sustainability

MDPI

Article

Cloud Computing, Big Data, and Blockchain Technology Adoption in ERP Implementation Methodology

Patryk Morawiec and Anna Sołtysik-Piorunkiewicz *

Department of Informatics, Faculty of Informatics and Communication, University of Economics in Katowice, 40-287 Katowice, Poland; patryk.morawiec@edu.uekat.pl
* Correspondence: anna.soltysik-piorunkiewicz@uekat.pl

Abstract: The aim of the paper is to present the new factors of ERP (Enterprise Resource Planning system) implementation related to the usage of cloud-based and blockchain information technology and to discover potential possibilities of using cloud computing, big data, and blockchain technologies in the methodology of ERP implementation. The article covers the characteristics of the current implementation methodologies and also discusses how these technologies can be adopted in the implementation process. During the study, a literature review was carried out and survey-based interviews with project managers were performed. Previous studies examined in the literature review have some limitations. Most of them are focused on ERP performance in the cloud or measure success factors of ERP implementation. A research gap exists regarding the impact of technologies in the implementation process and the results of this process. The research shed some light on cloud computing and blockchain in ERP implementation. The conclusions are as follows: (1) Some methods of sustainable methods of ERP implementation with the use of cloud technologies, blockchain, and big data have been examined in research studies, but there is still a lack of publications with in-depth analyses of the impact of blockchain on ERP implementation success. (2) The practitioners recommended the new technologies based on cloud computing and big data in the process of ERP implementation, and more knowledge about blockchain would have a positive impact on the success of sustainable ERP implementation as well as on the willingness to adopt the new technologies.

Keywords: ERP; cloud computing; big data; blockchain; implementation methodology; ICT (Information and Communication Technology) adoption factors

Citation: Morawiec, P.; Sołtysik-Piorunkiewicz, A. Cloud Computing, Big Data, and Blockchain Technology Adoption in ERP Implementation Methodology. *Sustainability* **2022**, *14*, 3714. https://doi.org/10.3390/su14073714

Academic Editor: Ewa Ziemba

Received: 1 December 2021
Accepted: 28 February 2022
Published: 22 March 2022

1. Introduction

ERP implementation is a complex and long process during which the enterprise has to face many additional tasks and organizational changes. The complexity level of implementation in organizational, technological, and economic terms is constantly growing [1]. The necessity of carrying out these changes quite often leads to implementation project failure. The article describes the role of ICT technologies in the form of blockchain, big data, and cloud computing in support of the ERP system implementation process for IT project success.

Using the appropriate project methodology can reduce failure risk. According to the CHAOS Report, an IT project failure study conducted regularly by The Standish Group, in 2015, 29% of all projects ended in success and 19% ended in failure [2]. In the 2020 edition of the report, the success and failure rates of the projects were 31% and 19%, respectively [3]. Slightly different results appear in the Panorama Consulting Group reports, where there is a visible upward trend in successful projects year to year. In 2018, 42% of all ERP implementation projects were successful [4], with 88% in 2019 [5]. In 2020 [6] and 2021 [7], nearly all respondents (93% in 2020 and 92% in 2021) considered their ERP implementation projects a success and no respondents viewed their project as a failure.

Information and communication technologies (ICTs), according to many researchers, have an impact on sustainable and societal development, for example, in the case of households [8,9], government—especially the local government [10,11]—and business. Ziemba [12–14] proposed the synthetic indexes for the measurements of a sustainable information society for households, government units, and enterprises. Research studies have shown the background and development of a sustainable information society measurement model in Poland. The factors of ICT adoption in these sectors are divided into four groups—economic factors, ecological factors, sociocultural factors, and political factors, of which the most significant of them are factors related to the economy [9]. ICT research specifications are visible in cloud computing, big data, and other technologies related to Industry 4.0 and Society 5.0 concepts [15–17].

Over the past 20 years, agile software development methods have been created and developed. Nowadays, an agile approach has become the established standard, not only in the field of software development but also in the project management of various industries, such as logistics or pharmaceuticals. In this context, there are some research problems to explore: (1) Does a method or methods of ERP implementation exist with the use of cloud technologies, big data, or blockchain technologies? (2) How can cloud computing, big data, and blockchain technologies affect sustainability in ERP implementation? In Section 2, the theoretical study is described to present the background of the research problems. Next, the research methodology is described in Section 3. Then, the results and discussion are described in Section 4. Finally, the conclusions are presented in Section 5. Additionally, the limitations of the study are described in Section 6.

2. Theoretical Background

There are organizational and technical problems related to ERP implementation processes. Many of these problems can be easily avoided by using the proper implementation methodology, as it can be deduced from the CHAOS Report and the Panorama Consulting Group report mentioned above. A large difference is observed between using waterfall-type methodologies and agile-based methodologies in the case of ERP project implementation success.

The concept of using blockchain, big data, and cloud computing was proposed in [18] and developed in [19], with detailed descriptions of the methodology phases. The proposal for the methodology with the use of the mentioned technologies was based on a literature study of success factors, analysis of a specific case study, and a general literature review regarding ERP implementation.

The proposed methodology is based on four phases [19], as follows:

- Inception phase—Works related to most formal and pre-implementation procedures, starting with customer decisions about implementing a new or replacement system; includes activities such as feasibility studies, the formulation of a development team, and signing a contract with the chosen vendor.
- Analysis phase—Covers activities related to gathering information from customers and the analysis of business processes in the organization. It also includes presentations of the system prototype, its functionality, and customer feedback about the presented material.
- Construction phase—Includes tasks related to the physical implementation of the ERP system (installation, configuration, and programming—for custom-made solutions) in the customer environment and works related to the system's final preparation to "go live" step (customization, data migration, acceptance testing, and integration).
- Operation phase—This post-implementation phase covers the activities after the system is transferred to the final recipient, such as end-user training, user support, system maintenance, and adaption to environmental changes (business and legal).

Figure 1 illustrates an implementation process timeline using the proposed methodology based on [8].

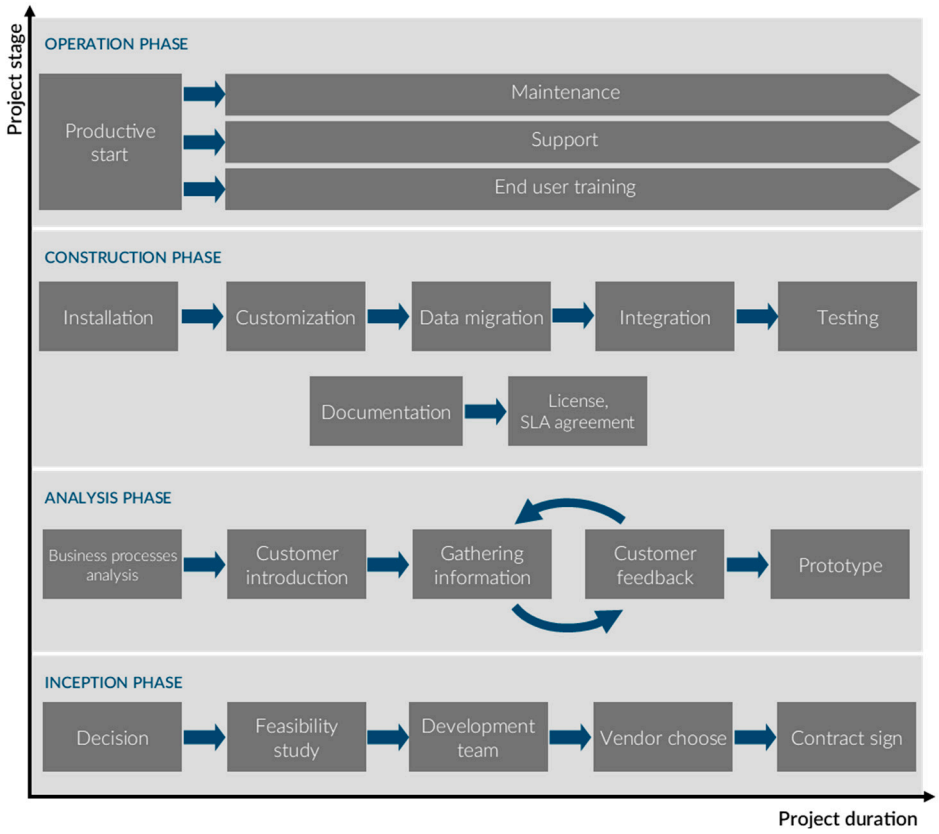

Figure 1. ERP implementation project timeline.

The end of each phase is the beginning of the next phase. The final phase (operation phase) is continuous. Maintenance, user support, and the training of new users are intertwined. These activities end when the implemented system is no longer in use and the decision for a new implementation is made.

Figure 2 presents a Venn diagram illustrating the correlation between the phases and the use of potential technology.

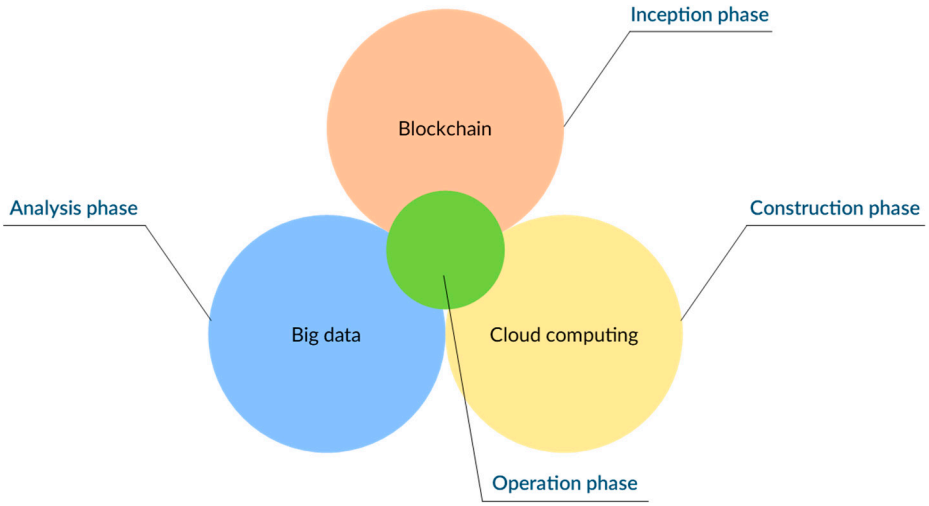

Figure 2. Potential technology support in project phases.

