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Digitalization Business Strategies in Energy Sector: Solving Problems with Uncertainty under Industry 4.0 Conditions

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Abstract: Digital transformation is a concept based on the use of digitalization and digitization. Digitalization leads to change of business models and provides a competitive advantage also in the energy sector. The process of change towards a digital business requires a specific strategy type, aimed to solve problems with uncertainty caused by Industry 4.0 implementation. This paper aims to propose a theoretical model combining different digitalization strategies and business models. Their theoretical foundations were discussed in the literature review part and related empirical research questions were attempted to be answered by the reference method analysis. The quantitative method of analysis was based on the secondary data from Eurostat for all EU member states and backed the theoretical part in terms of ICT variables. The novelty of this research is based on Hellwig's reference method used in management sciences and the presented managerial implications. The discussed challenges of the energy sector are related to the digital strategy implementation, relationships between digital transformation and business models, and solutions for such issues as strategy communication and new roles for managers, who should become digital leaders in the energy sector organizations. The main consequence of the proposed model in this study, for the energy sector companies' managers, is that uncertainty in modern energy sector organizations is more related to employees and their technical skills than implemented ICT itself.

Keywords: business models; digital revolution; energy sector transformation; Hellwig's method; Industry 4.0; literature review; strategic management

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1. Introduction

The energy sector is the core of the economy, where a growing number of electronic devices fuel the growing energy demand [1]. The observed changes in the energy prices influence not only organizations but also have an impact on the countries and international policy [2]. The development of different digital technologies and strategies in the energy sector can also cover the growing energy need [3,4] and can support the transformation towards clean and nuclear or more sustainable and renewable technologies [5,6]. Therefore, the importance of the energy sector is still growing. Digital technologies are driving cost efficiency, providing new revenue opportunities, and changing business models in the energy sector [7].

This paper aims to propose both a theoretical model combining different digitalization strategies and business models and empirical answers for the formulated two research questions. The theoretical basis for the theoretical model was discussed in the literature review part. The theoretical model is built upon different strategic management schools' reviews [8,9] and is related to future research in the areas of digital strategy development [10,11]. Strategic management evolves as a result of the emergence and criticism of successive schools of strategic management, which differ in their assessment of the sense and possibilities of building a strategy [12]. Two research questions were formulated as the result of the literature review and were addressed in the reference Hellwig's method analysis of secondary Eurostat data. This paper is based on the conviction that a strategic management framework is fundamental for any business sector transformation and decision-making process [3,5,6]. The method adopted in this paper is inference literature analysis [13,14] based scientific literature of the subject complemented by the statistical analysis called reference method analysis [15,16] or the Hellwig method [16,17]. The empirical part also serves as the starting point for future research. The planned research is going to be a survey for the energy sector organizations developed on the variables used in this study reference method. The relationships between business models and the Industry 4.0 technologies as an element of ICT in the energy sector [18,19] are not often explored in the scientific strategic management literature [7,20–22]. Then, the research gap identified in this paper is related to the lack of a theoretical model combining different digitalization strategies and business models. We also identified scarcity in scientific literature dedicated to the relationships between digital transformation and the energy sector. Moreover, scientists attempt to study the relations between digital transformation elements and business models implemented in the energy sector. Therefore, the proposed model is also important for further analyses of widely understood digital strategies in strategic management and uncertainty context for the energy sector challenges in the European Union [3].

The formulated aim of this paper is supported by the three main sections of this paper presented [23]. After already presenting in Section 1 reasons to undertake the subject, the goal of the paper and research gap were explained [24,25]. In Section 2, which is a literature review, digital strategies are discussed. In this section, we also propose the theoretical model in form of a matrix for business strategies and business models. In Section 3, the business models based on digitization are presented and complemented by the communication models which describe such transformation [26]. We understand that this element is not the only aspect of ICT in strategy support. Section 4 is a discussion over problems and uncertainty in a modern business environment. In Section 5, Hellwig's method [15] is presented and explained. The used variables for the quantitative method [15,23,27] are introduced along with their results to back the previously proposed theoretical model [28]. Detailed calculations results are presented in the Appendix A. The description of the calculation provides the explanation and interpretation of the results. Finally, there is a discussion where the results are interpreted in the context of the other studies, followed by the conclusions section. In these two last sections, there are also described the limitations of the study, theoretical and managerial implications, and also possible future research directions.

2. Literature Review

2.1. Definitional Issues

Digital transformation and business strategy development allow organizations to adapt to their client's individual needs [29,30], to follow the trends in the business sector [31,32], and to align with each other in the value networks [33,34]. These changes enable organizations to gain a competitive advantage [35,36] and possibly sustainability [37,38] based on digitalization [9,39] and technology implementation [40,41] called digitization [42]. Digitization involves the use of (Information and Communication Technologies) ICT solutions to increase the efficiency of the existing processes [43,44] through automation [45,46]. However, in the European context [42], digitization as the core of the Industry 4.0 concept [47,48] is much more than just automation development [44,49]. Digital transformation is business transformation enabled by digitalization [12,50]. Digitalization is "a multidimensional process that leads to the convergence of the real and virtual worlds, becoming the main driver of innovation and change in the economy" [49]. Digitization "refers to creating a digital representation of physical objects or attributes" [42]. Industry 4.0 is the European Union concept for the combination of digital transformation and digitalization [42,51]. The relationships between digitization, digitalization, and digital transformation are presented in Figure 1.

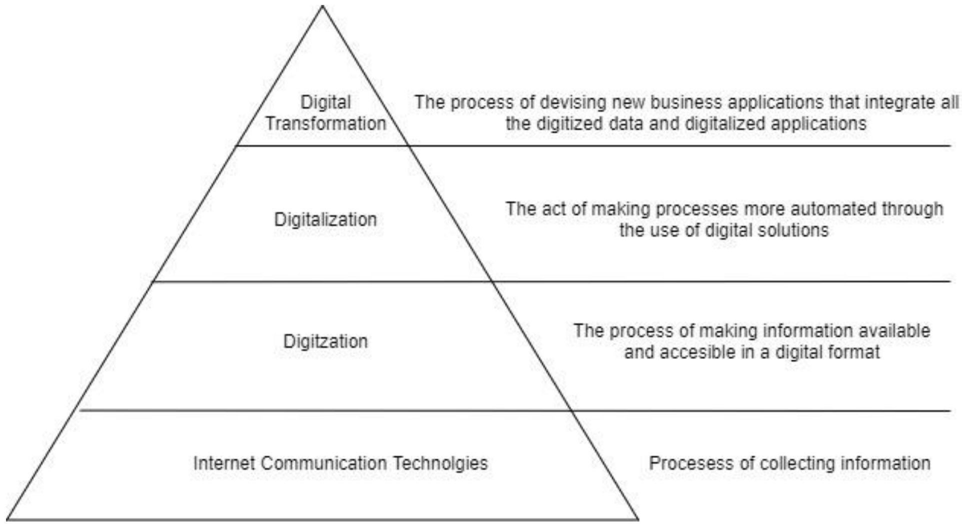

Figure 1. Digital transformation pyramid. The author's elaboration is inspired by [42].

The transformation of the economy towards a digital and sustainable one is a subject of the European Commission studies and issued documents [52,53]. Eurostat also formulated variables measuring ICT performance [54]. The variables specific for the energy sector [55,56] were so far not proposed [57] to track progress towards "digital future" and green economy and to reflect the differences among countries [56,58]. The EU, in the strategic document "Europe 2020", sees energy sector digitalization as a key factor in smart growth based on tech knowledge and innovation. The European Commission formulated a digital strategy for the whole EU [58] and presented concerns at the cross-national level on digitalization [59] combined with the energy transition [60]. Then the process of monitoring is important in terms of [53]: energy production of and access to digital technologies [46]; uptake and usage of digital technologies [61,62]; impact of digital technologies [63,64], changes in the economy and on the labor market [65,66]. Besides the anchored in the digitalization process expectations related to the business models development and achieved sustainability [22], there are also identified threats in the energy sector [3,46]. On the other hand, the digital transformation and the energy sector are intertwined [4,67] and depend on each other because they secure economic progress [34,68,69]. The visible area of development of business models related to the energy sector is growing interest in electric cars, smart and autonomous vehicles [70].

2.2. Digital Strategies

Strategic management is a constant decision-making process, especially in the energy sector [3,5]. There is a continuous assessment of utility and uncertainty [71], which are the basic dimensions of rational action [4,72] in strategic management. These efforts aim to search for challenging solutions [73,74] and result in different strategic management school approaches [75,76].

Strategies described in the Economic Scale School perspective [77], present the possibilities of implementing digital solutions in large-scale production, commercial, and service processes [34]. These are related to running Industry 4.0 technologies: big data, automatization, Internet of Things, artificial intelligence, additive manufacturing, and cloud computing [44,78]. In the energy sector, these solutions affect the scale and the speed of digital business strategy implementation [79,80]. The strategies built on the economy of scale enable some enterprises to achieve advantages at a lower operational level than in the traditional analog process (for example, replacement of the energy meters) [81,82]. In this approach, a digital strategy describes the overall vision of a company in the context of digitalization, including the strategic measures to achieve it" [52]. Such a strategy defines "concrete, short-, medium- and long-term digitalization goals and initiatives in the context of products, services, and value creation as well as for the organization and culture of a company" [83].

