scale problems 2. GdPR2 Decision-making difficulties based on PoC conclusions
4. Budget gap (Gb)	P.1.4, P.3.1	1. GbGR1 Adding additional work scopes in the scope of projects that causes unforeseen costs 2. GbGR2 Project scope drifting and the distribution of costs over time (increase in the cost of money over time)
5. Knowledge gap (Gk)	P.3.3, P.2.1, P.2.2, P.2.3, P.2.4, P.1.3	1. GkGR1 Project products used by the least qualified personnel, causing numerous operational problems 2. GkGR2 Small digital competences in the vast majority of operational personnel 3. GkGR3 Difficulty creating prototypes 4. GkGR4 Difficulty drawing conclusions from PoC

Table 1. *Cont.*

Gap (Gn)	Premises (P)	Potential Problems (GnPRn)
6. Motivation gap (Gm)	P.3.2	1. GmGR1Reluctance to getting involved in digitization projects 2. GmGR2 Fear and concerns about the use of technology
7. Cultural gap (Gc)	P.3.5, P.2.5	1. GmGR1 Conflicts due to the clash of the planning and control culture with the new style of collaborative work by project managers 2. GmGR2 Little permission to make mistakes during prototyping 3. GmGR3 Conflict between agile management and a traditional approach

Source: Own study.

Based on the data collected in Table 1, it can be concluded that during the implementation of the company's digitization process, many different problems may arise that can be manifested at various levels of the organization. Depending on the type and stage of a given entity's development, the characteristics of management gaps may be different, and the problems themselves may be of different intensity.

3.3. Research Hypotheses Development

On the basis of the constructed conceptual model, hypotheses were formulated that relate to the verification of the possibility of identification in the digitization process of individual management gaps:

- Score gap.

Hypothesis 1 (H1). *In the process of digitizing an enterprise under the conditions of Industry 4.0, a scope gap can be identified.*

Positive verification of the hypothesis means that in the company the difference between a general approach to strategy development and a detailed approach to implementation. The details are critical to the implementation of the strategy.

- Time gap.

Hypothesis 2 (H2). *In the process of digitizing an enterprise under the conditions of Industry 4.0, a time gap can be indicated.*

Positive verification of the hypothesis means that the paradox of operational speed delays, which consists in striving for a quick effect in a short time at the expense of long-term planning. This shortens the strategic planning stage and generates delays in projects as part of which large-scale issues are undertaken.

- Decision gap.

Hypothesis 3 (H3). *In the process of digitizing an enterprise under the conditions of Industry 4.0, a decision gap can be identified.*

Positive verification of the hypothesis means confirmation of the existence of decision-making disorder that involves transferring strategic decisions to the project area.

- Budget gap.

Hypothesis 4 (H4). *In the process of digitizing an enterprise under the conditions of Industry 4.0, a budget gap can be identified.*

Positive verification of a hypothesis means the existence of the difference between the actual budget and the planned budget for digitization that arises from the scope gap and the decision gap.

- Knowledge gap.

Hypothesis 5 (H5). *In the process of digitizing an enterprise under the conditions of Industry 4.0, a knowledge gap can be identified.*

Positive verification of the hypothesis means identifying differences in the levels of knowledge in individual management layers. Motivation gap.

Hypothesis 6 (H6). *In the process of digitizing an enterprise under the conditions of Industry 4.0, a motivation gap can be identified.*

Positive verification of a hypothesis implies the existence of differences in the levels of motivation and involvement in digitization in the management and operational layers.

Hypothesis 7 (H7). *In the process of digitizing an enterprise under the conditions of Industry 4.0, a cultural gap can be identified.*

Positive verification of the hypothesis means the existence of differences in the leadership attitudes of managers and project managers that lead to conflicts. The management board's focus on traditional planning and control contrasts with the development of collaborative attitudes in project managers

In the next chapter, the existence of gaps is empirically verified on the basis of empirical results.

4. Methods

4.1. Hypotheses Empirical Verification

The goal of this manuscript is to verify the existence and identify of the management gaps, that lead to formation of digitization problems in companies under the conditions of Industry 4.0. The achievement of the goal will be achieved through the verification of the H1-H7 hypotheses. The hypotheses will be verified by the indirect deduction method, which means a type of inference in which the justification is made on the basis of logical assumptions. On the other hand, the truth of the premises is confirmed on the basis of an earlier literature analysis, which is a kind of authority.

The existence of the gap can be confirmed due to the presence of the prerequisites for blurring borders P and problem PR:

$$\text{I. In} \neq \emptyset \wedge \exists \text{ GPR. GnPRn} \neq \emptyset \rightarrow \text{Hn} = 1$$

If in the empirical study sets I and PR are not empty, their elements can be indicated, i.e., it is possible to determine that there is a specific gap and it is possible to identify it, which confirms the hypothesis. The reasoning was used to confirm the H1–H7 hypotheses.