As it is shown in Figure 2, various spectra of mentioned technologies can be used in different project phases. Selected technologies are not limited to a specific phase of the

project, but each technology has a unique advantage that the authors recommend using at the appropriate project stage.

A characteristic feature of the inception phase is its legal and formal nature, which is perfectly suited to blockchain technology implementation, especially in regard to the matter of trust.

Big data analyses are useful in the analysis phase, which relies on data and customer feedback. Thanks to big data algorithms and methods, the vendor is able to better understand what the customer wants and prepare the implemented system for specific business processes within the company.

The main issue of the construction phase is management, and the main success factor is good communication between the customer and vendor. To support the processes taking place in this phase, cloud computing and cloud-based project management tools can be recommended for ERP project implementation success. In addition, the entire ERP solution can rely on the cloud environment. One of the challenging issues of the implementation of IT systems is the requirements engineering, which, if poorly carried out or rapidly changed, often leads to project failure [20,21].

One of the measures of success is the satisfaction of the key stakeholders involved in the project, on the part of both the customer and the vendor [22,23]. Key stakeholders are individuals or entire organizations that influence or can be influenced by the activities related to the project. Zaleski and Michalski proved that an important relationship between stakeholders and risk management exists, which can influence the success of a project [22].

2.1. Cloud Computing Technology in the Context of ERP Implementation

Cloud computing is one of the fastest developing examples of ICT, and cloud-based ERP system usage has increased in the last few years. According to Gartner's predictions in 2021, 32% of large ERP users might switch from an on-premises model to a software-as-a-service model [24]. AlBar and Hoque identified the main factors affecting the adoption of a cloud-based ERP system [25]. Some aspects of the direct positive influence on the adoption intention of cloud ERP systems are relative advantage, observability, ICT skills and infrastructure, top-level management support, and a less stringent and competitive environment. Direct negative influence on cloud ERP adoption intention has complexity. The most beneficial stakeholders of cloud-based ERP implementation might be small and medium-sized enterprises (SMEs), which often, due to limited qualified personnel resources, cannot afford to implement expensive, advanced on-premises solutions (e.g., hardware, licenses) or carry out a long and complicated implementation process [26]. Access to up-to-date, low-cost, secure, and flexible IT solutions can give SMEs an opportunity to compete with larger entities and improve their business performance [27], which is important from an economics point of view due to the major market share of the SME sector and the GDP impact [27,28].

According to Assunção et al., cloud-based solutions also play a crucial role in big data analytics due to providing an infrastructure and a service-based business model that big data follows [29]. Riley and Delic developed the concept of the enterprise knowledge cloud as a platform for knowledge sharing [30]. Cloud technologies are also beneficial in implementation project management due to the possibility of using CASE tools online or project management software [19] for the IT solution demonstration by the vendor. Cloud deployment models can also be more flexible and affordable, especially for SMEs, which might be an important factor for implementation project success.

Based on the previous studies, research question 1 (RQ1) was established: Does a method/methods of ERP implementation exist with the use of cloud computing technologies?

2.2. Blockchain Technology in the Context of ERP Implementation

Blockchain and distributed ledger technology (DLT) are relatively new phenomena initially related to cryptography and electronic payment by a P2P network—nowadays, more widely used in other areas and fields. Mougayar considers blockchain use in business as

a data exchange network for moving value between peers [31]. Uriate et al. formulated a theorem about distributed SLA contract management with the help of blockchain and smart contracts [32]. According to this theorem, an SLA is transformed into a smart contract with the use of Solidity programming language and the Ethereum platform. The consumer and provider are signed up to the network, and after the provider submits the SLA agreement, the consumer has to confirm it. The next step is to deploy the service in a multi-cloud decentralized environment. In the presented prototype, the monitoring of the data and the verification of the consensus protocol (proof of concept) is provided by a trusted third party [32].

In the ERP system, in general, or particularly as an accounting/financial module, blockchain is considered to be a potential solution for transparency-related issues or data protection [33]. In addition, other parts of the enterprise that are managed by the ERP system, such as logistics, business process management, or production management has the potential to gain benefits from blockchain/distributed ledger technology. Blockchain potential has been noticed by the SAP company by introducing the SAP Cloud Blockchain Platform in SAP S/4HANA and SAP Leonardo environment in 2018 [34,35]. This platform integrates different customers' blockchain solutions with existing applications [36]. The SAP Blockchain works as a cloud platform (blockchain-as-a-service). The benefits of using such a platform may include centered business processes, easy transportation management, and global tracking [36]. The Oracle company also implemented their own blockchain solution in a SaaS model as well as an on-premises solution [37,38].

Based on the previous studies, research question 2 (RQ2) was established: Does a method/methods of ERP implementation exist with the use of big data technologies?

2.3. Big Data in the Context of ERP Implementation

Large, complex, and fast-growing data are often referred to as big data, although this term is a buzzword and some professionals find it misleading and confusing due to the lack of a formal definition [39]. The concept of big data refers to the analysis of datasets that are characterized by specific features. Commonly associated with big data are the so-called 3Vs—volume, variety, and velocity. Over time, this concept has grown to 4V and 4V+C (volume, variety, velocity, veracity, and complexity) [40], and nowadays, it is even extended to 8Vs (the 4Vs and, additionally, variability, value, visualization, and validity [41]). Mayer-Schönberger and Cukier [42] tried to formulate a definition of the big data phenomenon as something that can be realized at a big scale and cannot be realized at a small scale in the case of gaining new knowledge or creating new markets, organizations, and relationships that change the quality. Another well-known definition of big data was presented in the McKinsey & Co. Report from 2011 as data for which the scale, distribution, diversity, and/or timeliness require the use of new technical architectures and analytics to enable insights that unlock new sources of business value [43]. The undoubted advantage of big data is the ability to analyze unstructured data sets, for example, video files, pictures, or data in many different formats.

Gorkhali and Xu suggested studying the interaction between big data analytics and an enterprise information system to achieve higher benefits from both [44]. The potential of big data analytics in information systems management, as well as sustainable project management, was described by Lake and Drake [45], especially in the analysis phase of system implementation, where big data provides faster and more accurate data. Furthermore, according to the Economist Intelligence Unit's survey of CSOs and CIOs, big data is most useful in scenario planning improvement due to the better quantification of risk related to a particular scenario [45].

Based on the previous studies, research question 3 (RQ3) was established: Do method/methods of ERP implementation exists with the use of big data technologies?

2.4. Sustainable Methods of ERP Implementation for IT Project Success

Sustainability in management is a significant problem due to the worsening socio-ecological factors that are largely responsible for enterprises [46]. Directors and top-level

management play key roles in implementing sustainable development principles and strategies in organizations. According to Pabian [46], the activities of top management in the context of sustainable development include the following:

- Argumentation and persuading employees to implement sustainable solutions and principles;
- Employee training in sustainability areas;
- Motivation to respect sustainability rules;
- Formal execution of activities in sustainability areas.
- There are some methods in organizations implementing sustainable practices in project management [47], as follows: Crisis management—The organization reacts to critical situations it has caused, such as ecological catastrophe or practices that violate human rights.
- Compliance—Sustainable development as a necessity of being compliant with regulations to continue as a growing concern.
- Resources optimization—The organization develops a sustainability strategy to reduce waste and costs and/or maximize productivity.
- Goal orientation—The organization benefits from a sustainable policy. Resources and employees are managed in a sustainable way to achieve constant growth and value creation.

The sustainable orientation of organizations is also beneficial for investors who invest in Sustainability Index Funds and have a direct impact on the competitive advantage, trust for the brand and its reputation, employee engagement and loyalty, and relationships with other market entities [47].

The study of the impact of the principles of sustainable development on ERP system implementation methodologies is an extension of previous works [18,19] and an additional research objective.

In the context of ERP system implementation, sustainable practices can be considered especially in the context of energy consumption during the implementation as well as after the implementation, during the current system usage. The concepts of sustainable ERP implementation (also called S-ERP) and sustainable business processes modeling are already known and described in the scientific literature. According to Chofreh et al. [48], a sustainable ERP system, should measure sustainability indicators in an organization's business processes more than in traditional ERP, for example, the ecological footprint and the amount of resources required for production.

The implementation of an S-ERP is a more difficult and complex process than that of a traditional ERP system due to the necessity of taking into account the economic, environmental, and social aspects of sustainability as well as the influence of new data types, new stakeholders, and business processes [48]. ERP implementation in a sustainable-oriented corporation is a key success factor in enterprise performance. ERP systems increase the reliability of internal control to enhance a positive brand image and the sustainable operations of an enterprise [49]. Sustainability in ERP implementation methodology was also mentioned in the work by Mackay and Calitz [50], where the use of the appropriate methodology is highlighted as a critical success factor in ensuring the sustainability of the business process in ERP implementation.

An ERP system itself might also be a useful tool to measure the company's production impact on the environment. Data structures in the ERP system are used to evaluate different production processes and their impact on the environment. As a consequence, the organization may be able to choose a less environmentally harmful path of carrying out the process [51]. Sustainable manufacturing is also included in the concept of Industry 4.0. An integrated approach to sustainability and technologies used in Industry 4.0 can unlock the full potential of environmentally sustainable manufacturing by enabling green production processes, a green supply chain, and designing green products [52]. A model of the influence of the Fourth Industrial Revolution activators on management processes in organizations was presented by Spałek [53]. Most of these activators were characterized by a high or very high positive influence on business processes, for example, artificial

intelligence, big data, cloud computing, data analysis, and cyber–physical systems. The only negative impact of Industry 4.0 activators on business processes was related to cybersecurity [53]. ERP integration and the role of IT infrastructure is also the subject of research by Autenrieth et al. [54].