The Industry Analysis School perceives digital strategies as a source of gaining high market shares with lower transaction costs than in the traditional industry [84]. Therefore, success is measured in terms of market share. Classic organizations build their shares through their own or external development, but always with high costs or taking over new businesses [85]. There is a need for digitization of cost leadership and differentiation and focus strategies [84,86]. However, they remain in the trend of the classical approach to reducing costs or distinguishing themselves [77]. "In e-business, the digital strategy of differentiation will be associated with higher performance than the generic strategy" [84]. "The third type of strategy is observed and outperforms both cost leadership and differentiation" strategies [84].

In the Resources Based View (RBV) School, the organization focuses on its key competencies as a source of its success [73]. Then, the main way to deal with uncertainty related to digitalization in an RBV approach is to refer to key resources that are not sensitive to the sectoral, territorial, or life-cycle context [87]. Value creation is an element of competitive struggle [79] and is the effect of a multisided business model. The value is gained in the organization through value appropriation through control from digital industry architecture [79]. In turn, the evolution of digital competencies characteristic of RBV can be described as a path from ICT classified as a resource that yields a competitive advantage in the energy sector [45].

The Innovation School is most often associated with disruptive innovation [88]. According to this approach, the best way to prepare for a radical change is to generate it. Digitization, and the technologies that compose it, are innovations of the disruptive type. These are technologies known as SMAC, which is an acronym for social, mobile, analytics, and cloud [61]. "Though SMAC technologies are the driver, digitalization is not a mere technical phenomenon, but also an economic and societal one" [45]. The appearance of start-ups related to the energy sector transformation is the best example of the dissemination of digitization strategies in the area of innovation and renewable technologies in the energy sector [89].

The best fit for the digital world are strategies associated with the Network Strategy School [90]. The uncertainty of the digital environment is limited, thereby relationships and dependencies between analyzed elements [78,91]. The basic determinants of network strategies are the so-called network rents related to transaction cost, appropriation, knowledge diffusion, value network, and network effect [92]. The first type of network rents, according to the theory of transaction costs, opened enterprises' way to network strategies [93]. Network strategies or cluster strategies, outsourcing strategies, coopetition strategies, and open innovation strategies created thanks to this theory gained a new quality when the organization's digitization became fully possible, especially in the business ecosystems [61]. Such networks are visible in the energy sector, where clusters are created based on energy generation (renewable installations), transfer, distribution, and retail of electricity [68,94]. Digitalization transforms the hierarchical organization into a contracted organization with specific ICT tools making these solutions effective [34]. What is more, the network effect theory plays a special role in building network strategies [95]—the network effect results from the inclusion of new customer groups into an already existing system. Thanks to low transaction costs in the digital world, this effect has become a network management "icon" [33]. Thanks to this theory, a huge group of strategies related to digital technology platforms has developed in the energy sector [96,97].

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The proposals for the interpretation of digital strategies from the presented strategy schools' perspective indicate the wide possibilities of their use in dealing with environmental risks in the energy sector. The energy sector companies' strategies change under the pressure related to the transformation towards the digital economy—the influence of the economy of scale changes in time. Organizations achieve economy of scale effect at a lower level than before due to digital transformation [43]. This is effective to the access to new technologies in the field of automation and new technologies related to energy generation [98]. Strategies related to achieving a privileged position in the sector also change. The energy sector changes by taking over companies from the periphery of the energy sector or those still reserved for other products. This pattern mainly applies to big data companies or companies using energy-driven products [99]. Strategies of energy companies adopt strategies built on competencies related to green energy as well as IoT and AI competencies [2,100]. Strategies based on the innovation of the digital economy gain importance in the areas where network strategies are most extensive [101]. At the same time, the greatest opportunities can be seen in the area of digital strategies interpreted through the Network Strategy School Theory [33]. This school provides the basis for developing digital strategies towards qualitatively new ways of business management in various economic sectors, the energy sector especially [9].

There are still new theories, new methods [4], new tools, new possibilities of measuring utility [102], and risk assessment in the management of energy sector development [103]. This is because companies operate in an environment in which they have to balance between the tensions created by the need to satisfy customer requirements, competitors' actions, and the costs they generate. At the same time, energy sector companies set and reformulate their digital business models, which is particularly difficult in an increasingly unstable environment characterized by uncertainty, complexity, and numerous disorders [104].

2.3. Digital Business Models

The strategy is a certain determinant and direction of action required, especially in the energy sector [68,103,105]. The tool for implementing the strategy is the business model [61,106]. As a consequence of the presented strategic management schools, the different business models can be considered. Classically, a business model is a kind of value proposition and the set of activities combined into a single whole. Therefore, the efficiency of resource flows, between individual elements, determines the success of a given business model [107,108].

The listed business strategies are a new class of considered categories that can be called digital business strategies in the energy sector. The implication of introducing this strategy type is the appropriate modification of the company's business model with elements of Industry 4.0 [109]. The digital business model is "a business model whose underlying business logic deliberately acknowledges the characteristics of digitalization and takes advantage of them; both in interaction with customers and business partners and in its internal operations" [110]; There are business models for products and services provided through digital platforms [111]. The business model is digital if it is introduced by this model's digital technologies, which start fundamental changes in the way business is carried out and revenues are generated [72]. Digital business models explain how energy sector firms engage their customers digitally to create value via mechanisms such as websites and mobile devices [112].

Each business model has important dimensions, which are associated with values coming from (1) creation logic, (2) capturing mechanisms, (3) delivery architecture, and (4) stakeholder network. These points can be further elaborated, as in [113]:

1. Value creation logic describes the logic of creating and delivering value; an important view in this approach is the network's effectiveness and its approach to stakeholders.
2. Value capture mechanism reflects how the value from the created product or service is captured (i.e., charging fees).
3. Value delivery architecture defines a unique organizational structure and its configuration as well as a boundary. In this approach, the digital approach to creating value and capturing value is very important.
4. Value stakeholder network reflects a modular approach and the creation of an internal self-regulating network based on mediation as well as unique network resources; characteristic features of this model are modularity, orchestration, and self-organization.

The uncertainty and risk are an element that, so far, has not been appreciated in business models [90] and should be mentioned. In particular, the combination of strategy and business model change [114] generates some uncertainty, which may be assumed to be acceptable. This uncertainty is related to the main directions of digital strategies. We can classify this type of risk in three ways [90]: business execution (initiative) risks, co-innovation (interdependence) risks, and adoption (integration) risks [115]. Implementation of the strategy and changing the company's business model create the risk in each of the three categories for a given enterprise and define what elements should be assessed at the interface between strategy and business model [95]. The following examples meet the definition and features of the presented digital business model:

1. The Experience Model is based on giving consumers a unique experience or special values that they are ready to pay (example—Tesla).
2. The Subscription Model works by bringing a customer into the business based on a monthly payment, giving them continued access to a specific product/service (example—Netflix).
3. The "Free" Model is based on the data provided by the user, which turns into a product. This means that this data becomes the most valuable part of the business and can be used for advertising purposes (examples—Facebook, Instagram, Google, Twitter).
4. Access-Over-Ownership Model is related to a "sharing" philosophy. The client pays to use the product/service, but it does not become the client's possession; a client can only access it. This is one of the most disruptive business models as it gives the same experience as purchasing something, but without having the ownership implications (examples—Zipcar, Airbnb, Mintos).
5. The Ecosystem Model is based on the ownership implications associated with increased value based on the quantity of bought goods/services (examples—Google, Apple).
6. On-Demand Model is based on users' payments for a service that they do not have time to do for themselves but is fulfilled by people with time and the need to earn (examples—Uber, Lyft, Sharenow, Delivery Hero).
7. Freemium Model is one of the most popular business models online. This model is based on a specified time when users get either a "basic" (free) version of a product/service or a "free" trial. This user will then have the option to upgrade to a paid version of said product/service (examples—Slack, Miro, Zoom, Mailchimp).

Companies presented above as the examples of the most important business models [111,116] are the source of inspiration [19] for the energy sector companies [40] involved in energy generation, transfer, distribution, and sell [23,68]. We intentionally do not mention the energy sector companies to avoid bias [117,118]. There are business models specific for the electric energy companies directly related to listed above models [119]: electric utility owner-operator, an electric utility with the private concessionaire, electric utility make-ready, an electric utility with government incentive, electric utility to a meter. These business models differ within each other the scale of the investment of the private sector, utility, or public-private partnership [119].

It is possible to combine a given strategy with a business model. Figure 2 shows the possible application of a business model and the characteristics of the strategy in the reviewed literature in point 2.1. In this graphical model, it is visible that one business model may use different features of a given strategy. This can determine the competitive advantage and the uniqueness of the organization's strategy and business model. Presented synthesis of business models and strategies is the authors' contribution to the science. The general view of a proposed theoretical model is applicable in various economic sectors, in the energy sector especially.