4.2. Empirical Methods

The chosen research method is a case study because the chosen research goal concerns the area of verification of the occurrence of specific phenomena described in the scope of the theoretical model. From the point of view of the conducted research, the qualitative aspect is more important than the quantitative one. The area of observation of management problems is the area of three main management layers of a digitized company. The characteristics of the mentioned problems, the degree of their intensity, as well as the

context of their emergence may vary, which is important for the research. Taking these reasons into account, instead of conducting quantitative surveys, which have errors, i.e., imposing the researcher's cognitive grid on the respondent, forcing the formulation of an opinion, being unable to capture subconscious aspects of activities, and excessively concentrating on measurements [85] (p. 48), the qualitative case study methodology was selected. It is a widely used method and improved in management in the field of qualitative methods [86]. The literature on the subject indicates that case studies may be characterized by a variable degree of systematicity and strict discipline, but they always strive for an in-depth, qualitative interpretation [87] (pp. 1465–1474). Therefore, efforts were made to keep a strict discipline of the conducted analysis. The data used to formulate the case study was collected on the basis of participant observation. The author of the article took part in ongoing project activities, acting as an advisor to the management board, observing the team's work and formulating conclusions. The observation was made from July 2020 to February 2021. In the case of the conducted research, efforts were made to maintain a systematic analysis based on the management gaps presented in Table 2, while keeping openness in the search for causes of problems, and the management context of their occurrence.

Table 2. Participants of the in-depth interview.

Gap	Organization Area	Organizational Role
Scope gap	IT	IT Director
Time gap	Management Board, management of functional divisions	Chief Executive Officer
Decision gap	Management Board, management of functional divisions	Chief Executive Officer
Budget gap	Finance and controlling division	Chief Financial Officer
Knowledge gap	Administration	Chief Administrative Officer
Motivation gap	HR	HR Director
Cultural gap	HR	HR Director

The selected type of case study is descriptive, as it focuses on an insightful description of the phenomenon. In the construction of the case study, selected elements of the exploratory herd case are also used to search for a cause-and-effect explanation of the described phenomena.

The description of the case study was supplemented with an in-depth interview with the surveyed company's managers who were assigned to the areas characteristic of the occurrence of problems in accordance with their organizational responsibility, as shown in Table 2.

According to the division from Table 2, managers were asked to describe the methods of dealing with the revealed problems that were undertaken.

The participants of the research were selected among the participants of the company's management board. The condition for participation in the research was involvement in the digitization process during the last two years.

4.2.1. Number of Cases

One case is considered in the case study, however, concerns a group of enterprises nibbling 68 entities. The surveyed company is a clear leader on the Polish market. Depending on the branch of activity, its market share, measured by the value of revenue, ranges from 50 to 70%. The other players are small, dispersed local companies. The surveyed enterprise predominantly contracts services for these companies, therefore indirectly, the market share of the surveyed enterprise may be even higher. Thus, the analysis

of more cases not from the cognitive point of view would not necessarily provide new qualitative conclusions.

4.2.2. Selection Criteria

The choice of this particular company was dictated by three aspects related to its characteristics: duration of its operation, importance of the service sector for the Polish economy, and specificity of its operating activities. The time aspect, i.e., the company's long history on the market (30 years), naturally forced the entity to implement various types of transformations. The effect of the conditions of Industry 4.0 and the digitization process on company management should be clearly visible in this type of entity, and the participants in the activities should be aware of the changes taking place in the organization. When analyzing the significance aspect of the case under study, it should be emphasized that the development of the service sector in Poland is a consequence of the transformations and changes that took place in the country after 1989. Before that period, the centrally regulated policy of the Polish economy was primarily focused on the development of industry. It was only in the 1990s that the emerging capitalism allowed for a rapid increase in employment in service activities. In the years 1990–2012, the share of people working in this sector increased from 37% up to 55%. The sector's share in generating gross value added also increased. The service sector undergoes constant internal changes, in which specialized business services are of particular importance [88] (pp. 31–32). Those services are currently one of the main carriers of intellectual value and generate the largest market margins. To keep this trend going, it is necessary to use digitized solutions in services and to be open to the effect of Industry 4.0 megatrends. The selection of a service company as the subject of a case study allows showing how the possibility of using Industry 4.0 technology affects operating activities other than production, which are the subject of many literature studies that have been prepared. In this case, the company not only needs to change internally, but it also has to learn to use technology as part of providing the services. These services are to a large extent traditional, related to people, therefore it is much difficult to apply technology in this area.

4.2.3. Data Collection and Analysis

Data collection was carried out in the process of analysis of design and strategic documentation. The analysis covered the strategic goals described in strategic documents, as well as the project goals eaten up in the strategy documents. Documents of digitization programs were also analyzed and the relationship between program objectives and strategic objectives was examined. The financial statements were analyzed. The review of strategic projects implemented in the area of development, IT, controlling, sales, operations (providing services) and HR. The entire documentation of the draft electronic attendance list has been analyzed. The results of 31 projects carried out in 2019–2020 were analyzed, using the organization's internal platforms for reporting results and project progress. Data from in-depth interviews were collected in the form of lists of the main information provided, which were then verified by the respondents