Based on the previous studies, research question 4 (RQ4) was established: How can cloud computing, big data, and blockchain technologies affect sustainability in ERP implementation for IT project success?

3. Materials and Methods

The materials collected for the study included literature resources and enterprise cases (a survey of project managers). The selection of literature to analyze was based on the approach of Webster and Watson [55]. The full methodology is shown in Figure 3.

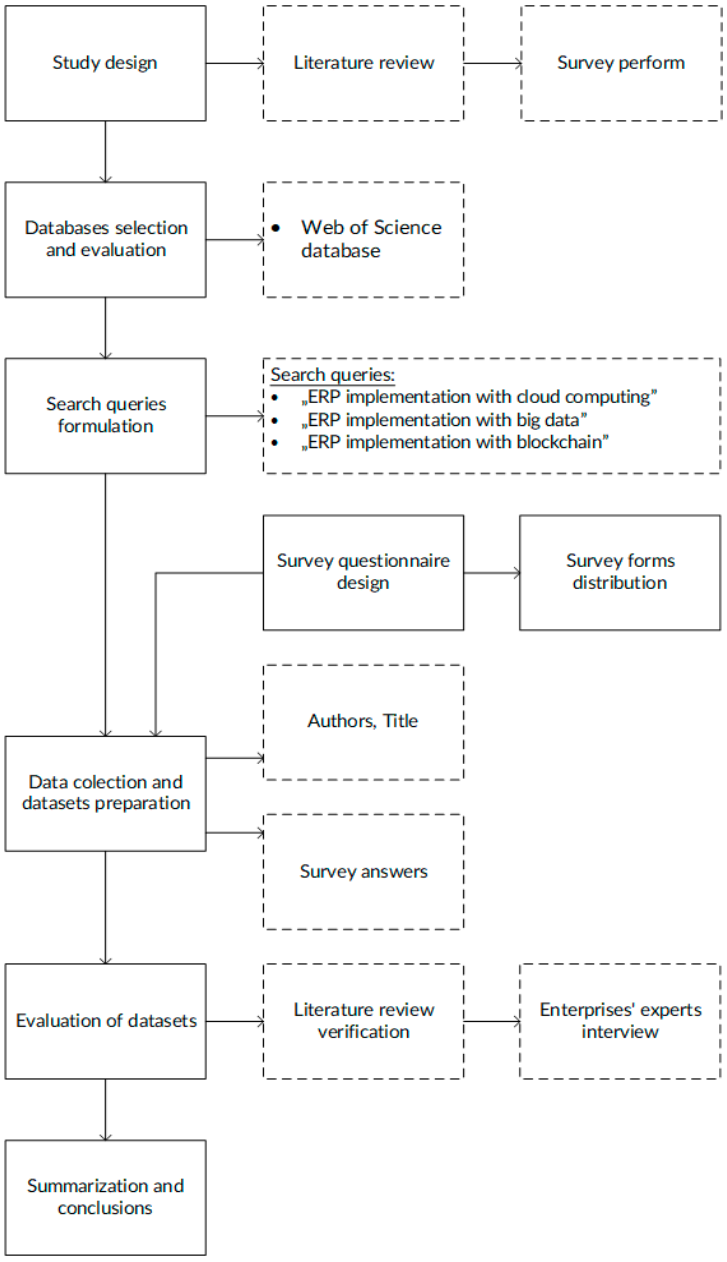

Figure 3. Methodology schema.

The dedicated research methodology was performed based on theoretical and practical studies, with the steps described below:

Step 1: The theoretical aspects of ERP implementation methodology were discovered based on a literature review of cloud computing, big data, and blockchain technology usage. The research questions asked were as follows:

RQ1: Does a method/methods of ERP implementation exist with the use of cloud computing technologies?

RQ2: Does a method/methods of ERP implementation exist with the use of blockchain technologies?

RQ3: Does a method/methods of ERP implementation exist with the use of big data technologies?

RQ4: How can cloud computing, big data, and blockchain technologies affect sustainability in ERP implementation for IT project success?

Step 2: Based on the research questions 1, 2, and 3 (RQ1, RQ2, and RQ3), the literature was reviewed, using the Web of Science database.

Step 3: The practical aspects of ERP implementation methodology were discovered using cloud computing, big data, or blockchain technologies in the context of enterprises operating in Poland. Interviews of the chosen enterprises were conducted based on a questionnaire, and the questions were examined by IT project managers.

Step 4: The interviews were conducted regarding the research question 4 (RQ4), and included the following research problems:

1. Knowledge about cloud computing, big data, or blockchain technologies;
2. Willingness to adopt cloud computing, big data, or blockchain technologies;
3. Impact on project success;
4. Perception of benefits related to technology use.

Step 5: The research findings based on the answers of the three enterprises to the questionnaire were presented based on expert interviews.

The research methods used for the studies included a critical literature review and an interview based on the survey questionnaire.

The literature review was performed with a search query, using the Web of Science database, in regard to knowledge about ERP system implementation and the adoption and use of new information technologies by enterprises. The search queries covered the following criteria: (1) "ERP implementation with cloud computing", (2) "ERP implementation with big data", and (3) "ERP implementation with blockchain". The exclusion criteria were titles and abstracts unrelated to the topic. There was a total of 26 results for the first query, 29 for the second, and 2 for the third, which were examined manually by title and author keywords to find the best matching papers. Finally, 37 articles were reviewed.

The second research method used in this study was an interview based on a survey questionnaire. The interviews were performed in Poland between March 2020 and July 2021 with a group of project managers responsible for ERP system implementation in three enterprises. The answers provided by the survey interviewees are described in Section 4. The conclusions, based on the literature review and in the context of the results and discussion, are presented in Section 5. Additionally, some limitations are presented in Section 6.

4. Results

4.1. Literature Review Results

In the course of the literature review, the following papers were studied. The literature review results are presented in Table 1 in alphabetical order by title.

Table 1. Research studies of ERP implementation in context of usage of cloud computing, blockchain, and big data technologies.

Author(s)	Publication Title
Oppong et al. [56]	A new strategy for harnessing knowledge management in e-commerce
Singh et al. [57]	A Study of Impact of ERP and Cloud Computing in Business Enterprises
Picek et al. [58]	Acceptance of cloud ERP systems in Croatian companies: analysis of key drivers and barriers
Alves and Matos [59]	Adoption of Enterprise Resource Planning System—Some Preliminary Results
Goti-Elordi et al. [60]	Application of a business intelligence tool within the context of big data in a food industry company
Ranjan et al. [61]	Application of emerging technologies in ERP implementation in Indian manufacturing enterprises: an exploratory analysis of strategic benefits
Gangwar [62]	Cloud computing usage and its effect on organizational performance
Lee and Wang [63]	Cloud-based enterprise resource planning with elastic model-view-controller architecture for Internet realization
de Oliveira and Rodello [64]	Critical Success Factors for Cloud-based ERP Systems Deployment
Autenrieth et al. [54]	Current Significance of IT-Infrastructure enabling Industry 4.0 in Large Companies—A Multiple Case Study
Lorenc and Szkoda [65]	Customer Logistic Service in the Automotive Industry with the Use of the SAP ERP System
El Hamdi et al. [66]	Disposition of Moroccan SME Manufacturers to Industry 4.0 with the Implementation of ERP as a First Step
Arif et al. [67]	Enterprise-wide information system for construction: A document-based approach
Fosso Wamba et al. [68]	ERP Adoption and Use in Production Research: An Archival Analysis and Future Research Directions
Morales et al. [69]	ERP Evaluation in Cloud Computing Environment
Sousa and Lopez [70]	ERP Impact on Number of Employees and Personnel Costs in Small and Medium-Sized Enterprises—A Panel Data Approach
Siswanto and Maulida [71]	ERP Module Requirements for Micro, Small and Medium Enterprise Fashion Industry in Bandung
Lechesa et al. [72]	ERP Software as Service (SaaS): Factors Affecting Adoption in South Africa
Catherine and Abdurachman [73]	ERP System Adoption Analysis Using TOE Framework in Permata Hijau Group (PHG) Medan
Svejvig et al. [74]	Hype or Reality: Will Enterprise Systems as a Service Become an Organizing Vision for Enterprise Cloud Computing in Denmark?
Gupta et al. [75]	Identification of challenges and their ranking in the implementation of cloud ERP: A comparative study for SMEs and large organizations
Goel et al. [76]	Impact of Cloud Computing on ERP Implementations in Higher Education
Sishi and Telukdarie [77]	Implementation of Industry 4.0 Technologies in the Mining Industry: A Case Study
Chen and Voigt [78]	Implementation of the Manufacturing Execution System in the Food and Beverage Industry
Telukdarie et al. [79]	Industry 4.0 implementation for multinationals
Chien et al. [80]	Is There Differentia between Traditional and Cloud ERP on Implementation Activity?

Table 1. *Cont.*

Author(s)	Publication Title
Huang and Handfield [81]	Measuring the benefits of ERP on supply management maturity model: a big data method
Gupta and Misra [82]	Moderating Effect of Compliance, Network, and Security on the Critical Success Factors in the Implementation of Cloud ERP
Gupta et al. [83]	Organizational, technological and extrinsic factors in the implementation of cloud ERP in SMEs
Bhatia and Gupta [84]	Principles and practices for the implementation of Cloud-based ERP in SMEs
Muslmani et al. [85]	Reducing Integration Complexity of Cloud-Based ERP Systems
El Hajj and Serhan [86]	Study on the Factors that Determine the Success of ERP Implementation
Wang and Saputra [87]	Terminal Automation System: Automation Solution in the Oil and Gas Industry
Paquet and Paviot [88]	The adoption of an on-line ERP by SME: Between concern and necessity
Moeuf et al. [89]	The industrial management of SMEs in the era of Industry 4.0
Park and Jeong [90]	The QoS-based MCDM system for SaaS ERP applications with Social Network
Boillat and Legner [91]	Why Do Companies Migrate Towards Cloud Enterprise Systems?