		Digital Business Model						
		The Experience Model	The Subscription Model	The Free Model	Access-Over-Ownership Model	Ecosystem Model	On-Demand Model	Freemium Model
Digital Strategy	Economy Scale Strategy School		x	x		x	x	x
	Industry Analysis School		x	x			x	x
	Resources Base View school	x	x			x		
	Innovation School	x		x	x	x		
	Network Strategy School		x	x	x	x	x	x

Figure 2. The model of relations between digital business models and digital strategies. Author's elaboration.

The strategy has mechanisms to deal with uncertainty in the energy sector caused by technological changes [120]. The more strategies that can be used in a given business model, the lower the risk of uncertainty resulting from a given business model. The digital strategies based on the Network Strategy School are related to the biggest (six) number of digital business models. Contrary, the Resource-Based View school implies only three digital business models. This also implies the observation that business models are not so elastic as digital strategies.

2.4. Digital Strategies Communication

Digitalization strategies introduce a comprehensive organizational change [83] that breaks with the current status quo, radically changes the functioning of the company [121], and consequently, necessitates changing the culture of the organization [122]. Such a comprehensive change must be properly prepared [78,80] because of the energy sector importance [68]. Communication processes play a key role in this preparation [123] and assure the exchange of information to evaluate and measure strategy performance measured between companies and countries. Then communication makes it possible to prepare the ground for a change in the organizational reality. It allows reducing social anxieties related to the energy transformation [124]. Digital technologies [125] can support strategies and business models and help energy sector companies to reduce their negative impact on the natural environment [126,127]. Digital strategies' communication helps to proceed change towards cleaner energy [128,129] or renewable energy sources [130], place communication as the pivot for developed business strategies axes [131]. The communication explains and informs society about the expected impact of the adopted technologies on the organizations' stakeholders [31,71]. It also allows to overcome inevitable resistance, reduces uncertainty [71], explains the goals and course of the change, and provides support in the event of any doubts and tensions [5]. In the process of implementing a digital strategy, communication thus becomes one of the key processes that must be properly prepared in terms of such elements as recognizing the information needs of recipients [132], the content and form of messages, the time and frequency of transmission, and the information channels used [68]. A significant role in this regard is played by digital leaders [63,114].

When planning a communication strategy for the needs of digitalization processes, it should be remembered that in this case, the content of the message itself may be a particular problem [133]. The energy sector transformations towards green (renewable) or clean (nuclear power) technologies always raise concerns in society [68]. Firstly, people are afraid of content related to technology. Secondly, they dismiss it as incomprehensible, posing a threat because it is expressed using hermetic concepts and language reserved for IT professionals [134]. This causes their blockage, exclusion, and an even greater problem with understanding the message at a later time [135]. Due to the lack of understanding of the content conveyed, natural human fears related to rapid technological development, e.g., related to the fear of the domination of artificial intelligence, loss of control, or permanent surveillance, begin to emerge [136]. In addition, communication problems may be aggravated, in the case of such implementation, by organizational problems or conflicts closely related to each change, which certainly does not make things easier [137]. People feel threatened by the digitalization processes because they are afraid of losing their current position, work, relationships, and sphere of influence [90].

In the case of communication regarding information technology, digitalization, the possessed amount of knowledge on a given topic, and thus the ability to acquire, understand and accept new content, does not necessarily correspond to the position held. It should be remembered that not only the position but also technical knowledge is important when receiving the communicated content [138]. In the case of an information technology message, knowledge may be structured differently from the traditional organizational hierarchy. Employees at lower levels of the hierarchy may have much more knowledge in this area than managers from the top of the corporate hierarchy [139]. Noticing this fact can help in building a catalog of information needs of recipients and stakeholders of the digitalization change. Such a catalog can become the basis for determining the current training needs in this area [78]. It should be emphasized that communication processes should use a wide set of different communication channels [123,133], and at the same time, strive to customize the information provided as much as possible based on a previously prepared set of identified information needs of recipients [122]. On the one hand, such targeted provision of information dedicated to given recipients is now possible within the available transmission channels. On the other hand, it gives a greater chance of reaching the information recipient [48]. Current employees are inundated with a lot of information of very different levels of importance through the available communication channels. Often, important messages are lost in the multitude of unimportant ones [140]. To increase the effectiveness of the message, it is worth taking care of a kind of marketing of internal information channels. When using a given channel is associated with a specific reward, the chance of reaching the recipient with an important message increase [138]. It is worth remembering that it is not enough to broadcast information through multiple channels; they must also be credible and accepted by the recipients, so it is worth using for such communication also those channels that are not necessarily official, but by finding acceptance among the recipients, they increase the effectiveness of the message (blogs, cloud, social media posts, Instagram, Facebook, YouTube, etc.) [122].

It is also worth taking advantage of the possibilities offered by the current communication channels to use them not only as a tool for the simple transfer of information from the sender to the recipient but also based on their technical capabilities, to build a knowledge base for future use [68]. For example, by checking the times and places of logging in and the subject of information obtained, articles read, activity on forums, one can obtain information that allows in the future to even better tailor the message to the needs of recipients by expanding the content in the area of topics that arouse the greatest interest or doubts [141]. Undoubtedly, a very valuable feature of modern information channels, especially those based on social media, is the ability to react to emerging problems in almost real-time. By observing the activity on corporate forums, after publishing controversial or simply key information for changing information, it can provide additional information almost in real-time, clarify doubts, which may significantly contribute to lowering the temperature of the discussion, preventing the problem from growing to rank too high. Communication of the change in direction is important for a business strategy and business models' implementation.

3. Materials and Methods

The purpose of the reference method [15,17] in this article is to answer two research questions as a result of the comparison of the level of the conditions among EU countries. On this level of comparison, the most often used method is Hellwig's reference method [23,27]. There are similar studies that use the same method to compare phenomena among different countries [27,142]. The choice of this method was based on its ordering features, statistical similarity among compared objects, multidimensional variables [143], and relevant simplicity of the required calculations [16]. The implementation of digital strategies is based on the usage of ICT technologies is a complex phenomenon [144]. Therefore, the Eurostat secondary data were used in this research [53]. The indicators were defined by Eurostat and their units are presented in Table 1. The use of such a set is justified by the performed literature review discussion and presented graphical model. Then asked research questions are:

Table 1. ICT usage in enterprises based on the Eurostat method.

Digitalization Area	Measured Characteristic	Symbol
E-commerce	Enterprises having received orders online (at least 1%)—% of enterprises (tin00111)	x_1
	Share of enterprises' turnover on e-commerce—% (tin00110)	x_2
Internet Connection	Enterprises with broadband access (tin00090)	x_3
	Enterprises giving portable devices for a mobile connection to the internet to their employees (tin00125)	x_4
E-business	Enterprises using radio frequency identification (RFID) instrument (tin00126)	x_5
	Enterprises whose business processes are automatically linked to those of their suppliers and/or customers (tin00115)	x_6
Competitiveness and innovation	Enterprises using software solutions, such as CRM to analyze information about clients for marketing purposes (tin00116)	x_7

Source: Own study based on [53].

RQ1: Which EU's countries group has a higher rate of digital transformation?

RQ2: How are identified countries' groups related to the energy sector development?

The variables used in calculations were assigned by symbols x with the number lower index (x_i). As a result, the total number of 7 variables was determined in this way [68]. The data from the year 2019 were used for the calculations, which ensures the comparability and reliability of the data [142]. The presented variables are general and were selected to be turned into questions in the planned future survey among energy sector organizations.

Moreover, the application of the standardization method allows for the verification of the obtained results in the comparison of countries with similar development conditions [142]. This comparison result indicates the conditions for digital transformation.

As the variables presented in Table 1 cannot be aggregated directly using appropriate standardization, then normalization was applied. According to this formula, the method of zero unitarization was selected to standardize the process based on the interval of a normalized variable. All presented variables positively influence the described phenomenon of the digital transformation and are called stimulants (x_1–x_7). Then, indicators were selected for the standardization process based on the following formula:

$$\text{for stimulants}: \quad z_{ij} = \frac{x_{ij} - \min(x_{ij})_i}{\max(x_{ij})_i - \min(x_{ij})_i} \tag{1}$$

where:

z_{ij} is the normalized value of the *j*-th variable in the *i*-th country;
x_{ij} is the initial value of the *j*-th variable in the *i*-th country;
$\min(x_{ij})_i$ is the minimum value of x_{ij};
$\max(x_{ij})_i$ is the maximum value of x_{ij}.

Diagnostic features normalized in this way take the value from the interval (0;1). The closer the value to unity, the better the situation in terms of the investigated feature; the closer the value to zero, the worse the conditions for the digital transformation.