5. Case Study Results

5.1. Company Description

One of the largest service companies in Poland, which started its operations in the 1990s, was analyzed. The service company conducts diversified activities in the business segment. The main areas of activity are simple cleaning services, security services, patient service and catering, Facility Management and Professional Services, including advanced services dedicated to the industry, e.g., cleaning of water reservoirs, installation of technical devices. The share of basic services, the sale of which translates into about 80% of the company's revenues, dominates in the company. The company currently employs approximately 34,000 people in Poland. The recipients of the services are small and large companies, industry and public institutions, including hospitals. The company's annual

revenue is around EUR 500 million, and the share of labor costs in total costs is very high, approximately 80%. Due to the change announced in Poland that would be related to the rapid increase in the minimum wage by almost 44% by 2023, the company undertakes numerous strategic activities aimed at transformation. The increase in the minimum wage can cause a significant rise in general costs and lower profits. Especially in the case of simple services in the FM area, where the margins are not high (between ten and twenty percent), the increase in the minimum wage is a challenge for the company's functioning. Additionally, the company's activity requires an extensive coordination structure, which makes the fixed costs of activity significant. The services are provided in a dispersed structure—at the customers' premises. The services are performed by task teams whose organization and supervision requires extensive planning and control processes. The company also has mobile teams that change the location of work. The company's organizational structure is not uniform. The company has developed based on acquisition of external entities. Not all transactional integration processes were completed successfully. Therefore, the integration of the acquired companies' IT systems with the company's systems is difficult and has been carried out for many years.

Currently, the company undertakes numerous initiatives related to robotization and automation of services, as well as increasing innovation. Since 2016, the company has been conducting activities focused on digitization, which mainly concerned the implementation of unit systems, i.e., the implementation of a central system for planning and financial settling of service contractors' work (SAP system), implementation of the automatic administration service system (HCM), and domain systems supporting administrative processes in acquired entities. Despite many implementations, a large part of the group is still outside the systems—this value is estimated at around 20% of the staff. In 2018, digitization in the company was reflected for the first time in the directions of strategic development, which were decomposed to the tasks of the management board's individual members. Those directions included:

- Automation of processes, which in the operational layer was associated with the implementation of work planning systems, and control of employees working in the field. The implementation of domain systems of the TMS class (Task Management System) and the electronic attendance list, which was to be the basic system used in the entire enterprise, started.
- The digitization of administrative processes, aimed at transferring all processes into digital form and resignation from traditional documentation, was implemented. This resulted in the launch of the "paperless" program.
- There was robotization and cobotization of Professional Services, which allows replacing staff with machines, leading to lower labor costs, and increased quality of services provided.
- The company was slowly heading to be based on data, which in the operational layer translated into the desire to create a tool simulating the structure and costs associated with it. Additionally, initiatives related to data organization were launched so that it is possible to make appropriate conclusions based on big data.
- The digital competences of employees, which consisted in launching training projects increasing knowledge about ICT, were increased. Training sessions were carried out both for managers and for line workers who were taught how to use basic devices and software.
- A digital transformation program was also launched, the scope of which focused on selecting shift ambassadors, promoting the "digital culture" understood in the company as commitment and openness to new technologies.

The biggest project implemented in the company was the electronic attendance list, which was programmed by one of the internal technology suppliers. This software was developed in 2019 and implemented as part of several contracts carried out by the company with clients from the medical sector. The implementation allowed detecting inconsistencies resulting from the comparison of the actual staffing providing services at the facilities

with the staffing recorded on the payroll. The comparison showed that the supervision systems were ineffective, and the company paid people who do not actually perform the entrusted tasks. Encouraged by the good implementation results, the management board decided to implement the project in the entire company. Due to the fact that the application was ready, a bold goal was to make the application available to all users. However, when releasing the application, a number of problems related to supplying the application with data that was different for different groups of contracts were encountered. Additionally, on a scale of 34,000 employees, it was obvious to ensure cooperation of the application with the previously implemented systems due to the reporting consistency requirement. The integration primarily concerned the need to download appropriate employee data and then compare the employees' presence or absence with the schedule and payroll list. Therefore, these activities required integrating the application with databases which are the source of information about the employee, contracts performed and the physical place where the contracts are performed. The SAP system for payroll and payment planning required integration as well. It turned out to be difficult to ensure that the systems work together, leading to a one-year over-schedule and involving unplanned funds. Another group of problems concerned the line workers, among whom it was necessary to train presence inspectors, replace the telephone equipment, as well as solve current problems with the application operation. Staff training was additionally hindered by problems with the application use, which, when supplied with data from imperfect sources, displayed information that could not be used when checking presence at service locations. The implementation resulted in the launch of new projects in the company—creation of a data warehouse combining data on employees, contracts and places of service provision. There was also a proposition to create a visual map of places where services are provided, and work is performed in the entire group. The project team, which consisted of 36 people from various areas of the company, indicated difficulties in the flow of information, and the need to explain the origins of the problems to the management board, which was not always understood. Instead of trying to remove the limitations, pressure was put on quick results, which in turn forced the project team to implement substitute and temporary solutions. The scope of the project expanded significantly, which was not discussed by the steering or strategic committee, which focused primarily on the necessary functionalities without noticing the scope of integration that was expanding. The organizational problem was called the "iceberg" problem where only the tip is visible at the strategic level. As for the electronic attendance list, it was a simple verification and report generating functionality. The technical scope concerning the IT architecture, data sources, and integration was "under the surface of water" and was not seen from the strategic level. The fact that the electronic attendance list project was the first project implemented in the company on such a large scale in also important. Therefore, the implementation of this project contributed to the diagnosis of the company's condition in terms of the ability to adapt digital solutions. It was also related to solving the company's large-scale problems within the project

5.2. Data Collected in Research

Table 3 Lists the problems that the implementation of this project revealed in relation to the defined management gaps.