A synthesis of the publication keywords was performed with the use of RapidMiner Studio software [92]. Figure 4 shows a chart featuring the term popularity.

Figure 4. Results of the literature search reflecting the keyword popularity.

The studied papers concerned searches related to (1) "ERP implementation with cloud computing", (2) "ERP implementation with big data", and (3) "ERP implementation with blockchain". There were no publications that mentioned ERP implementation with blockchain

technology. The keywords describing the articles were based on 37 deeply analyzed papers. Table 2 presents the statistics based on the keywords in the selected publications along with the number of occurrences. The keywords were examined and synonyms were unified, for example, IoT and Internet of Things and cloud ERP and cloud-based ERP. The most popular topics of the researched papers were related to cloud computing, small and medium-sized enterprises (SMEs), Industry 4.0, critical success factors, ERP systems, big data, and the Internet of Things. There were some additional keywords mentioned in the studied papers related to business information systems mad research methods analyses, i.e., "Food and beverage industry", "TAM", "Business Intelligence", "CRM", "Survey", "Compliance", "Integration", "SCM", "Network", "Information systems". The other keywords were related to the following topics: "Business to business (B2B)", "Acceptance of cloud ERP systems", "Enterprise", "e-Business", "Part Automotive Industry", "construction", "ERP impact", "ERP adoption", "Business optimization", "Procurement", "Cloud-ERP adoption", "ERP Implementation Success", "production control", "Business to consumer (B2C)", "ERP systems modules", "Interface, IT-Infrastructure", "e-Logistics", "Implementation", "Adoption and use", "panel data", "Module Requirement", "Challenges", "Manufacturing execution system", "Implementation activities", "Information management", "Information security", "Supply Chain", "SaaS ERP", "Advanced manufacturing", "technological organizational environmental framework", "Information system architecture evaluation", "SAP ERP", "Literature review", "System", "number of employees", "MSME", "South Africa", "enterprise systems", "Higher Technical Education", "MES engineering", "Organization information processing theory", "Qualitative Interviews", "Buyer–supplier relationships", "Strategy", "Smart manufacturing", "key drivers", "Portugal", "Mobility", "resource-based view", "Web programming", "Just in Time", "document methodology", "Research agenda", "Market", "personnel costs", "Fashion", "organizing vision", "Large organizations", "ERP implementation", "Model-driven engineering", "Smart production systems", "AHP", "Management", "Tank Terminal", "Innovation diffusion theory", "operational improvement", "SaaS quality", "migration", "Electronic commerce (E-commerce)", "barriers", "Cloud Solutions", "Just in Sequence", "Data", "institutional theory", "Terminal Automation System (TAS)", "MCDM", "case study", "Electronic data interchange (EDI)", "BSC", "security", "Big Data Analytics", "SMB", "Quality evaluation model", "adoption", "Enterprise information portal (EIP)", "SPSS", "successful implementation", "Pairwise comparison", "Decisiveness", "Knowledge management (KM)", "Transformation driver".

Table 2. Keyword analysis.

Keyword	Occurrences	[%] *
Cloud computing, ERP	14	7.91
Cloud ERP	7	3.95
SME, Industry 4.0	6	3.39
SaaS	5	2.82
Critical success factors	4	2.26
ERP systems, big data, Internet of Things	3	1.69
Food and beverage industry, TAM, business intelligence, CRM, survey, compliance, integration, SCM, network, information systems	2	1.13
Others	1	0.56

* Number of occurrences/all found keywords (177).

The keyword analysis was performed because of the need to present the characteristics of the selected publications.

4.2. Survey Questionnaire Analysis Results

The results of the interviews based on the survey are as follows:

At first, we studied three chosen enterprises case studies—Enterprise No. 1, Enterprise No. 2, and Enterprise No. 3. The metrics of the studied enterprises are shown in Table 3. The basic characteristics of three enterprises described in the case studies are based on

the following criteria: size, estimated number of employees, estimated annual revenue (in million PLN), and range of activities, that is, if it is an international company and the number of countries it operates in.

Table 3. Selected enterprise characteristics.

Criteria	Enterprise No. 1	Enterprise No. 2	Enterprise No. 3
Size	Medium	Small	Small
Estimated Number of employees	50–249	10–49	2–9
Estimated annual revenue (in million PLN)	>20	1–5	<1
International company?	Yes	No	No
Operating in how many countries?	2	1	1

The enterprises participating in the survey were varied. Most of them were small enterprises operating only in one country, with annual revenue of about 1 million PLN. The interview questionnaires were qualitative with the support of quantitative questions. Each enterprise was represented by one IT project manager. They were asked to answer the questions in the questionnaire.

The questionnaire was divided into two parts. The first was related to ERP system implementation, and the second concerned the status of their knowledge about blockchain, big data, and cloud computing in three enterprises operating in Poland. The questionnaire consisted of 39 closed and 10 open questions in the first part and 30 closed and 15 open questions in the second part.

Table 4 presents detailed results from the questionnaire.

Table 4. Results of enterprise interviews.

Result	Enterprise No. 1	Enterprise No. 2	Enterprise No. 3
Project in general	Failure	Success	n.d.
Knowledge			
Cloud computing	Yes	Yes	Yes
Big data	Yes	Yes	Yes
Blockchain	Yes	No	Yes
Willingness to adopt			
Cloud computing	No	Yes	Yes
Big data	Yes	Yes	Yes
Blockchain	Yes	No	No
Opinion about impact on project success			
Cloud computing	No	Yes	Yes
Big data	Yes	Yes	Yes
Blockchain	Yes	No	No
Perception of benefits related to technology use			
Cloud computing	Yes	No	No
Big data	Yes	No	No
Blockchain	Yes	No	No

n.d.—no data obtained.

The answers regarding project success were ambiguous; one enterprise saw the ERP implementation as a failure, the second one as a success, and the third did not answer this question. The answer "Yes" means that "the technology should be a priority for action", and "No" means "it is completely unnecessary".

Each selected enterprise had knowledge about big data and cloud computing, while two of the three respondents were familiar with blockchain technology. This result is positive and indicates the orientation in technological trends in Polish enterprises (see Figure 5).

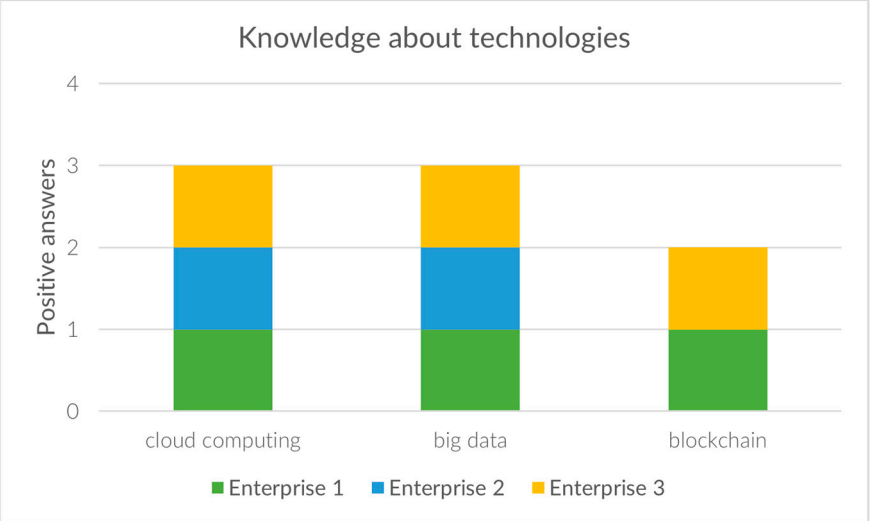

Figure 5. Enterprise knowledge about technologies.

The participants were also asked if they saw the need or willingness to adopt such technology in their enterprise and in which areas or departments did they see this need. Each selected enterprise saw the need to adopt big data in the company, two enterprises were willing to adopt cloud computing, and one enterprise was willing to adopt blockchain (see Figure 6).

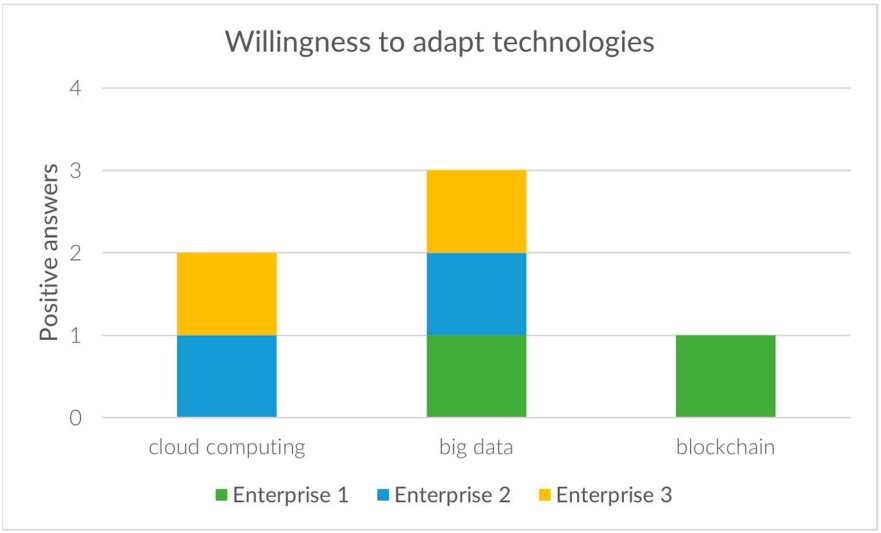

Figure 6. Enterprise willingness to adopt technologies.