In the next step, the normalized values of variables formed the basis for calculating the median and standard deviation for each of the countries studied. Median values were determined by the number of 28 EU countries using the formula [68]:

$$\text{for even numbers of observations}: \quad Me_i = \frac{Z\left(\frac{m}{2}\right)_i + Z\left(\frac{m}{2}+1\right)_i}{2} \tag{2}$$

$z_{i\,(j)}$ is the *j*-th statistical ordinal for the vector $(Z_{i1}, Z_{i2}, \ldots, Z_{im})$, $i = 1, 2, \ldots, n$; $j = 1, 2, \ldots, m$.

The standard deviation was calculated according to the following equation:

$$S_{di} = \sqrt{\frac{1}{m}\sum_{j=1}^{m}(z_{ij} - \bar{z})} \tag{3}$$

where: $\bar{z}$ is the mean value for z_{ij}.

Based on the median and standard deviation, an aggregate measure w_i of the digital transformation was calculated for each country:

$$w_i = M_{ei}(1 - S_{di}); w_i < 1 \tag{4}$$

Values close to 1 indicate a higher level of digital transformation in the specific EU countries, resulting in a higher rank [1,2]. The aggregate measure places a higher rank on EU member states with a higher median of features describing the specific country. Those with a smaller contrast between the values of features in the chosen state, as expressed by the value of the standard deviation. The procedure selected for evaluating the digital strategies implementation condition levels provided a multidimensional comparative analysis. Such calculations allowed a comparison between the European Union countries and grounds for classifying them into four uniform groups (Table 2), where $\overline{w}$ is the mean value of the synthetic measure, and *S* is the standard deviation of the synthetic measure as indicated in formulas [142,145].

Table 2. Interpretation of aggregate measure comparative analysis.

Group	Mathematical Characteristic	Meaning
I	$w_i \geq \overline{w} + S$	high level
II	$\overline{w} + S > w_i \geq \overline{w}$	medium-high level
III	$\overline{w} \geq w_i \geq \overline{w} - S$	medium-low level
IV	$w_i < \overline{w} - S$	low level

Source: Authors' calculations; where $\overline{w}$ is the mean value of the synthetic measure; S is the standard deviation of the synthetic measure.

The aggregate measure prefers countries with a higher median of features describing the specific EU member state and those with smaller contrast between the values of features in the specific country expressed as standard deviation [145]. The procedure chosen for evaluating the ICT usage in enterprises operating in the EU countries provided a multi-dimensional comparative analysis [94,142,146]. Such analysis allowed for a comparison between member states of the EU, providing grounds for classifying them into uniform groups (Table 2).

The presented procedure identified countries' groups in the range from highest to lowest ICT usage.

4. Results and Discussion

According to the $w_{i,}$ values for the 28 EU countries, they were assigned to one of the groups concerning their level of evaluating the ICT usage in enterprises and representing the implementation of digital strategies and digital transformation [61]. The level of ICT usage was evaluated in the 28 EU countries based on seven variables (Table 1) for data from 2019, and the results of the analysis are presented in Table 3. This addresses the first research question (RQ1), and there is a group of EU countries with a higher rate of digital transformation. The analysis shows that there are companies in EU countries that operate in high-level management towards Industry 4.0, and it presents countries with the best conditions for digital development described in cross-country comparisons of digital transformation. The identified countries which are digital leaders in the EU are Estonia and Latvia, along with the other countries in group I (Table 3).

Table 3. ICT usage in enterprises in EU countries comparison.

Group	Countries
I	Estonia, Latvia, Finland, Denmark, Sweden, Germany, Austria, United Kingdom, Luxembourg, Netherlands, Malta,
II	Lithuania, Poland, Belgium, France, Czechia, Slovakia, Slovenia, Ireland
III	Hungary, Cyprus, Italy, Spain, Portugal, Greece
IV	Romania, Bulgaria, Croatia

Source: Authors' calculations.

The presented results above can be compared with the other studies which asses the transformation towards the digital future of the EU countries in the context of renewable energy [147] sustainable development based on ICT usage [142]. The identified groups of countries prove the relation between macroeconomic indicators and ICT usage [148]. The second research question (RQ2) in terms of the achieved results remains unanswered because of the weak causality between identified countries groups and energy sector development. "A major challenge for management researchers is to see whether the theories and explanations stand the test of reality and whether they can be used to shed light on and increase our understanding of daily business events" [26]. Therefore, it is worth emphasizing that the tools, strategies, and processes of digitalization play an essentially auxiliary role in achieving greater efficiency in specific goals of contemporary organizations of the energy sector. Too much intensification of activities and allocation of too many funds to the development of digitalization on the scale of a single enterprise may lead to far-reaching deficits in other key areas. The development of digitalization strategies in the energy sector may also lead to problems in copyright issues to certain innovations [57] or disputes regarding the access and possibility of using certain technologies in selected markets. Long-term involvement in conflicts of this type may, in turn, lead to a distraction from the most important strategic goals. "Digital transformation as integration of digital technology into business results in fundamental changes of way world does business, communicate and develops on the national and international level" [148].

Another important observation concerns the necessity of introducing digital solutions in the energy sector. Taking into account the potential of their use to increase efficiency, productivity, but also safety, speed, and convenience, as well as reduce costs—mainly due to the aforementioned three megatrends in this area: the use of artificial intelligence (AI) in business processes, development of advanced sensors to monitor processes, remote accessibility in various organizational areas. Contemporary energy sector companies cannot afford to stay behind the main competitors who will probably be interested in the identified opportunities. The justification, in this case, cannot be the lack of specific resources to develop digitalization strategies or a smaller scale of operations, or a less advanced phase of development of a given organization. Energy sector companies are large organizations usually related to the appropriate distribution and allocation of resources. For small companies: "it is not a question of whether they should introduce Industry 4.0 or not, but rather how they can do so as quickly as possible to maintain or achieve a large competitive advantage" [65]. Taking into account the above-mentioned aspects, we propose the following questions as a basis for further research on the possibilities of reducing uncertainty and business risk through the development of digitalization strategies in the energy sector:

1. Is it possible to create a digitalization business model directed to minimizing both the internal and external business uncertainty focusing on and developing the utilization mechanism of Industry 4.0 instruments, technologies, and solutions?
2. How will the implementation of digitalization strategies as a dedicated business model introduction differ in small and large enterprises?

Then the set of selected Eurostat variables can be used as questions in the survey among energy sector companies to better indicate relations between ICT usage and energy sector development. As intended by the authors of this article, the planned research process will contribute to the development of management sciences in the field of developing and implementing digitalization strategies, particularly in the area of risk reduction and business uncertainty in the energy sector. One of the most important aspects of the planned research will be analyzing the impact of digitalization strategies on the tendency to undertake international activity among energy sector companies reflected in the cross-national comparisons.

5. Conclusions

There are visible sources of the observed digitalization transformation process in the energy sector [68,83] related to three main sections of this paper. The first is visible in the strategic management approach reflected by different schools and strategies mechanisms; this employs different elements of digitalization in the energy sector [1,77,149]. The second element is related to the synergy between the developed strategy and business models. This part is the authors' contribution to the science and complement indicated theoretical dimension of the research gap. The presented results can be extended to the other economic areas. The third element is related to communication strategy and reduction of uncertainty caused by the digital strategy implementation or induced changes in the energy sector. In these terms, this is the novelty introduced by this paper based on an attempt to present the relations between ICT usage and the energy sector involvement in the digital transformation visible in smart grid creation and usage of smart meters.

Digitalization strategies cover topics present for many years in management literature, particularly within the subarea of strategic management. In contemporary approaches, tools in the field of digitalization strategies can be beneficial in the context of coping with uncertainty and business environment changeability, the possibility of faster and more effective streamlining of various organizations and increasing their efficiency, and the possibility of measuring the implemented processes in the energy sector. This results in "ordering" the organization, leading to a clear reduction of chaos. An invaluable factor that can be treated as a common denominator of the presented concepts is probably proper communication, which, using the currently available and developed technologies in the field of Industry 4.0 in the energy sector, generates completely new solutions and communication channels compared to the tools used only a few years ago. Faster speed, better accessibility, and more accurate customization of communication channels seem to be key in this area.

Taking the above assumptions into account, the authors of this article focused on presenting and linking selected strategic thinking proposals (Economic Scale School, Industry Analysis, Resources Base View, Innovative Strategy School, Network Strategy School) with business models dedicated to the conducted considerations (the Experience Model, the Subscription Model, the Free Model, the Access-Over-Ownership Model, the Ecosystem Model, the On-Demand Model, the Freemium Model), effectively used and developed in modern business in the energy sector. In this case, the assumed goal was to outline the background for further considerations regarding the possibility of using digitalization strategies and to identify the currently best-suited business models aimed at reducing risk and uncertainty in business operations. The presented theoretical model (Figure 2) presents the connection between digital business models and digital strategies. The theoretical implication of this study also lies in the presented variables, which prove that without measurement of the digital transformation in the energy sector, we cannot achieve certain expected strategic goals and induced changes. In the result of the adopted method, we addressed only RQ1 when RQ2 was refuted. There are country groups in which economic development creates positive conditions for digital transformation. There are identified UE's countries groups with a range from a high level of ICT usage (group I) to the lowest level of digital transformation (group IV).