Each of the problems identified in Table 3 was related to a certain reaction undertaken by managers. The list of managers' reactions is presented in Table 4.

Table 3. Management gaps and problems of a service company in the digitization process.

Gap	Premises P	Problems GPR
1. Scope gap	Present: P.3.4; P.1.4, P.1.1, P.1.2	1. GsPR1—present—No progress in digitization due to long project implementation (other projects depend on the implementation of the electronic attendance list) 2. GsPR2—present—Adding additional scopes of work to the scope of the electronic attendance list project (the need to build an additional database for collecting power data, building a data exchange bus) 3. GsPR3—present—Change of the scope of the attendance list progressing over time (need to integrate with other systems) 4. GsPR4—present—Most decisions and problems are solved by the project team as they require detailed operational knowledge. On the other hand, the decisions made translate into the company's overall architecture. 5. GsPR.5—present—The diagnosis of the company's condition is made through the implementation of the electronic attendance list project. Based on project-related problems, additional projects are launched, which delay the delivery of the required basic functionality
2. Time gap	Present: P.1.4	1. GtPR2—present—Project delays are visible (exceeding several times the projected completion time). 2. GtPR1—present—The focus on fast results in all layers of management makes it impossible to cover the entire organization with planning 3. GtPR3—present—Project teams indicate that it is difficult to determine the end of the project. The schedule update consists in shifting tasks over time
3. Decision gap	Present: P.3.1	1. GdPR—present—As part of the project, decisions are made that are beyond its scope and the project manager's competences 2. GdPR—present—The project manager avoids asking the management board to make decisions because decisions are not made or it takes a long time 3. GdPR2—present—The boundary between PoC and the project is blurred, because decisions based on implementation applications are delayed
4. Budget gap	Present: P.1.4, P.3.1	1. GbGR—present—Decisions related to budget expansion are postponed 2. GbGR1—present—When reporting the need to increase the scope and related costs, the project manager must take into account long-lasting negotiations
5. Knowledge gap	Present: P.3.3, P.2.1, P.2.2, P.2.3, P.2.4, P1.3	1. GkGR2, GkGR1—present—Big problems with the use of the application among line workers 2. GkGR3—present—Difficulty accepting the prototyping-based approach (if something is not planned it is treated as a symptom of project manager's ignorance)
6. Motivation gap	Present: P.3.2	1. GmGR1—present—Reluctance to participate in digitization projects (no motivation system, additional difficult work for potential project managers who perform functional tasks at the same time) 2. GmGR2—present—Fear and concerns about the use of technology amplified by stories about the potential effects of technology use (massive employment terminations due to the use of robots) 3. GmGR2—present—Project-related "fake news" about application irregularities, poor project organization, etc. 4. GmGR2—present—Conviction of an imminent failure

Table 3. *Cont.*

Gap	Premises P	Problems GPR
7. Cultural gap	Present P.3.5, P.2.5	1. GmGR2—present—The project manager shut himself away to providing information about problems, which was associated with little permission to make mistakes while building new application prototypes 2. GmGR3—present—A visible conflict of agile and traditional management approaches when making the schedule 3. GmGR2—present—Little management board support and little tolerance for errors 4. GmGR1—present—The prevailing organizational culture was based on problem escalation and searching for people to blame instead of problem solving, which translated into delays and demotivation 5. GmGR1—present—The management board is certain that project teams waste time, and implements a tool for recording working time in projects

Table 4. Actions undertaken by manager in connection with solving problems related to the gaps.

Gap		Actions Undertaken by Managers	Manager's Discretionary Frequency Rating
1. Scope gap	1.	Breaking the project down into stages	Rare
	2.	Introducing substitute solutions and carrying out works related to the additional scope of activities beyond the basic project scope	Often
	3.	Defining points of contact between implemented projects (process inputs and outputs)	Rare
	4.	Launching the "impact assessment" program defining relationships between projects	Often
	5.	Striving to build a common data use strategy, including the development of a data warehouse and transformation of the reporting and data download methods	Often
	6.	Transferring the decision-making responsibility to the project team while supplementing the team's composition with key experts and managers	Rare
	7.	Focusing on maintaining a consistency of organizational processes	Often
2. Time gap	1.	Project reviews are organized	Often
	2.	An analysis of the causes of delays was made	Rare
	3.	Introducing project prioritization (there is still no common timetable)	Rare
3. Decision gap	1.	Project steering committees and strategic committees are organized. However, these committees assess projects rather than make key decisions	Often
	2.	During the project, the coordination of management activities related to the company's	Often
4. Budget gap	1.	The company implements central planning of project budgets and strategic tasks organized by controlling	Often