Most of the participants had no opinion about development support for the technologies from the government or public sector or saw the need for their support but with the provision that there are more urgent priorities to support.

Their opinions about the impact on project success were similar to their willingness to adopt technologies; all participants agreed that big data implementation could impact IT project success, two agreed that cloud computing could impact project success, and one believed that blockchain could impact project success (see Figure 7).

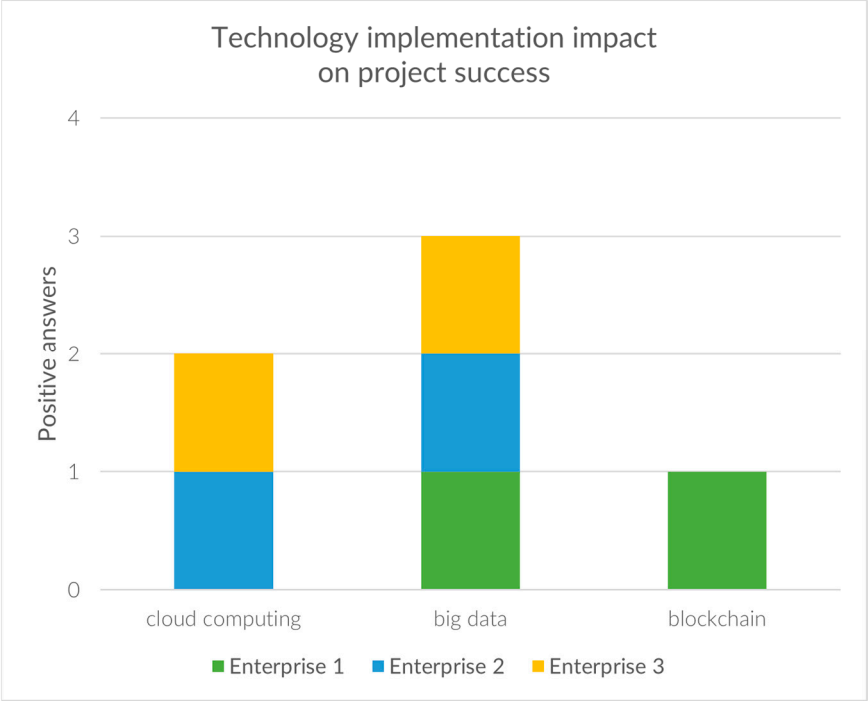

Figure 7. Technology implementation impact on project success.

The perception of threats related to the implementation of each of the technologies implementation was optimistic. Most participants saw no threats related to any of the mentioned technologies, but one participant saw threats related to all of them—in blockchain development, "data availability" was seen as a threat, in big data, a "lack of flexibility", and in cloud computing, "intellectual rights" was mentioned as a threat (see Figure 8).

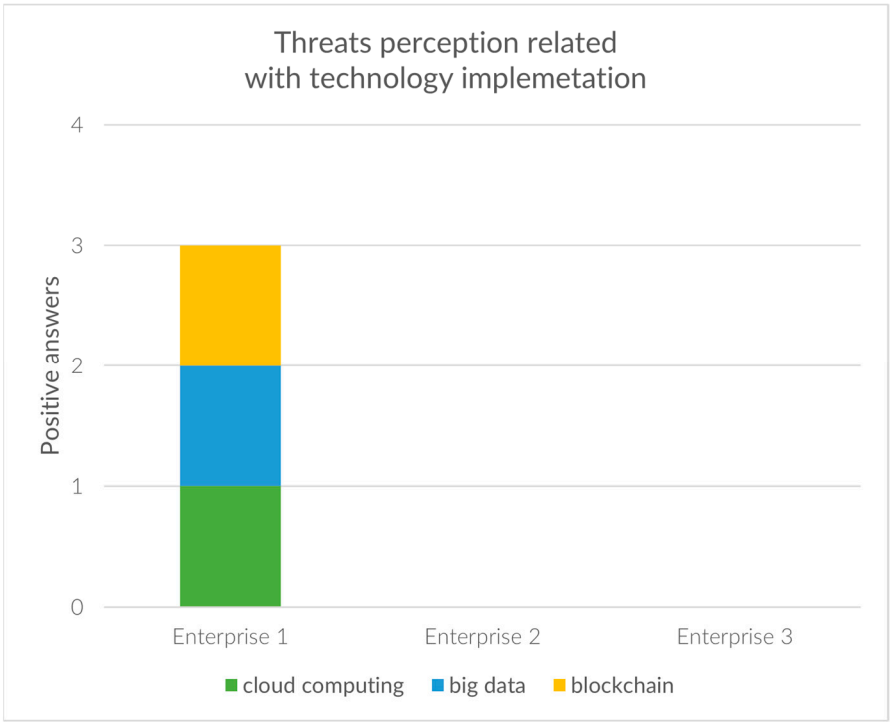

Figure 8. Threat perception related to technology implementation.

Two of the three participants agreed with the statement "cloud computing is able to impact IT project success", but they did not explain how it can affect the success of a project so there is a lack of empirical data measuring the impact of cloud computing use on ERP implementation success. All participants agreed with the statement "big data is able to impact IT project success". The explanation of this impact was "statistical reliability of assessments". The impact of big data on ERP implementation project success could be positive. Due to the small number of positive answers, questions regarding the impact of blockchain on IT project success cannot be verified. One participant agreed with the statement "blockchain technology is able to impact IT project success" due to "objective information exchange"; other participants disagreed with this statement.

5. Discussion

5.1. Blockchain Technology Impact on ERP Implementation

Within the literature, there is no sufficient evidence about the role of blockchain in the ERP implementation process. Faccia and Petratos stated that many uses of blockchain in particular ERP system modules are mostly related to accounting modules and supply chain management [93]. Similar observations were made by Grover et al. in the case of B2B offerings [33]. However, blockchain and distributed ledger technologies are not yet mature technologies and are still in development. The potential use of these technologies has been noticed by major ERP vendors, such as Microsoft, Oracle, and SAP. The analysis of the survey responses also did not find that blockchain technology has an impact on project success and that there is no visible willingness to adopt this technology in the near future.

5.2. Big Data Technology Impact on ERP Implementation

According to the literature analysis as well as the survey results, big data has the potential to be an important factor in successful ERP implementation. All of the interviewed enterprises are planning to implement a big data solution in their companies and all of them had knowledge about big data and believe big data implementation might have an impact on project success. Huang and Handfield developed that the support of big data in vendor selection will have an impact on ERP implementation success [81].

5.3. Cloud Computing Technology Impact on ERP Implementation

Cloud computing technology seems to have the biggest potential in ERP implementation success due to being mature technology that is widely implemented around the world. Singh et al. considered cloud computing as a potential solution to improve company agility, efficiency, and IT department responsiveness in the context of replacing outdated IT solutions in enterprises [57]. The issue of the adoption of an ERP system has been examined in several studies. Picek et al. presented a study of the acceptance of a cloud ERP system in Croatia [58]. Alves and Matos researched reasons why enterprises adopted ERP systems in Portugal; the reasons were mostly the need for the integration of applications, demand for real-time information, and information integration [59]. The ERP implementation process concept presented in [30] might be useful for reducing the communication barriers between vendors and customers, especially when the customer has access to the information.

In addition, according to the survey results analysis, cloud computing is believed to be an important factor of project success, and most of the examined enterprises are planning to adopt this technology in the near future.

5.4. Sustainable Methods of ERP Implementation

According to Arif et al., the problems with ERP implementation come from its monolithic nature and lack of flexibility. They proposed a document-based approach in ERP implementation [67]. Another solution to consider might be to include a cloud-based approach to implement an ERP system [94]. Lorenc and Szkoda presented the supporting role of SAP ERP in lean processes such as JIT (Just in Time) and JIS (Just in Sequence) [65].

The literature also presents the concept of S-ERP (sustainable ERP), which fits in the general trend of combining sustainability and management both in projects and common operations. More details on information systems and their impact on environmental sustainability are presented in Melville's research based on the TAM model, where it is presented as an important but inadequately understood weapon in the quest for sustainability that enables new practices and processes to support belief formation, action formation, and outcome assessment [95]. Due to "green IT" solutions, an important element of the sustainable development at enterprise level are modern information technologies that affect the efficiency of enterprises and enable the implementation of such innovations in the three following dimensions [96]: (1) ecological—the transformation from an energy-consuming economy into an environmentally friendly economy and solutions that increase energy efficiency; (2) social—better communication between stakeholders, real-time action, and information exchange, (3) economic—increasing the financial indicators due to effective data management and analysis.

6. Conclusions

According to the studies conducted by Wątróbski et al. [8] and Ziemba [9,10,12–14] on ICT adoption in enterprises, households, and government units focused on a sustainable information society, the specific areas of ICT were shown in the context of ERP implementation methodology. The aim of this study was to examine the possible use of cloud computing, big data, and blockchain technologies in ERP system implementation methodology. The subject of the study was developed on previous research findings described in [15–19]. The study was conducted through a literature review and an interview with the use of proprietary questionnaire methods.

The study was conducted to answer theoretical and practical research questions. The theoretical aspects of the study concerned four research questions, as follows: RQ1—Does a method/methods of ERP implementation exist with the use of cloud computing technologies? RQ2—Does a method/methods of ERP implementation exist with the use of blockchain technologies? RQ3—Does a method/methods of ERP implementation exist with the use of big data technologies? RQ4—How can cloud computing, big data, and blockchain technologies affect sustainability in ERP implementation for IT project success?

The practical aspects of the ERP implementation methodology for IT project success were discovered in the context of using at least one of the chosen ICTs—cloud computing, big data, or blockchain technologies. The study was performed with three chosen enterprises operating in Poland. Interviews with the chosen enterprises were conducted based on the questionnaire, and the questions were examined by IT project managers.