The limitations of this research are: use of the secondary data from Eurostat and that data were related only to the single year 2019, the European context of the research (Industry 4.0 definition), and the weak causality between ICT usage in the energy sector (although highly probable). The choice of the variables used in this research was based on the transformation process and expected structural changes in the energy system made by the increased use of ICT (digital tools). Such technologies influence all elements of the energy system and change their function. There is a change in production from a few large power plants to many small power plants—transformation of the market structure from centralized and mostly national into decentralized and ignoring boundaries. The transmission of energy also changes from this, based on large power lines (electricity) and pipelines (gas and oil), to this including small-scale transmission and regional supply compensation. Distribution in the energy sector also changes from a top to bottom direction (customer is passive, only paying) into both directions of distribution (active customer also participating in the system).

The article presents those different types of business models which can use hypothetically different strategic thinking types. This makes them more resistant to potential risks and environmental variability. Such a built-in possibility of the business model (Figure 2), which allows for switching between strategic options in the event of certain disturbing factors, should be considered an invaluable advantage in the energy sector. Three of the considered business models in the energy sector were identified as the most effective in this respect: the Subscription Model, the Free Model, and the Ecosystem Model. Another assumed step in the research procedure, in this case, is the creation of a hybrid construct—a possibly universal digitalization business model aimed at effective risk reduction and examining the possibility of its practical implementation on a European scale. This is to be achieved by the proposed research questions, which constitute the conceptual basis of the planned, multi-stage research process.

The digitalization strategies are not implemented independently in the energy sector [136]. According to the authors of this article, the decisive role here is played by strategic leaders. These managers, who sometimes have to be inclined to take risks and challenging decisions, especially at the beginning of a specific energy sector activity [150]. This later leads to a situation of reducing uncertainty in the future activity of a given organization. Strategic leaders choose a specific business model; therefore, they constitute the target group of respondents to the planned research. Their attention is often directed to inter-organizational networks and cross-countries comparisons on the European level, which are often treated as systems generating business opportunities to reduce the business risk [31]. The role of strategic leaders in such systems cannot be questioned. Decisions regarding the selection and implementation of digitalization strategies in the energy sector are key in the initial stages of creating network systems, which seem to be a perfectly suited environment for their implementation.

Therefore, the theoretical model proposed in this paper can also be used outside the energy sector and the transferability of the solutions between different economic fields is important in the time of shift towards renewable energy sources [128,151]. This reflects the universal meaning of the presented findings and managerial implications [7,22]. First, quality, knowledge, and information management are part of digitalization business strategies [75] and can improve the energy sector performance [4]; this is because "the digital transformation is about more than technology, it is also a cultural change" [152]. Second, this article serves to draw a preliminary background for the survey research among companies in the energy sector in the European Union, and such a survey aims to answer the two new research questions formulated in the discussion section. Third, the authors propose some new research avenues for future study, which can develop those presented in this paper reference method analysis [13,68]. Fourth, the research variables (items) are based on Eurostat's secondary data and secure reproducibility of the research [86] in the planned survey.

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Appendix A

Table A1. Detailed calculations results.

Group I		Group II		Group III		Group IV	
Country	w_i	**Country**	w_i	**Country**	w_i	**Country**	w_i
Estonia	0.967	Lithuania	0.700	Hungary	0.689	Romania	0.688
Latvia	0.954	Poland	0.698	Cyprus	0.689	Bulgaria	0.687
Finland	0.848	Belgium	0.692	Italy	0.688	Croatia	0.424
Denmark	0.814	France	0.691	Spain	0.688	Romania	0.688
Sweden	0.794	Czechia	0.689	Portugal	0.688		
Germany	0.756	Slovakia	0.689	Greece	0.688		
Austria	0.741	Slovenia	0.689				
United Kingdom	0.734	Ireland	0.689				
Luxembourg	0.722						
Netherlands	0.716						
Malta	0.702						
$\overline{w} = 0.722$							
S = 0.096324							

Source: Authors' calculations.

References

1. Uniejewski, B.; Nowotarski, J.; Weron, R. Automated Variable Selection and Shrinkage for Day-Ahead Electricity Price Forecasting. *Energies* **2016**, *9*, 621. [CrossRef]
2. Tutak, M.; Brodny, J.; Bindzár, P. Assessing the Level of Energy and Climate Sustainability in the European Union Countries in the Context of the European Green Deal Strategy and Agenda 2030. *Energies* **2021**, *14*, 1767. [CrossRef]
3. Szum, K.; Nazarko, J. Exploring the Determinants of Industry 4.0 Development Using an Extended SWOT Analysis: A Regional Study. *Energies* **2020**, *13*, 5972. [CrossRef]
4. Borowski, P.F. Digitization, Digital Twins, Blockchain, and Industry 4.0 as Elements of Management Process in Enterprises in the Energy Sector. *Energies* **2021**, *14*, 1885. [CrossRef]
5. Sulich, A.; Sołoducho-Pelc, L.; Ferasso, M. Management Styles and Decision-Making: Pro-Ecological Strategy Approach. *Sustainability* **2021**, *13*, 1604. [CrossRef]
6. Ram, M.; Theodorakopoulos, N.; Worthington, I. Policy transfer in practice: Implementing supplier diversity in the UK. *Public Adm.* **2007**, *85*, 779–803. [CrossRef]
7. Bergenholtz, C.; Waldstrøm, C. Inter-organizational network studies-a literature review. *Ind. Innov.* **2011**, *18*, 539–562. [CrossRef]
8. Camarero Orive, A.; Santiago, J.I.P.; Corral, M.M.E.-I.; González-Cancelas, N. Strategic Analysis of the Automation of Container Port Terminals through BOT (Business Observation Tool). *Logistics* **2020**, *4*, 3. [CrossRef]
9. Niemczyk, J. Poziomy rozwoju sieci międzyorganizacyjnej a ryzyko (The Level of Inter-organizational Networks' Development: Risk Associated with Networks' Activities). *Mark. Rynek* **2015**, *5*, 161–170.
10. Villalba-Diez, J.; Ordieres-Meré, J. Human–Machine Integration in Processes within Industry 4.0 Management. *Sensors* **2021**, *21*, 5928. [CrossRef] [PubMed]
11. Sikorski, T.; Jasiński, M.; Ropuszyńska-Surma, E.; Węglarz, M.; Kaczorowska, D.; Kostyla, P.; Leonowicz, Z.; Lis, R.; Rezmer, J.; Rojewski, W.; et al. A Case Study on Distributed Energy Resources and Energy-Storage Systems in a Virtual Power Plant Concept: Technical Aspects. *Energies* **2020**, *13*, 86. [CrossRef]
12. Kaleta, A.; Radomska, J.; Sołoducho-Pelc, L. The relationship between the approach to strategic management and innovativeness in companies of various sizes. *Argum. Oeconomica* **2018**, *40*, 203–224. [CrossRef]
13. Kiviet, J.F.; Niemczyk, J. On the limiting and empirical distributions of iv estimators when some of the instruments are actually endogenous. *Adv. Econom.* **2014**, *33*, 425–490. [CrossRef]
14. Grzybowska, K. Identification and Classification of Global Theoretical Trends and Supply Chain Development Directions. *Energies* **2021**, *14*, 4414. [CrossRef]
15. Hellwig, Z. Application of the Taxonomic Method to the Countries Typology according to their Level of Development and the Structure of Resources and Qualified Staff. *Przegląd Stat.* **1968**, *4*, 307–326.