Table 4. *Cont.*

Gap		Actions Undertaken by Managers	Manager's Discretionary Frequency Rating
5. Knowledge gap	1.	Organization of on-line training	Often
	2.	Conducting training courses by application users for other users	Often
	3.	Starting a helpline and information campaigns	Often
	4.	Substantive support for line workers by managers	Often
6. Motivation gap	1.	Actions aimed mainly at line workers (soft training, appointment of shift leaders)	Often
	2.	Implementation of mechanisms that monitor the number of application users	Rare
7. Cultural gap	1.	Organization of training on combining agile and traditional management	Rare

6. Discussion

Taking into account the data collected in Tables 3 and 4, it is possible to positively confirm all the hypotheses H1–H7 and describe management gaps.

6.1. Scope Gap

During the analysis, both the premises and the problems related to their occurrence were identified. It allowed to positively verify the H1:

$$P,GsPR \neq \emptyset \rightarrow \exists x:((x \in P\ (Px)\ v\ GsPRn\ (x))$$

$$GsPR1, GsPR2, GsPR3, GsPR4, GsPR5 \in GsPR \neq \emptyset$$

$$P.\ 3.4;\ P.1.4,\ P.1.1,\ P.1.2 \in P \neq \emptyset$$

$$P.\ Pn \neq \emptyset \wedge \exists\ GPR.\ GsPRn \neq \emptyset \rightarrow H1 = 1$$

There is a visible difference between general directions of development and implementation, which requires a specific approach and changes at the level of the entire company's architecture. The strategy was prepared without a diagnosis of the company's technological condition. Thus, the launched projects are not making any progress, and the proposed strategic directions are hardly visible. It is currently difficult to distinguish between the project scope and the organizational change scope. What is more, there is a phenomenon of "scope shifting" between project teams at the operational level, which try to limit the scope of their own projects trying to counteract its increase. The scope gap is visible primarily at the operational level. The management board focuses on analyzing any delays.

In connection with solving problems related to the scope gap, managers often took actions connected with centralizing and controlling, that were focused on maintaining traditional ways of scope management in the company. There was a visible effort to maintain the existing state of affairs and an attempt to force digitization projects into the procedures used for routine activities, even at the cost of looking for replacement solutions that fit into the project scope.

6.2. Time Gap

During the analysis, both the premises and the problems related to their occurrence were identified. It allowed to positively verify the H2:

$$P,GtPR \neq \emptyset \rightarrow \exists x:((x \in P\ (Px)\ v\ GtPRn\ (x))$$

$$\text{GtPR1, GtPR2, GtPR3} \in \text{GtPR} \neq \emptyset$$

$$\text{P. 1.4} \in \text{P} \neq \emptyset$$

$$\text{P. Pn} \neq \emptyset \wedge \exists \text{ GPR. GtPRn} \neq \emptyset \rightarrow \text{H2} = 1$$

The management board puts the main emphasis on delivering quick results expected by the owner. The time goals of implementations are set in isolation from the actual implementation conditions. Long-term plans in the context of digitization do not exceed the annual perspective. As part of the projects, ad hoc decisions are also made to resolve issues quickly and not to report delays

In connection with solving problems related to the time gap, managers took only one action connected with project review. In managers' opinions reviews were not effective enough and did not give particular results.

6.3. Decision Gap

During the analysis, both the premises and the problems related to their occurrence were identified. It allowed to positively verify the H3:

$$\text{P,GdPR} \neq \emptyset \rightarrow \exists x:((x \in \text{P (Px) v GdPRn (x))}$$

$$\text{GdPR1, GdPR1, GdPR2} \in \text{GdPR} \neq \emptyset$$

$$\text{P.3.1} \in \text{P} \neq \emptyset$$

$$\text{P.Pn} \neq \emptyset \wedge \exists \text{ GPR. GdPRn} \neq \emptyset \rightarrow \text{H3} = 1$$

In a company, some decisions that should result from the transformation directions are made in project teams. Decisions on the architecture of data sources, the development of key tools for company support are made by the electronic attendance list design team. Some of the problems reported by the project team become the subject of a general recommendation for action.

In connection with solving problems related to the decision gap, managers often took actions connected with project steering committees, but instead of taking decisions they were more focused on assessment than problem solving and decision making. Design decisions were subject to frequent changes

6.4. Budget Gap

During the analysis, both the premises and the problems related to their occurrence were identified. It allowed to positively verify the H4:

$$\text{P,GbPR} \neq \emptyset \rightarrow \exists x:((x \in \text{P (Px) v GbPRn (x))}$$

$$\text{GbPR1, GbPR1} \in \text{GbPR} \neq \emptyset$$

$$\text{P. 1.4, P.3.1} \in \text{P} \neq \emptyset$$

$$\text{P. Pn} \neq \emptyset \wedge \exists \text{ GPR. GbPRn} \neq \emptyset \rightarrow \text{H4} = 1$$

There is a hidden budget gap in the company. Despite a significant increase in the project scope, the budget remains unchanged or is changed only to a small extent. Decisions related to costs are delayed and made as a last resort.