There is not much evidence of integrating cloud computing, blockchain technology, and big data technology into ERP implementation methodology, so there is still a need for developing a mature model for the success of ERP implementation methodology with the adoption of new technologies in Industry 4.0. In the study, new factors of ERP implementation methodology related to the usage of cloud-based and blockchain information technology were investigated. Some methods of ERP implementation with the use of cloud technologies and big data have been examined in research studies, but there is still a lack of publications with in-depth analyses of the impact of blockchain on ERP implementation success.

Current research confirms the need to conduct further in-depth analyses of the impact of ICT on business in the context of sustainable development, sustainable production, and sustainable business processes management [97,98].

This study was an attempt to characterize the possibilities of using cloud computing, big data, and blockchain technologies in the ERP system implementation process. According to Faccia and Petratos [93], their case study research results show that blockchain technology has an impact on the efficiency, productivity, and security of ERP implementation. Additionally, efforts were made to find a link between the use of technology and a sustainable method of implementation.

The current research topic is topical and important due to the high failure rate of projects. Implementing the described methodology with the support of cloud computing, big data, and blockchain technologies is expected to bring potential benefits to practitioners and enterprise management struggling with ERP implementation, for example, SAP S/4 HANA.

Pańkowska et al. [99] consider sustainability in ICT as using technology to encourage sustainable practices in society as a whole. In addition, they shared their expectations for technologies to change the current practices in supply chain management, energy consumption, and smart cities and green urban design.

The concept of the S-ERP system might become the desired standard in developing and implementing ERP systems, especially in key economic sectors responsible for environment degradation, for example, energy, water management, and so forth.

7. Limitations

The literature review was based on the Web of Science database, and no publications were found that mentioned ERP implementation with blockchain technology. A review of the critical literature review requires deeper analysis to determine the impact of ICT technologies on ERP implementation methodologies in Industry 4.0. The study limitations primarily include the theoretical considerations of ERP implementation without enough testing in a practical environment. In order to present a better understanding of modern ERP system implementation methodologies, future authors should research articles and practical examples from many different sources. To fully explore all possibilities and the success rate of blockchain and cloud-based methodology, a series of practical case studies is necessary. Another potential research direction is examining the influence of other technologies and tools, for example, artificial intelligence on ERP implementation, which is already the subject of some studies [100].

Author Contributions: Conceptualization, P.M. and A.S.-P.; methodology, A.S.-P.; software, P.M.; validation, P.M. and A.S.-P.; formal analysis, A.S.-P.; investigation, P.M. and A.S.-P.; resources, P.M. and A.S.-P.; data curation, P.M.; writing—original draft preparation, P.M.; writing—review and editing, A.S.-P.; visualization, P.M.; supervision, A.S.-P.; project administration, P.M.; funding acquisition, A.S.-P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data sharing not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Wachnik, B. *Wdrażanie Systemów Informatycznych Wspomagajacych Zarządzanie*; Polskie Wydawnictwo Ekonomiczne: Warszawa, Poland, 2016; ISBN 978-83-208-2248-9.
2. CHAOS Report 2015. Available online: https://www.standishgroup.com/sample_research_files/CHAOSReport2015-Final.pdf (accessed on 7 July 2021).
3. Review Standish Group—CHAOS 2020: Beyond Infinity. Available online: https://hennyportman.files.wordpress.com/2021/01/project-success-qrc-standish-group-chaos-report-2020.pdf (accessed on 27 November 2021).
4. *2018 ERP Report*; Panorama Consulting Solutions: Greenwood Village, CO, USA, 2018; Available online: https://www.panorama-consulting.com/resource-center/erp-industry-reports/panoramas-2018-erp-report/ (accessed on 27 October 2021).
5. *2019 ERP Report. People, Process, Technology*; Panorama Consulting Solutions: Greenwood Village, CO, USA, 2019; Available online: https://www.panorama-consulting.com/resource-center/erp-software-research-and-reports/panorama-consulting-solutions-2019-erp-report/ (accessed on 27 October 2021).
6. *2020 ERP Report*; Panorama Consulting Group: Greenwood Village, CO, USA, 2020; Available online: https://www.panorama-consulting.com/resource-center/2020-erp-report/ (accessed on 27 October 2021).
7. *2021 ERP Report*; Panorama Consulting Group: Greenwood Village, CO, USA, 2021; Available online: https://f.hubspotusercontent40.net/hubfs/4439340/Reports/ERP%20Report/2021-ERP-Report-Panorama-Consulting-Group.pdf/ (accessed on 27 October 2021).

8. Wątróbski, J.; Ziemba, E.; Karczmarczyk, A.; Jankowski, J. An Index to Measure the Sustainable Information Society: The Polish Households Case. *Sustainability* **2018**, *10*, 3223. [CrossRef]
9. Ziemba, E. Sustainability Driven by ICT Adoption within Households, Enterprises, and Government Units. *Procedia Comput. Sci.* **2021**, *192*, 2279–2290. [CrossRef]
10. Ziemba, E. The Contribution of ICT Adoption by Local Governments to Sustainability—Empirical Evidence from Poland. *Inf. Syst. Manag.* **2021**, *38*, 116–134. [CrossRef]
11. Pańkowska, M.; Sołtysik-Piorunkiewicz, A. ICT Supported Urban Sustainability by Example of Silesian Metropolis. *Sustainability* **2022**, *14*, 1586. [CrossRef]
12. Ziemba, E. The Contribution of ICT Adoption to Sustainability: Households' Perspective. *Inf. Technol. People* **2019**, *32*, 731–753. [CrossRef]
13. Ziemba, E. Synthetic Indexes for a Sustainable Information Society: Measuring ICT Adoption and Sustainability in Polish Government Units. In *Information Technology for Management: Emerging Research and Applications, Proceedings of the 15th Conference, AITM 2018, and 13th Conference, ISM 2018, Held as Part of FedCSIS, Poznan, Poland, 9–12 September 2018*; Revised and Extended Selected Papers; Ziemba, E., Ed.; Lecture Notes in Business Information Processing; Springer International Publishing: Cham, Switzerland, 2019; Volume 346, ISBN 978-3-030-15153-9.
14. Ziemba, E. Synthetic Indexes for a Sustainable Information Society: Measuring ICT Adoption and Sustainability in Polish Enterprises. In *Information Technology for Management: Ongoing Research and Development*; Ziemba, E., Ed.; Lecture Notes in Business Information Processing; Springer International Publishing: Cham, Switzerland, 2018; Volume 311, pp. 151–169. ISBN 978-3-319-77720-7.
15. Sołtysik-Piorunkiewicz, A.; Zdonek, I. How Society 5.0 and Industry 4.0 Ideas Shape the Open Data Performance Expectancy. *Sustainability* **2021**, *13*, 917. [CrossRef]
16. Morawiec, P.; Sołtysik-Piorunkiewicz, A. Knowledge Management Significance in Agile Organization in Lights of COVID-19 Pandemic Changes. In *Information Systems. EMCIS 2021*; Themistocleous, M., Papadaki, M., Eds.; Lecture Notes in Business Information Processing; Springer: Cham, Switzerland, 2022; pp. 705–722. ISBN 978-3-030-95947-0.
17. Sołtysik-Piorunkiewicz, A.; Morawiec, P. Cloud Based Business Process Modeling Environment—The Systematic Literature Review. In *Recent Challenges in Intelligent Information and Database Systems, Proceedings of the 13th Asian Conference, ACIIDS 2021, Phuket, Thailand, 7–10 April 2021*; Hong, T.-P., Wojtkiewicz, K., Chawuthai, R., Sitek, P., Eds.; Springer: Singapore, 2021; pp. 416–428.
18. Morawiec, P. Budowa Metodyki Wdrożeń Systemów ERP z Wykorzystaniem Blockchain i Technologii Chmurowych. Master's Dissertation, University of Economics in Katowice, Katowice, Poland, 2020.
19. Morawiec, P.; Sołtysik-Piorunkiewicz, A. The New Role of Cloud Technologies in Management Information Systems Implementation Methodology. In *Proceedings of the Future Technologies Conference (FTC) 2020, Volume 3*; Arai, K., Kapoor, S., Bhatia, R., Eds.; Advances in Intelligent Systems and Computing; Springer International Publishing: Cham, Switzerland, 2021; Volume 1290, pp. 423–441. ISBN 978-3-030-63091-1.
20. Wróblewski, P. *Zwinnie do Przodu: Poradnik Kierowania Projektów Informatycznych*; Wydawnictwo Helion: Gliwice, Poland, 2020; ISBN 978-83-283-6654-1.
21. Plecka, P. Metoda Przedwdrożeniowego Wymiarowania Zmian Oprogramowania Wybranej Klasy Systemów ERP. Ph.D. Dissertation, Koszalin University of Technology, Koszalin, Poland, 2017.
22. Zaleski, S.; Michalski, R. Success Factors in Sustainable Management of IT Service Projects: Exploratory Factor Analysis. *Sustainability* **2021**, *13*, 4457. [CrossRef]
23. De Wit, A. Measurement of Project Success. *Int. J. Proj. Manag.* **1988**, *6*, 164–170. [CrossRef]
24. Ahn, B.; Ahn, H. Factors Affecting Intention to Adopt Cloud-Based ERP from a Comprehensive Approach. *Sustainability* **2020**, *12*, 6426. [CrossRef]
25. AlBar, A.M.; Hoque, R. Factors Affecting Cloud ERP Adoption in Saudi Arabia: An Empirical Study. *Inf. Dev.* **2019**, *35*, 150–164. [CrossRef]
26. Cunha, C.R.; Morais, E.P.; Sousa, J.P.; Gomes, J.P. The Role of Cloud Computing in the Development of Information Systems for SMEs. *J. Cloud Comput.* **2017**, e736545.
27. Assante, D.; Castro, M.; Hamburg, I.; Martin, S. The Use of Cloud Computing in SMEs. *Procedia Comput. Sci.* **2016**, *83*, 1207–1212. [CrossRef]
28. Krakowiak, M.; Bajor, T. Cloud Computing as a Prospect for the Sector of Small—And Medium-Size Companies in the Polish Market. *New Trends Prod. Eng.* **2019**, *2*, 103–113. [CrossRef]
29. Assunção, M.D.; Calheiros, R.N.; Bianchi, S.; Netto, M.A.S.; Buyya, R. Big Data Computing and Clouds: Trends and Future Directions. *J. Parallel Distrib. Comput.* **2015**, *79–80*, 3–15. [CrossRef]
30. Riley, J.; Delic, K. Enterprise Knowledge Clouds: Next Generation Knowledge Management Systems. In *Cloud Computing and Software Services: Theory and Techniques*; Ahson, S.A., Ilyas, M., Eds.; CRC Press: Boca Raton, FL, USA, 2011; ISBN 978-1-4398-0316-5.
31. Mougayar, W. *Blockchain w Biznesie: Możliwości i Zastosowania Łańcucha Bloków*; Wydawnictwo Helion: Gliwice, Poland, 2019; ISBN 978-83-283-4932-2.