16. Szkutnik, W.; Sączewska-Piotrowska, A.; Hadaś-Dyduch, M. *Taxonomic Methods with the Statistica Program [Metody Taksonomiczne z Programem Statistica]*; Katowice Economics University Press [Wydawnictwo Uniwersytetu Ekonomicznego w Katowicach]: Katowice, Poland, 2015.
17. Dmytrów, K. Comparison of Several Linear Ordering Methods for Selection of Locations in Order-picking by Means of the Simulation Methods. *Acta Univ. Lodz. Folia Oeconomica* **2018**, *5*, 81–96. [CrossRef]
18. Brodny, J.; Tutak, M. Analysing the Utilisation Effectiveness of Mining Machines Using Independent Data Acquisition Systems: A Case Study. *Energies* **2019**, *12*, 2505. [CrossRef]
19. Giraldo, S.; la Rotta, D.; Nieto-Londoño, C.; Vásquez, R.E.; Escudero-Atehortúa, A. Digital transformation of energy companies: A colombian case study. *Energies* **2021**, *14*, 2523. [CrossRef]
20. Walentynowicz, P.; Pieńkowski, M. Application of Industry 4.0 Technologies to Support Lean Companies. In *Education Excellence and Innovation Management: A 2025 Vision to Sustain Economic Development during Global Challenges, Proceedings of the IBIMA Conference, Seville, Spain, 1–2 April 2020*; Soliman, K.S., Ed.; International Business Information Management Association (IBIMA): King of Prussia, PA, USA, 2020; pp. 17414–17423.
21. Ramakrishna, S.; Ngowi, A.; Jager, H.D.; Awuzie, B.O. Emerging Industrial Revolution: Symbiosis of Industry 4.0 and Circular Economy: The Role of Universities. *Sci. Technol. Soc.* **2020**, *25*, 505–525. [CrossRef]
22. Moktadir, M.A.; Kumar, A.; Ali, S.M.; Paul, S.K.; Sultana, R.; Rezaei, J. Critical success factors for a circular economy: Implications for business strategy and the environment. *Bus. Strateg. Environ.* **2020**, *29*, 3611–3635. [CrossRef]
23. Sowinski, J. The Impact of the Selection of Exogenous Variables in the ANFIS Model on the Results of the Daily Load Forecast in the Power Company. *Energies* **2021**, *14*, 345. [CrossRef]
24. Parker, J.; de Baro, M.E. Green Infrastructure in the Urban Environment: A Systematic Quantitative Review. *Sustainability* **2019**, *11*, 3182. [CrossRef]
25. Warke, V.; Kumar, S.; Bongale, A.; Kotecha, K. Sustainable Development of Smart Manufacturing Driven by the Digital Twin Framework: A Statistical Analysis. *Sustainability* **2021**, *13*, 139. [CrossRef]
26. BarNir, A.; Gallaugher, J.M.; Auger, P. Business process digitization, strategy, and the impact of firm age and size: The case of the magazine publishing industry. *J. Bus. Ventur.* **2003**, *18*, 789–814. [CrossRef]
27. Maśloch, P.; Maśloch, G.; Kuźmiński, Ł.; Wojtaszek, H.; Miciuła, I. Autonomous Energy Regions as a Proposed Choice of Selecting Selected EU Regions—Aspects of Their Creation and Management. *Energies* **2020**, *13*, 6444. [CrossRef]
28. Klepacki, B.; Kusto, B.; Bórawski, P.; Bełdycka-Bórawska, A.; Michalski, K.; Perkowska, A.; Rokicki, T. Investments in Renewable Energy Sources in Basic Units of Local Government in Rural Areas. *Energies* **2021**, *14*, 3170. [CrossRef]
29. Srovnal, V.; Horák, B.; Bernatík, R.; Snášel, V. Strategy extraction for mobile embedded control systems apply the multi-agent technology. *Lect. Notes Comput. Sci.* **2004**, *3038*, 631–637. [CrossRef]
30. Makieła, Z.; Kusio, T. Prerequisites of innovativeness in industry 4.0. In *Sustainability, Technology and Innovation 4.0*; Routledge: London, UK, 2021; pp. 47–63.
31. Arredondo-Méndez, V.H.; Para-González, L.; Mascaraque-Ramírez, C.; Domínguez, M. The 4.0 Industry Technologies and Their Impact in the Continuous Improvement and the Organizational Results: An Empirical Approach. *Sustainability* **2021**, *13*, 9965. [CrossRef]
32. Silva, N.; Barros, J.; Santos, M.Y.; Costa, C.; Cortez, P.; Carvalho, M.S.; Gonçalves, J.N.C. Advancing Logistics 4.0 with the Implementation of a Big Data Warehouse: A Demonstration Case for the Automotive Industry. *Electronics* **2021**, *10*, 2221. [CrossRef]
33. Kovalchuk, S.V.; Funkner, A.A.; Balabaeva, K.Y.; Derevitskii, I.V.; Fonin, V.V.; Bukhanov, N.V. *Towards Modeling of Information Processing within Business-Processes of Service-Providing Organizations*; Springer International Publishing: Berlin/Heidelberg, Germany, 2020; Volume 12137, ISBN 9783030503703.
34. Niemczyk, J.; Trzaska, R. Towards a Network Strategy: Economic Rent Perspectives. In *Vision 2020: Sustainable Economic Development and Application of Innovation Management from Regional expansion to Global Growth, Proceedings of the 32nd International Business Information Management Association Conference (IBIMA), Seville, Spain, 15–16 November 2018*; Soliman, K.S., Ed.; International Business Information Management Association (IBIMA): King of Prussia, PA, USA, 2018; pp. 4842–4859.
35. Worthington, I. Corporate perceptions of the business case for supplier diversity: How socially responsible purchasing can 'pay'. *J. Bus. Ethics* **2009**, *90*, 47–60. [CrossRef]
36. Chen, C.; Han, J.; Fan, P. Measuring the Level of Industrial Green Development and Exploring Its Influencing Factors: Empirical Evidence from China's 30 Provinces. *Sustainability* **2016**, *8*, 153. [CrossRef]
37. Gajdzik, B.; Grabowska, S.; Saniuk, S.; Wieczorek, T. Sustainable Development and Industry 4.0: A Bibliometric Analysis Identifying Key Scientific Problems of the Sustainable Industry 4.0. *Energies* **2020**, *13*, 4254. [CrossRef]
38. Park, J.-I.; Lee, S. Examining the spatial patterns of green industries and the role of government policies in South Korea: Application of a panel regression model (2006–2012). *Renew. Sustain. Energy Rev.* **2017**, *78*, 614–623. [CrossRef]
39. Fernandez, C.M.; Alves, J.; Gaspar, P.D.; Lima, T.M. Fostering Awareness on Environmentally Sustainable Technological Solutions for the Post-Harvest Food Supply Chain. *Processes* **2021**, *9*, 1611. [CrossRef]
40. Miśkiewicz, R.; Rzepka, A.; Borowiecki, R.; Olesiński, Z. Energy Efficiency in the Industry 4.0 Era: Attributes of Teal Organisations. *Energies* **2021**, *14*, 6776. [CrossRef]