In connection with solving problems related to the budget gap, managers took often traditional actions connected with central planning of project budgets and strategic tasks organized by controlling

6.5. Knowledge Gap

During the analysis, both the premises and the problems related to their occurrence were identified. It allowed to positively verify the H5:

$$P,GbPR \neq \emptyset \rightarrow \exists x:((x \in P\ (Px)\ v\ GbPRn\ (x))$$

$$GkPR1, GkPR2, GkPR3 \in GkPR \neq \emptyset$$

$$P.\ 3.3, P.2.1, P.2.2, P.2.3, P.2.4, P1.3 \in P \neq \emptyset$$

$$P.\ Pn \neq \emptyset \wedge \exists\ GPR.\ GkPRn \neq \emptyset \rightarrow H5 = 1$$

There is a wide variety of knowledge on technology in the company. Additionally, there is a different understanding of digitization problems in different management layers. Reluctance to share information about problems may be noticed

In connection with solving problems related to the knowledge gap, managers often took actions connected with training and supporting. The lack of appropriate knowledge and skills in the organization in the field of digitization processes was noticeable for managers. Counteracting this state of affairs was indicated as one of their priorities.

6.6. Motivation Gap

During the analysis, both the premises and the problems related to their occurrence were identified. It allowed to positively verify the H6:

$$P,GmPR \neq \emptyset \rightarrow \exists x:((x \in P\ (Px)\ v\ GmPRn\ (x))$$

$$GmGR1, GmGR2, GmGR2, GmGR2 \in GmPR \neq \emptyset$$

$$P.\ 3.2 \in P \neq \emptyset$$

$$P.\ Pn \neq \emptyset \wedge \exists\ GPR.\ GmPRn \neq \emptyset \rightarrow H6 = 1$$

Significant differences in the levels of motivation and commitment to digitization were observed within the company. High commitment and willingness to act were observed in the management layer, where each member of the management board was responsible for achieving digitization-related goals, whereas in the operational layer, where the reluctance to implement projects was observed, there was a decrease in motivation. There was also reluctance to use technology among line workers, which was manifested by a low share of application use by logged in employees (about 50%)

In connection with solving problems related to the motivation gap, managers often took actions aimed mainly at line workers (soft training, appointment of shift leaders). The lack of appropriate digital competences of employees providing services was very visible for managers, and activities related to their development were, in the opinion of managers, of key importance.

6.7. Cultular Gap

During the analysis, both the premises and the problems related to their occurrence were identified. It allowed to positively verify the H7:

$$P,GcPR \neq \emptyset \rightarrow \exists x:((x \in P\ (Px)\ v\ GcPRn\ (x))$$

$$GcPR1, GcPR1, GcPR2, GcPR2, GcPR3 \in GcPR \neq \emptyset$$

$$P.\ 3.5, P.2.5 \in P \neq \emptyset$$

$$P.\ Pn \neq \emptyset \wedge \exists\ GPR.\ GcPRn \neq \emptyset \rightarrow H7 = 1$$

Significant differences in the leadership attitudes of management and project managers leading to difficulties in reporting problems were observed. The management board focused more on the project progress and on explaining the reasons for the delays than on

supporting the project manager in removing the restrictions. Additionally, the technology provider worked using the SCRUM methodology, which significantly hindered the creation of a schedule in the water-fall structure that the management board required

In connection with solving problems related to the motivation gap, training on combining agile and traditional management was rarely organized. This action suggests that the company realized the need to introduce a different management style. However, the enterprise is still at the stage of acquiring knowledge related to it.

6.8. General Discussion

Research results show that the analyzed company focuses most of its activities on work related to the scope of projects, while it definitely ignores the soft aspects, i.e., motivation and approach to project implementation, related to work culture.

When analyzing the decision gap, it can be noticed that the company is aware of the existence of problems and ways to modify management activities are searched for (three attempts a year to change the way of supervising projects from the digitization program); however, they are still insufficiently effective. This result is in line with the results of a study by the Standish Group, which indicated that decision-making problems are currently one of the main failures of projects [24]. Under the conditions of Industry 4.0, the amount of data to be interpreted is very large, which may justify difficulties in the decision process. However, there are decision support methods based on big data solutions, which the company does not use yet. These systems are largely dedicated to manufacturing companies and through the use of distributed sensors communicating via a wireless network, they analyze data and support real-time decision making [89,90]. There are, however, meta-models, such as those proposed by Martinez et al. [91], reflecting corporate and technical architectures that can be adapted to selected service enterprise processes. Systems created on the basis of these meta-models can be used in a service company for modeling service costs, contracting and supporting decisions made by people thanks to the use of big data analyzes. The surveyed enterprise, however, focusing on internal development, without the participation of external entities has limited access to the latest technology and limited competences in the field of its implementation.