32. Uriarte, R.B.; de Nicola, R.; Kritikos, K. Towards Distributed SLA Management with Smart Contracts and Blockchain. In Proceedings of the 2018 IEEE International Conference on Cloud Computing Technology and Science (CloudCom), Nicosia, Cyprus, 10–13 December 2018; pp. 266–271.
33. Grover, P.; Kar, A.K.; Vigneswara Ilavarasan, P. Blockchain for Businesses: A Systematic Literature Review. In *Challenges and Opportunities in the Digital Era*; Al-Sharhan, S.A., Simintiras, A.C., Dwivedi, Y.K., Janssen, M., Mäntymäki, M., Tahat, L., Moughrabi, I., Ali, T.M., Rana, N.P., Eds.; Lecture Notes in Computer Science; Springer International Publishing: Cham, Switzerland, 2018; Volume 11195, pp. 325–336. ISBN 978-3-030-02130-6.
34. Gupta, R. *Introducing Blockchain with SAP Leonardo*; Rheinwerk Publishing Inc.: Quincy, MA, USA, 2019.
35. Schuster, A. SAP HANA Blockchain: An Introduction. Available online: https://blogs.sap.com/2018/06/13/sap-hana-blockchain-a-technical-introduction/ (accessed on 12 January 2022).
36. Smith, E. SAP Blockchain: Introduction, Implementation, Benefits & More! ITChronicles. 2021. Available online: https://itchronicles.com/blockchain/sap-blockchain-introduction-implementation-benefits-more/ (accessed on 12 January 2022).
37. Oracle Blockchain Platform Cloud Service. Available online: https://www.oracle.com/pl/blockchain/cloud-platform/ (accessed on 12 January 2022).
38. Oracle Blockchain. Available online: https://www.oracle.com/blockchain/ (accessed on 12 January 2022).
39. Few, S. *Big Data, Big Dupe: A Little Book about a Big Bunch of Nonsense*; Analytics Press: El Dorado Hills, CA, USA, 2018; ISBN 978-1-938377-10-5.
40. Allison, R. *Visualizing Data with SAS®: Selected Topics*; SAS Institute: Cary, NC, USA, 2017; ISBN 978-1-63526-105-9.
41. 8 Characteristics of Big Data—Know the 8 V's of Big Data. Tech Blogger. Available online: https://contenteratechspace.com/blogs/8-characteristics-of-big-data/ (accessed on 27 October 2021).
42. Mayer-Schönberger, V.; Cukier, K. *Big Data: Rewolucja, Która Zmieni Nasze Myślenie, Pracę i Życie*; MT Biznes: Warszawa, Poland, 2014; ISBN 978-83-7746-515-8.
43. Manyika, J.; Chui, M.; Brown, B.; Bughin, J.; Dobbs, R.; Roxburgh, C.; Hung Byers, A. *Big Data: The Next Frontier for Innovation, Competition, and Productivity*; McKinsey Global Institute: Washington, DC, USA, 2011; p. 156.
44. Gorkhali, A.; Xu, L.D. Enterprise Architecture, Enterprise Information Systems and Enterprise Integration: A Review Based on Systems Theory Perspective. *J. Ind. Intg. Mgmt.* **2019**, *04*, 1950001. [CrossRef]
45. Lake, P.; Drake, R. *Information Systems Management in the Big Data Era*, 1st ed.; Advanced Information and Knowledge Processing; Springer: Cham, Switzerland, 2014; ISBN 978-3-319-13503-8.
46. Pabian, A. Rola dyrekcji w promowaniu i wdrażaniu zasad sustainability w przedsiębiorstwie. *Przegląd Organizacji* **2015**, *4*, 6–11. [CrossRef]
47. Carboni, J.; Duncan, W.R.; Gonzalez, M.; Milsom, P.; Young, M. *Zrównoważone Zarządzanie Projektami: Podręcznik GPM*; pm2pm: Kraków, Poland, 2020; ISBN 978-83-928596-1-1.
48. Chofreh, A.G.; Goni, F.A.; Malik, M.N.; Khan, H.H.; Klemeš, J.J. Evaluation of the Sustainable Enterprise Resource Planning Implementation Steps. *Chem. Eng. Trans.* **2019**, *72*, 445–450. [CrossRef]
49. Huang, S.Y.; Chiu, A.A.; Chao, P.C.; Arniati, A. Critical Success Factors in Implementing Enterprise Resource Planning Systems for Sustainable Corporations. *Sustainability* **2019**, *11*, 6785. [CrossRef]
50. Mackay, M.M.W.; Calitz, A.P. Successful and Sustainable ERP Implementations. In Proceedings of the SAPICS 2011 Conference, Sun City, South Africa, 28 June 2011; pp. 1–23.
51. Dziemba, Ł.; Senczyna, S. System informatyczny ERP jako narzędzie obliczania oddziaływania procesów produkcji na środowisko. *Innowacje w Zarządzaniu i Inżynierii Produkcji* **2017**, *2*, 10.
52. De Sousa Jabbour, A.B.L.; Jabbour, C.J.C.; Foropon, C.; Godinho Filho, M. When Titans Meet—Can Industry 4.0 Revolutionise the Environmentally-Sustainable Manufacturing Wave? The Role of Critical Success Factors. *Technol. Forecast. Soc. Chang.* **2018**, *132*, 18–25. [CrossRef]
53. Spałek, S. *Zarządzanie Projektami w Przedsiębiorstwie: Perspektywa Czwartej Rewolucji Przemysłowej*; Polskie Wydawnictwo Ekonomiczne: Warszawa, Poland, 2020; ISBN 978-83-208-2409-4.
54. Autenrieth, P.; Lorcher, C.; Pfeiffer, C.; Winkens, T.; Martin, L. Current Significance of IT-Infrastructure Enabling Industry 4.0 in Large Companies. In Proceedings of the 2018 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC), Stuttgart, Germany, 17–20 June 2018; pp. 1–8.
55. Webster, J.; Watson, R.T. Analyzing the Past to Prepare for the Future: Writing a Literature Review. *MIS Q.* **2002**, *26*, 13–23.
56. Oppong, S.A.; Yen, D.C.; Merhout, J.W. A New Strategy for Harnessing Knowledge Management in E-Commerce. *Technol. Soc.* **2005**, *27*, 413–435. [CrossRef]
57. Singh, G.; Manna, M.S.; Bhasin, G.S. A Study of Impact of ERP and Cloud Computing in Business Enterprises. In Proceedings of the World Congress on Engineering and Computer Science, San Francisco, CA, USA, 23–25 October 2013; International Association of Engineers: Hong Kong, China, 2013; Volume 1, pp. 86–89.
58. Picek, R.; Mijac, M.; Androcec, D. Acceptance of Cloud ERP Systems in Croatian Companies: Analysis of Key Drivers and Barriers. In Proceedings of the 20th International Scientific Conference "Economic and Social Development", Prague, Czech Republic, 27–28 April 2017; pp. 513–522.