41. Borowiecki, R.; Siuta-Tokarska, B.; Maroń, J.; Suder, M.; Thier, A.; Żmija, K. Developing digital economy and society in the light of the issue of digital convergence of the markets in the European Union countries. *Energies* **2021**, *14*, 2717. [CrossRef]
42. Gupta, M. Sen What is Digitization, Digitalization, and Digital Transformation—Clarifying Terminology. Available online: https://www.arcweb.com/blog/what-digitization-digitalization-digital-transformation (accessed on 2 November 2021).
43. Jwo, J.-S.; Lin, C.-S.; Lee, C.-H.; Zhang, L.; Huang, S.-M. Intelligent System for Railway Wheelset Press-Fit Inspection Using Deep Learning. *Appl. Sci.* **2021**, *11*, 8243. [CrossRef]
44. Sulich, A.; Zema, T.; Zema, P. Schemes for Verification of Resources in the Cloud: Comparison of the Cloud Technology Providers. In *Towards Industry 4.0—Current Challenges in Information Systems*; Studies in Computational Intelligence; Hernes, M., Rot, A., Jelonek, D., Eds.; Springer International Publishing: Berlin/Heidelberg, Germany, 2020; pp. 145–162.
45. Teubner, R.A.; Stockhinger, J. Literature review: Understanding information systems strategy in the digital age. *J. Strateg. Inf. Syst.* **2020**, *29*, 101642. [CrossRef]
46. Dobrowolski, Z. Internet of Things and Other E-Solutions in Supply Chain Management May Generate Threats in the Energy Sector—The Quest for Preventive Measures. *Energies* **2021**, *14*, 5381. [CrossRef]
47. Gajdzik, B.; Grabowska, S.; Saniuk, S. A Theoretical Framework for Industry 4.0 and Its Implementation with Selected Practical Schedules. *Energies* **2021**, *14*, 940. [CrossRef]
48. Basir, R.; Qaisar, S.; Ali, M.; Aldwairi, M.; Ashraf, M.I.; Mahmood, A.; Gidlund, M. Fog Computing Enabling Industrial Internet of Things: State-of-the-Art and Research Challenges. *Sensors* **2019**, *19*, 4807. [CrossRef] [PubMed]
49. Łobejko, S. Strategie cyfryzacji przedsiębiorstw [Enterprise digitization strategies]. In *Proceedings of the XXI Konferencja Innowacje w Zarządzaniu i Inżynierii (21st Innovation in Management and Production Engineering Conference), Zakopane, Poland, 25–27 February 2018*; Knosala, R., Ed.; Oficyna Wydawnicza Polskiego Towarzystwa Zarządzania Produkcją: Opole, Poland, 2018; pp. 641–652.
50. Gajdzik, B.; Wolniak, R. Transitioning of Steel Producers to the Steelworks 4.0—Literature Review with Case Studies. *Energies* **2021**, *14*, 4109. [CrossRef]
51. dos Santos Areias, I.A.; Borges da Silva, L.E.; Bonaldi, E.L.; de Lacerda de Oliveira, L.E.; Lambert-Torres, G.; Almeida Bernardes, V. Evaluation of Current Signature in Bearing Defects by Envelope Analysis of the Vibration in Induction Motors. *Energies* **2019**, *12*, 4029. [CrossRef]
52. Rokicki, T.; Perkowska, A. Diversity and Changes in the Energy Balance in EU Countries. *Energies* **2021**, *14*, 1098. [CrossRef]
53. Eurostat ICT usage in enterprises (isoc_e). Available online: https://ec.europa.eu/eurostat/cache/metadata/en/isoc_e_esms.htm (accessed on 9 February 2021).
54. Bag, S.; Gupta, S.; Kumar, S. Industry 4.0 adoption and 10R advance manufacturing capabilities for sustainable development. *Int. J. Prod. Econ.* **2021**, *231*, 107844. [CrossRef]
55. Sakiewicz, P.; Piotrowski, K.; Kalisz, S. Neural network prediction of parameters of biomass ashes, reused within the circular economy frame. *Renew. Energy* **2020**, *162*, 743–753. [CrossRef]
56. Kozar, Ł. Energy sector and the challenges of sustainable development—Analysis of spatial differentiation of the situation in the EU based on selected indicators. *Zesz. Nauk. SGGW Warszawie Probl. Rol. Światowego* **2019**, *18*, 173–186. [CrossRef]
57. Greenstein, S.; Lerner, J.; Stern, S. Digitization, innovation, and copyright: What is the agenda? *Strateg. Organ.* **2013**, *11*, 110–121. [CrossRef]
58. European Commission Shaping Europe's Digital Future. Available online: https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/shaping-europe-digital-future_en (accessed on 21 November 2021).
59. European Commission A Europe Fit for the Digital Age. Available online: https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en (accessed on 29 October 2021).
60. European Commission Energy Strategy. Available online: https://ec.europa.eu/energy/topics/energy-strategy-and-energy-union_en (accessed on 29 October 2021).
61. Niemczyk, J.; Trzaska, R.; Trzaska, M. Scalability 4.0 as the main rent in Industry 4.0: The case study of Amazon. *Inform. Ekon. Pr. Nauk. Uniw. Ekon. Wrocławiu* **2019**, *2019*, 69–84. [CrossRef]
62. Eurostat. *Energy, Transport and Environment Statistics*, 2019th ed.; European Union: Brussels, Belgium, 2019; ISBN 9789276109716.
63. Organa, M. Strategic Leadership in Immature Inter-Organizational Networks—A Case Study of a Small Consulting Company. In *Network, Innovation, and Competence-Based Economy*; Ujwary-Gil, A., Potoczek, N.R., Eds.; Instytut Nauk Ekonomicznych Polskiej Akademii Nauk (Institute of Economic Sciences of the Polish Academy of Sciences): Warsaw, Poland, 2019; pp. 59–77. ISBN 9788361597629.
64. Wierzbic, A.; Szewczyk, K. Digitalization of audit actions in the Industry 4.0 era. *Inform. Ekon.* **2019**, *54*, 74–87. [CrossRef]
65. Matt, D.T.; Rauch, E. SME 4.0: The role of small-and medium-sized enterprises in the digital transformation. In *Industry 4.0 for SMEs: Challenges, Opportunities and Requirements*; Springer: Heidelberg/Berlin, Germany, 2020; pp. 3–36. ISBN 9783030254254.
66. Eurostat Overview—Digital Economy and society. Available online: https://ec.europa.eu/eurostat/web/digital-economy-and-society (accessed on 17 September 2021).
67. Rajnoha, R.; Lesnikova, P.; Stefko, R.; Schmidtova, J.; Formanek, I. Transformations in strategic business planning in the context of sustainability and business goals setting. *Transform. Bus. Econ.* **2019**, *18*, 44–66.
68. Sulich, A.; Sołoducho-Pelc, L. Renewable Energy Producers' Strategies in the Visegrád Group Countries. *Energies* **2021**, *14*, 3048. [CrossRef]

69. Sikorski, T.; Jasiński, M.; Ropuszyńska-Surma, E.; Węglarz, M.; Kaczorowska, D.; Kostyła, P.; Leonowicz, Z.; Lis, R.; Rezmer, J.; Rojewski, W.; et al. A Case Study on Distributed Energy Resources and Energy-Storage Systems in a Virtual Power Plant Concept: Economic Aspects. *Energies* **2019**, *12*, 4447. [CrossRef]
70. Kley, F.; Lerch, C.; Dallinger, D. New business models for electric cars-A holistic approach. *Energy Policy* **2011**, *39*, 3392–3403. [CrossRef]
71. Magruk, A. Analysis of Uncertainties and Levels of Foreknowledge in Relation to Major Features of Emerging Technologies—The Context of Foresight Research for the Fourth Industrial Revolution. *Sustainability* **2021**, *13*, 9890. [CrossRef]
72. Roblek, V.; Thorpe, O.; Bach, M.P.; Jerman, A.; Meško, M. The Fourth Industrial Revolution and the Sustainability Practices: A Comparative Automated Content Analysis Approach of Theory and Practice. *Sustainability* **2020**, *12*, 8947. [CrossRef]
73. Sołoducho-Pelc, L.; Sulich, A. Between sustainable and temporary competitive advantages in the unstable business environment. *Sustainability* **2020**, *12*, 8832. [CrossRef]
74. Radomska, J.; Wołczek, P.; Sołoducho-Pelc, L.; Silva, S. The impact of trust on the approach to management—A case study of creative industries. *Sustainabilty* **2019**, *11*, 816. [CrossRef]
75. Knez, M.; Jereb, B.; Jadraque Gago, E.; Rosak-Szyrocka, J.; Obrecht, M. Features influencing policy recommendations for the promotion of zero-emission vehicles in Slovenia, Spain, and Poland. *Clean Technol. Environ. Policy* **2021**, *23*, 749–764. [CrossRef]
76. Trzaska, R.; Mazgajczyk, E. Industry 4.0: Overview of Business Models in Additive Manufacturing. In *Education Excellence and Innovation Management: A 2025 Vision to Sustain Economic Development during Global Challenges, Proceedings of the 35th International Business Information Management Association Conference (IBIMA), Seville, Spain, 1–2 April 2020*; Soliman, K.S., Ed.; International Business Information Management Association (IBIMA): King of Prussia, PA, USA, 2020; pp. 18453–18464.
77. Niemczyk, J.; Trzaska, R. Klasyfikacja modeli biznesowych w Industry 4.0 [Industry 4.0 business models classification]. In *Zarządzanie Strategiczne w Dobie Cyfrowej Gospodarki Sieciowej [Strategic management in the Era of Digital Network Economy]*; Gregorczyk, S., Urbanek, G., Eds.; Wydawnictwo Uniwersytetu Łódzkiego: Lodz, Poland, 2020; pp. 265–294. ISBN 9788382203356.
78. Kozikowski, D.; Zema, T.; Sulich, A. Artificial Intelligence Usage and Ethics in the Choice Theory. In *Proceedings of the Education Excellence and Innovation Management: A 2025 Vision to Sustain Economic Development during Global Challenges, Seville, Hiszpania, 1–2 April 2020*; Soliman, K.S., Ed.; International Business Information Management Association: King of Prussia, PA, USA, 2020; pp. 7438–7449.
79. Bharadwaj, A.; El Sawy, O.A.; Pavlou, P.A.; Venkatraman, N. Digital business strategy: Toward a next generation of insights. *MIS Q. Manag. Inf. Syst.* **2013**, *37*, 471–482. [CrossRef]
80. Niemczyk, J.; Trzaska, R.; Borowski, K.; Karolczak, P. Scalability 4.0 as economic rent in Industry 4.0. *Transform. Bus. Econ.* **2019**, *18*, 824–838.
81. Mahmoud, M.A.; Md Nasir, N.R.; Gurunathan, M.; Raj, P.; Mostafa, S.A. The Current State of the Art in Research on Predictive Maintenance in Smart Grid Distribution Network: Fault's Types, Causes, and Prediction Methods—A Systematic Review. *Energies* **2021**, *14*, 5078. [CrossRef]
82. Chawla, Y.; Kowalska-Pyzalska, A.; Skowrońska-Szmer, A. Perspectives of smart meters' roll-out in India: An empirical analysis of consumers' awareness and preferences. *Energy Policy* **2020**, *143*, 1–15. [CrossRef]
83. Lipsmeier, A.; Kühn, A.; Joppen, R.; Dumitrescu, R. Process for the development of a digital strategy. In *Proceedings of the 53rd CIRP Conference on Manufacturing Systems 2020, Chicago, IL, USA, 1–3 July 2020*; Elsevier B.V: Amsterdam, The Netherlands, 2020; Volume 88, pp. 173–178.
84. Kim, E.; Nam, D.-I.; Stimpert, J.L. The applicability of Porter's generic strategies in the digital age: Assumptions, conjectures, and suggestions. *J. Manag.* **2004**, *30*, 569–589. [CrossRef]
85. Knop, K.; Rosak-Szyrocka, J. Evaluating and improving the effectiveness of the rolling mill in the production of medium steel sections in the selected company from the metallurgical industry. In Proceedings of the METAL 2016—25th Anniversary International Conference on Metallurgy and Materials, Brno, Czech Republic, 25–27 May 2016; pp. 1869–1875.
86. Kang, I.-G.; Kim, N.; Loh, W.-Y.; Bichelmeyer, B.A. A Machine-Learning Classification Tree Model of Perceived Organizational Performance in U.S. Federal Government Health Agencies. *Sustainability* **2021**, *13*, 329. [CrossRef]
87. Tuan, L.T. Environmentally-specific servant leadership and green creativity among tourism employees: Dual mediation paths. *J. Sustain. Tour.* **2020**, *28*, 86–109. [CrossRef]
88. Chang, C.-Y.; Tu, C.-A.; Huang, W.-L. Developing a Recommendation Model for the Smart Factory System. *Appl. Sci.* **2021**, *11*, 8606. [CrossRef]
89. Tavera Romero, C.A.; Ortiz, J.H.; Khalaf, O.I.; Ríos Prado, A. Business Intelligence: Business Evolution after Industry 4.0. *Sustainability* **2021**, *13*, 26. [CrossRef]
90. Euchner, J.; Ganguly, A. Business Model Innovation in Practice. *Res. Technol. Manag.* **2014**, *57*, 33–39. [CrossRef]
91. Niemczyk, J. *Strategia. Od planu do Sieci [Strategy. from Plan to Network]*; Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu: Wrocław, Poland, 2013.
92. Ashraf, W.M.; Uddin, G.M.; Farooq, M.; Riaz, F.; Ahmad, H.A.; Kamal, A.H.; Anwar, S.; El-Sherbeeny, A.M.; Khan, M.H.; Hafeez, N.; et al. Construction of Operational Data-Driven Power Curve of a Generator by Industry 4.0 Data Analytics. *Energies* **2021**, *14*, 1227. [CrossRef]
93. Alkon, A.H.; Cadji, Y.J.; Moore, F. Subverting the new narrative: Food, gentrification and resistance in Oakland, California. *Agric. Human Values* **2019**, *36*, 793–804. [CrossRef]