The level of the company's digital competences is low, which managers are aware of and undertake numerous training activities. Taking into consideration the motivation gap, managers often took actions aimed mainly at line workers (soft training, appointment of shift leaders) and forget about the need for transformation at the level of organizational culture and building consent for agile management. In this case, the share of training activities drops significantly in relation to the number of training programs dedicated to line employees.

It should be emphasized that such intensive activities aimed at digitization in the company are undertaken for the first time, which leads to numerous difficulties, and increases the need to deal with new limitations. The presented data also show that new technologies resulting from the Industry 4.0 concept do not function in a vacuum and do not change the company suddenly. The problems presented in Table 3 are not new problems, but are characteristic of technological implementations, which was shown in large-scale studies conducted by Jasińska and Szapiro in 2013 cf. [48]. However, they are occurring in such intensity for the first time. However, the scale of these problems is significantly greater in the surveyed enterprise compared to the results of the research carried out in the ICT sector.

One of the most important problems includes the focus on solving problems in an "ad hoc" mode, reluctance to long-term planning and difficulties in understanding large-scale problems related to digitization. At the same time, the low permission level to make mistakes increases project teams' reluctance to provide information, and thus the management board has limited knowledge about the real limitations of digitization. The consequences of the scope gap and insufficient planning are also visible in the results of adding new scopes to the project, increasing the budget of projects and the time of their

implementation. Although for the analyzed case these problems are new and associated with Industry 4.0, from the point of view of research on project failures, they are rather characteristic of the third industrial revolution [22,23]. This proves a certain regression of the company's activities in the implementation of digital solutions. This leads to a comparison of production companies that apply advanced technologies in Industry 4.0, developing towards building CPS systems [92,93]. When analyzing the databases of the subject literature, e.g., Scopus, it can be concluded that studies on production companies in the use of Industry 4.0 technology are of a significant advantage. Solutions used in mass production, which weave AI into the production processes of a customized but nonetheless repetitive product, provide an interesting research perspective, see more [94,95]. However, in practice, it is difficult to apply the case of a service enterprise, which in its operational activities struggles with other problems that often concern human nature. On the other hand, the elements of the proposed approach may be reflected in the processes of modeling, contracting services and counteracting failures in the scope of disbursement. It should be emphasized that service companies, which to a large extent implement their activities with the use of people, have a difficult task in automating their environments. Here, the competency, motivation and culture gaps play a significant role. In comparison with the results presented by Kadir and Broberg, who analyzed as many as 10 case studies, it can be assumed that despite the problems of human nature, thanks to the proper involvement of staff in the implementation of digitization tasks, significant benefits can be achieved regardless of the type of enterprise, see more [96].

7. Conclusions, Recommendations and Implications

New Industry 4.0 technologies present development prospects for the company, which is the subject of numerous literature studies by [1–11]. However, not all implementations are successful, and bold plans are often difficult to implement. Most of the literature manuscripts focus on the benefits, ignoring the problems and limitations that come with the implementation of Industry 4.0 solutions [21] (p. 18). Whereas, in order to carry out digitization, the company should be able to deal with the limitations of preventing the emergence of numerous problems and management gaps related to digitization and blurring of the boundaries of traditional management under the conditions of Industry 4.0.

The goal of this manuscript is to verify existence and identify of the management gaps that lead to formation of digitization problems in companies under the conditions of Industry 4.0. This goal was achieved by conducting a literature analysis and empirical research—case study analysis, and an in-depth interview with seven key managers of the company. The analysis focused on a Polish service company, in which strategic activities aimed at digitization and project implementation resulting from this strategy were carried out. Based on the conducted analysis, answers were given to the research questions Q1 by identifying a set of premises for the blurring of boundaries in the strategic, tactical and operational layer. The set of hypotheses 1–7 was positively verified, which allowed to answer the research question Q2 thanks to the identification of management gaps and specific problems connected with the company's digitalization process in Industry 4.0 conditions. The main conclusions are:

- The process of digitization in a company in the Industry 4.0 conditions is related to blurring the boundaries of operational, tactical and strategic management. The prerequisites of said blur are identifiable and appear in each of the said layers.
- Industry 4.0 conditions affect the perational, tactical and strategic management of the company.
- The occurrence of the premises of blurring the management boundaries is related to the need to adapt the organization to the new operating conditions related to Industry 4.0, otherwise numerous discontinuities of the management functions, here called management gap, may lead to problems in project implementation.

- The problems of digitization of an enterprise under the conditions of Industry 4.0 can be visible in all management layers, and a given problem may demonstrate a different effect in each of these layers.
- A company management under the conditions of Industry 4.0 should be carried out in a sustainable manner in all management layers. Too much focus on future development directions, while striving to achieve short-term results, leads to many problems the solving of which may cool down the motivation and commitment to development.
- The strategic activities should be targeted at determining the directions of company improvement, which should precede the efforts to implement advanced solutions in the field of Industry 4.0. This approach allows to provide a sustainable company development with the possibility of creating short-term effects and maintaining a long-term growth perspective
- The directions of Industry 4.0 transformation in some companies may concern solutions to simple technological problems, not AI. They are less spectacular as perceived by shareholders than the modern technological strategy of Industry 4.0 which the company aims at, but they constitute the development foundation. Therefore, work at the grass roots is an important way for the company's effective transformation and evolutionary improvement, which will allow benefiting from Industry 4.0 technologies in the coming years.
- Service companies may be less advanced in the field of digitization of organizations under the Industry 4.0 conditions, which is related to the occurrence of numerous problems resulting from the competency, motivation and culture gaps.