59. Do Céu Gaspar Alves, M.; Matos, S.I.A. Adoption of Enterprise Resource Planning System—Some Preliminary Results. In Proceedings of the European Conference on Information Management & Evaluation, Lisbon, Portugal, 9–10 September 2010; pp. 447–450.
60. Goti Elordi, A.; De La Calle Vicente, A.; Gil Larrea, M.J.; Errasti, A.; Uradnicek, J. Aplicación de un sistema business intelligence en un contexto big data de una empresa industrial alimentaria. *DYNA-Ingeniería e Industria* **2017**, *92*, 347–353. [CrossRef]
61. Ranjan, S.; Jha, V.K.; Pal, P. Application of Emerging Technologies in ERP Implementation in Indian Manufacturing Enterprises: An Exploratory Analysis of Strategic Benefits. *Int. J. Adv. Manuf. Technol.* **2017**, *88*, 369–380. [CrossRef]
62. Gangwar, H. Cloud Computing Usage and Its Effect on Organizational Performance. *HSM* **2017**, *36*, 13–26. [CrossRef]
63. Lee, H.-Y.; Wang, N.-J. Cloud-Based Enterprise Resource Planning with Elastic Model–View–Controller Architecture for Internet Realization. *Comput. Stand. Interfaces* **2019**, *64*, 11–23. [CrossRef]
64. De Oliveira, E.T.; Rodello, I.A. Critical Sucess Factors for Cloud-Based ERP Systems Deployment: A Study with Brazilian Companies. In Proceedings of the 2018 13th Iberian Conference on Information Systems and Technologies (CISTI), Caceres, Spain, 28 June 2018; pp. 1–6.
65. Lorenc, A.; Szkoda, M. Customer Logistic Service in the Automotive Industry with the Use of the SAP ERP System. In Proceedings of the 2015 4th International Conference on Advanced Logistics and Transport (ICALT), Valenciennes, France, 20–22 May 2015; pp. 18–23.
66. El Hamdi, S.; Abouabdellah, A.; Oudani, M. Disposition of Moroccan SME Manufacturers to Industry 4.0 with the Implementation of ERP as a First Step. In Proceedings of the 2018 Sixth International Conference on Enterprise Systems (ES), Limassol, Cyprus, 1–2 October 2018; pp. 116–122.
67. Arif, M.; Kulonda, D.; Egbu, C.; Goulding, J.S.; Toma, T. Enterprise-Wide Information System for Construction: A Document Based Approach. *KSCE J. Civ. Eng.* **2011**, *15*, 271–280. [CrossRef]
68. Fosso Wamba, S.; Kala Kamdjoug, J.R.; Akter, S.; Carillo, K. ERP Adoption and Use in Production Research: An Archival Analysis and Future Research Directions. In *Challenges and Opportunities in the Digital Era*; Al-Sharhan, S.A., Simintiras, A.C., Dwivedi, Y.K., Janssen, M., Mäntymäki, M., Tahat, L., Moughrabi, I., Ali, T.M., Rana, N.P., Eds.; Lecture Notes in Computer Science; Springer International Publishing: Cham, Switzerland, 2018; Volume 11195, pp. 539–556. ISBN 978-3-030-02130-6.
69. Morales, V.; Vendrametto, O.; dos Santos, S.D.; Lessa, V.S.; Sartor, E.A. ERP Evaluation in Cloud Computing Environment. In *Advances in Production Management Systems: Innovative Production Management towards Sustainable Growth*; Umeda, S., Nakano, M., Mizuyama, H., Hibino, N., Kiritsis, D., von Cieminski, G., Eds.; IFIP Advances in Information and Communication Technology; Springer International Publishing: Cham, Switzerland, 2015; Volume 459, pp. 78–84. ISBN 978-3-319-22755-9.
70. Sousa, J.E.; Lopez, V.B. ERP Impact on Number of Employees and Personnel Costs in Small and Medium Sized Enterprises—A Panel Data Approach. In *Proceedings of the Tenth International Conference on Enterprise Information Systems, Volume 1*; SCITEPRESS—Science and Technology Publications: Barcelona, Spain, 2008; pp. 196–202.
71. Siswanto, J.; Maulida, A. ERP Module Requirements for Micro, Small and Medium Enterprise Fashion Industry in Bandung. In Proceedings of the 2014 International Conference on Information Technology Systems and Innovation (ICITSI), Bandung, Indonesia, 24–27 November 2014; pp. 183–188.
72. Lechesa, M.; Seymour, L.; Schuler, J. ERP Software as Service (SaaS): Factors Affecting Adoption in South Africa. In *Re-Conceptualizing Enterprise Information Systems*; Møller, C., Chaudhry, S., Eds.; Lecture Notes in Business Information Processing; Springer: Berlin/Heidelberg, Germany, 2012; Volume 105, pp. 152–167. ISBN 978-3-642-28826-5.
73. Catherine, C.; Abdurachman, E. ERP System Adoption Analysis Using TOE Framework in Permata Hijau Group (PHG) Medan. *Int. J. Enterp. Inf. Syst.* **2018**, *14*, 91–105. [CrossRef]
74. Svejvig, P.; Storgaard, T.; Møller, C. Hype or Reality: Will Enterprise Systems as a Service Become an Organizing Vision for Enterprise Cloud Computing in Denmark? In *Enterprise Information Systems of the Future*; Poels, G., Ed.; Lecture Notes in Business Information Processing; Springer: Berlin/Heidelberg, Germany, 2013; Volume 139, pp. 190–197. ISBN 978-3-642-36610-9.
75. Gupta, S.; Misra, S.C.; Singh, A.; Kumar, V.; Kumar, U. Identification of Challenges and Their Ranking in the Implementation of Cloud ERP: A Comparative Study for SMEs and Large Organizations. *Int. J. Qual. Reliab. Manag.* **2017**, *34*, 1056–1072. [CrossRef]
76. Goel, S.; Ravi, D.; Deepak, D. Impact of Cloud Computing on ERP Implementations in Higher Education. *Int. J. Adv. Comput. Sci. Appl.* **2011**, *2*, e020622. [CrossRef]
77. Sishi, M.N.; Telukdarie, A. Implementation of Industry 4.0 Technologies in the Mining Industry: A Case Study. In Proceedings of the 2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), Singapore, 10–13 December 2017; pp. 201–205.
78. Chen, X.; Voigt, T. Implementation of the Manufacturing Execution System in the Food and Beverage Industry. *J. Food Eng.* **2020**, *278*, 109932. [CrossRef]
79. Telukdarie, A.; Buhulaiga, E.; Bag, S.; Gupta, S.; Luo, Z. Industry 4.0 Implementation for Multinationals. *Process Saf. Environ. Prot.* **2018**, *118*, 316–329. [CrossRef]
80. Chien, T.-K.; Syu, C.-S.; Lai, W.-L.; Chang, H.-L. Is There Differentia between Traditional and Cloud ERP on Implementation Activity? In Proceedings of the 2016 International Conference on Applied System Innovation (ICASI), Okinawa, Japan, 26–30 May 2016; pp. 1–4.
81. Huang, Y.-Y.; Handfield, R.B. Measuring the Benefits of ERP on Supply Management Maturity Model: A "Big Data" Method. *Int. J. Oper. Prod. Manag.* **2015**, *35*, 2–25. [CrossRef]

82. Gupta, S.; Misra, S.C. Moderating Effect of Compliance, Network, and Security on the Critical Success Factors in the Implementation of Cloud ERP. *IEEE Trans. Cloud Comput.* **2016**, *4*, 440–451. [CrossRef]
83. Gupta, S.; Misra, S.C.; Kock, N.; Roubaud, D. Organizational, Technological and Extrinsic Factors in the Implementation of Cloud ERP in SMEs. *J. Organ. Chang. Manag.* **2018**, *31*, 83–102. [CrossRef]
84. Bhatia, S.S.; Gupta, V. Principles and Practices for the Implementation of Cloud Based ERP in SMEs. *MATEC Web Conf.* **2016**, *57*, 1–4. [CrossRef]
85. Muslmani, B.K.; Kazakzeh, S.; Ayoubi, E.; Aljawarneh, S. Reducing Integration Complexity of Cloud-Based ERP Systems. In Proceedings of the First International Conference on Data Science, E-Learning and Information Systems, Madrid, Spain, 1–2 October 2018; pp. 1–6.
86. El Hajj, W.; Serhan, A. Study on the Factors That Determine the Success of ERP Implementation. *Proc. Int. Conf. Bus. Excell.* **2019**, *13*, 298–312. [CrossRef]
87. Wang, G.; Saputra, J.F.G. Terminal Automation System: Automation Solution in the Oil and Gas Industry. In Proceedings of the 2018 Indonesian Association for Pattern Recognition International Conference (INAPR), Jakarta, Indonesia, 7–8 September 2018; pp. 296–301.
88. Paquet, P.; Paviot, G. The adoption of an on-line ERP by SME: Between concern and necessity. *Revue Internationale PME* **2017**, *30*, 261–288. [CrossRef]
89. Moeuf, A.; Pellerin, R.; Lamouri, S.; Tamayo-Giraldo, S.; Barbaray, R. The Industrial Management of SMEs in the Era of Industry 4.0. *Int. J. Prod. Res.* **2018**, *56*, 1118–1136. [CrossRef]
90. Park, J.; Jeong, H.-Y. The QoS-Based MCDM System for SaaS ERP Applications with Social Network. *J. Supercomput.* **2013**, *66*, 614–632. [CrossRef]
91. Boillat, T.; Legner, C. Why Do Companies Migrate Towards Cloud Enterprise Systems? A Post-Implementation Perspective. In Proceedings of the 2014 IEEE 16th Conference on Business Informatics, Geneva, Switzerland, 14–17 July 2014; pp. 102–109.
92. Mierswa, I.; Klinkenberg, R. *RapidMiner Studio, Version 9.10*; RapidMiner GmbH: Dortmund, Germany, 2021.
93. Faccia, A.; Petratos, P. Blockchain, Enterprise Resource Planning (ERP) and Accounting Information Systems (AIS): Research on e-Procurement and System Integration. *Appl. Sci.* **2021**, *11*, 6792. [CrossRef]
94. Morawiec, P. Możliwości wdrożenia systemu informatycznego zarządzania w modelu natywnie chmurowym. In *Transformacja Cyfrowa Organizacji i Społeczeństw*; Ziemba, E., Karmańska, A., Eds.; Wydawnictwo Uniwersytetu Ekonomicznego w Katowicach: Katowice, Poland, 2021; pp. 154–165. ISBN 978-83-7875-730-6.
95. Melville, N.P. Information Systems Innovation for Environmental Sustainability. *MIS Q.* **2010**, *34*, 1. [CrossRef]
96. Misztal, A. IT jako element strategii zrównoważonego rozwoju przedsiębiorstwa. *Zeszyty Naukowe Politechniki Śląskiej* **2018**, 349–362. [CrossRef]
97. Ziemba, E. The Holistic and Systems Approach to the Sustainable Information Society. *J. Comput. Inf. Syst.* **2013**, *54*, 106–116. [CrossRef]
98. Ziemba, E. The Contribution of ICT Adoption to the Sustainable Information Society. *J. Comput. Inf. Syst.* **2019**, *59*, 116–126. [CrossRef]
99. Pańkowska, M.; Pyszny, K.; Strzelecki, A. Users' Adoption of Sustainable Cloud Computing Solutions. *Sustainability* **2020**, *12*, 9930. [CrossRef]
100. Aktürk, C. Artificial Intelligence in Enterprise Resource Planning Systems: A Bibliometric Study. *J. Int. Logist. Trade* **2021**, *19*, 69–82. [CrossRef]