Based on the research results, the following recommendations can be formulated:

- In order to counteract errors in the digitization process, the company, in the terms of Industry 4.0, should adapt the internal organization to the changing conditions of Industry 4.0. This adjustment should be made at the strategic, tactical and operational levels.
- In strategic planning related to digitization under the conditions of Industry 4.0, one should take into account the perspective of long-term development and limit the willingness to strive for quick effects and introduce sudden changes aimed at immediate benefit.
- The goals of digitization should be adapted to the competences and degree of digital maturity of the enterprise. If the advancement is low, the objectives concern the smallest possible areas of the organization, and then, as they are achieved, cover more complex areas. Setting too ambitious goals can lead to significant demotivation and the involvement of resources in ineffective processes.
- In order to support the digitization process, it is necessary to build openness in the enterprise to agile management methodologies and build a sense of consent among managers to make mistakes and experiment.
- The management system should be monitored in terms of detecting the reasons for the blurring of management boundaries and the problems associated with them.

The main theoretical implications of the article include the organization of knowledge about the digitization of an enterprise under the conditions of Industry 4.0 and the relationship of this process with enterprise management. The article enriches the theory of management with the phenomenon of blurring the boundaries of strategic, tactical and operational management in the process of digitization of an enterprise under the conditions of Industry 4.0. This phenomenon then became the basis for introducing the concept of management gaps in the article.

The main practical implications include formulating—based on the conducted business case analysis—recommendations and identifying a set of premises for the aforementioned blurring of management boundaries and problems related to the digitization of an enterprise in Industry 4.0 conditions. The ability to identify the occurrence of the above-mentioned premises in business practice may increase the effectiveness of digi-

tization processes by implementing appropriate responses to the related consequences. Increasing the awareness of the need to adapt the company to the new conditions prevailing in Industry 4.0 may accelerate decisions related to the cross-cutting transformation of the company.

8. Limitation and Future Research

The biggest limitation of the analysis carried out in the dissertation was the problems related to data collection, limitations of participant observation and limitations resulting from the research method. The first group of limitations includes a relatively high reluctance of employees of the examined enterprise to inform about problems related to digitization. This was due to the fact that activities aimed at digitization are one of the strategic priorities of the company; therefore, providing information about the existence of restrictions in its scope was considered by managers to undermine the company's reputation. Additionally, the analyzed internal documentation was at times incomplete and scattered across many different sources. Gaining access to the dossier was associated with a long wait time, which made it obsolete in some cases. In many cases, access to documentation was difficult due to the necessity to analyze the identified irregularities. In the case of an outside researcher, access would prove impossible. The author has gained the trust of the owners and managers, due to the fact that he performs an advisory role in the examined enterprise. However, it was related to another limitation of the analysis related to a certain degree of the author's participation in the company's activities, which could translate into some disturbances in data interpretation. On the other hand, the author had extensive knowledge of the company's operations, which made the analysis easier. There were standard limitations characteristic of the selected research methods. In the case of the case study, they were: slight openness of the respondents, limitations in their neutrality and in some cases low communication skills. There were also difficulties in interpreting the information obtained. In the case of in-depth interviews, it was difficult to provide the right time to obtain information because the top management in the company participated in the survey. Some interviews had to be resumed, which disturbed their course. The limitation in obtaining information from the participants of the study was the "sensitivity" of the topics discussed, the willingness to present activities in the best light and the general belief that Industry 4.0 concerns only the modernization of factories and production enterprises. However, the main limitation in the case of both methods was the relatively small scale of the research. Therefore, the test results do not meet the conditions of representativeness. However, taking into account that the share of the surveyed company in the services market in Poland is prevailing, and one may even be tempted to say that the company represents the "service sector in Poland"; the phenomena observed in the case study may very likely occur in other service entities.

Undertaking further research aimed at quantitative and statistical identification of errors and limitations of service enterprises in the process of digitization of enterprises under the conditions of Industry 4.0 would be an interesting area of analysis and provide scientific and practical conclusions. Continuation of the research in this form would make it possible to concretize the results collected in the article, which in relation to statistical research may be preliminary in nature. It is particularly important in future research to choose the right data collection and analysis to minimize the limitations identified in this article. An interesting research aspect would be to compare the results of strategic digitization activities with the operational results of projects. Measurement of the differences in these effects would allow to determine the depth and scope of the management gaps occurring in the enterprise. Improvement of management systems can also be supplemented with an analysis of the possibilities of supporting decision-making structures in the process of digitization of the enterprise, through the identification of key resources and information necessary for involvement at its various stages.

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