94. Kowalska, A.; Kovárník, J.; Hamplova, E.; Prazak, P. The Selected Topics for Comparison in Visegrad Four Countries. *Economies* **2018**, *6*, 50. [CrossRef]
95. Trzaska, R. Network Assessment of a Selected Organization from The Personnel Outsourcing Sector. In *Sustainable Economic Development and Advancing Education Excellence in the era of Global Pandemic, Proceedings of the 36th International Business Information Management Association Conference (IBIMA), Granada, Spain, 4–5 November 2020*; Soliman, K.S., Ed.; International Business Information Management Association (IBIMA): King of Prussia, PA, USA, 2020; pp. 9443–9453.
96. Olszak, C.M. Strategia cyfrowa współczesnej organizacji [Contemporary organization digital strategy]. *Stud. Ekon. Zesz. Nauk. Uniw. Ekon. Katowicach* **2015**, *232*, 164–177.
97. Cordova-Pizarro, D.; Aguilar-Barajas, I.; Rodriguez, C.A.; Romero, D. Circular economy in Mexico's electronic and cell phone industry: Recent evidence of consumer behavior. *Appl. Sci.* **2020**, *10*, 7744. [CrossRef]
98. Short, M.; Rodriguez, S.; Charlesworth, R.; Crosbie, T.; Dawood, N. Optimal Dispatch of Aggregated HVAC Units for Demand Response: An Industry 4.0 Approach. *Energies* **2019**, *12*, 4320. [CrossRef]
99. Ma, S.; Zhang, Y.; Liu, Y.; Yang, H.; Lv, J.; Ren, S. Data-driven sustainable intelligent manufacturing based on demand response for energy-intensive industries. *J. Clean. Prod.* **2020**, *274*, 123155. [CrossRef]
100. Brodny, J.; Tutak, M. Analyzing Similarities between the European Union Countries in Terms of the Structure and Volume of Energy Production from Renewable Energy Sources. *Energies* **2020**, *13*, 913. [CrossRef]
101. Eseonu, C.I.; Wyrick, D.A.; Vaccari, E. Empowering technological entrepreneurs: Developing a framework for technical business development. In Proceedings of the 2010 Industrial Engineering Research Conference, Cancun, Mexico, 5–9 June 2010.
102. Ferasso, M.; Beliaeva, T.; Kraus, S.; Clauss, T.; Ribeiro-Soriano, D. Circular economy business models: The state of research and avenues ahead. *Bus. Strateg. Environ.* **2020**, *29*, 3006–3024. [CrossRef]
103. Niemczyk, J.; Trzaska, R. Network Approach in Industry 4.0: Perspective of Coopetition. In Proceedings of the Contemporary Challenges in Cooperation and Coopetition in the Age of Industry 4.0, Proceedings of the 10th Conference on Management of Organizations' Development (MOD), Gniew, Poland, 22–24 May 2019; Zakrzewska-Bielawska, A., Staniec, I., Eds.; Springer: Berlin/Heidelberg, Germany, 2020; pp. 139–154.
104. Mielcarek, P. *Strategic Coherence and Process Maturity in the Context of Company Ambidextrousness*; C.H. Beck: Warsaw, Poland, 2021; ISBN 978-83-8235-568-0.
105. Rinaldi, G.; Thies, P.R.; Johanning, L. Current Status and Future Trends in the Operation and Maintenance of Offshore Wind Turbines: A Review. *Energies* **2021**, *14*, 2484. [CrossRef]
106. Dantas, T.E.T.; de-Souza, E.D.; Destro, I.R.; Hammes, G.; Rodriguez, C.M.T.; Soares, S.R. How the combination of Circular Economy and Industry 4.0 can contribute towards achieving the Sustainable Development Goals. *Sustain. Prod. Consum.* **2021**, *26*, 213–227. [CrossRef]
107. Osterwalder, A.; Pigneur, Y. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2010; ISBN 978-0-470-87641-1.
108. Jabłoński, A.; Jabłoński, M. Social Perspectives in Digital Business Models of Railway Enterprises. *Energies* **2020**, *13*, 6445. [CrossRef]
109. Stuss, M.M.; Makieła, Z.J.; Herdan, A.; Kuźniarska, G. The corporate social responsibility of polish energy companies. *Energies* **2021**, *14*, 3815. [CrossRef]
110. Bärenfänger, R.; Otto, B. Proposing a Capability Perspective on Digital Business Models. In *Proceedings of the 17th IEEE Conference on Business Informatics (CBI 2015), Lisbon, Portugal, 13–16 July 2015*; Institute of Electrical and Electronics Engineers Inc.: Piscataway Township, NJ, USA, 2015; Volume 1, pp. 17–25.
111. El Sawy, O.A.; Pereira, F. *Business Modelling in the Dynamic Digital Space*; Springer Briefs in Digital Spaces; Springer: Berlin/Heidelberg, Germany, 2013; ISBN 978-3-642-31764-4.
112. Weill, P.; Woerner, S.L. Optimizing your digital business model. *MIT Sloan Manag. Rev.* **2013**, *54*, 71–78. [CrossRef]
113. Kazan, E.; Tan, C.W.; Lim, E.T.K. Value creation in cryptocurrency networks: Towards a taxonomy of digital business models for bitcoin companies. In Proceedings of the Pacific Asia Conference on Information Systems (PACIS 2015), Bayfront Subzone, Singapore, 5–9 July 2015.
114. Jasińska, K.; Jasiński, B. A Corporate Communication in the Fourth Industrial Revolution. In *Proceedings of the Vision 2020: Sustainable Economic Development and Application of Innovation Management from Regional expansion to Global Growth, Proceedings of the 32nd International Business Information Management Association Conference (IBIMA), Seville, Spain, 15–16 November 2018*; Soliman, K.S., Ed.; International Business Information Management Association (IBIMA): King of Prussia, PA, USA, 2018; pp. 7418–7430.
115. Wu, L.; Shao, Z.; Yang, C.; Ding, T.; Zhang, W. The Impact of CSR and Financial Distress on Financial Performance—Evidence from Chinese Listed Companies of the Manufacturing Industry. *Sustainability* **2020**, *12*, 6799. [CrossRef]
116. Gavrila Gavrila, S.; de Lucas Ancillo, A. Spanish SMEs' digitalization enablers: E-Receipt applications to the offline retail market. *Technol. Forecast. Soc. Chang.* **2021**, *162*, 120381. [CrossRef]
117. Graczyk, A.M. Renewable Energy Investment Stimulants in Polish Agricultural Holdings as a Part of Supporting Sustainable Agricultura. *Econ. Environ. Stud.* **2017**, *17*, 693–706. [CrossRef]
118. Czaplicka-Kotas, A.; Kulczycka, J.; Iwaszczuk, N. Energy clusters as a new urban symbiosis concept for increasing renewable energy production-A case study of Zakopane city. *Sustainability* **2020**, *12*, 5634. [CrossRef]

119. Bopp, K.; Zinaman, O.; Lee, N. Electric Vehicle Charging Infrastructure: Business Model and Tariff Design Support to the Lao PDR. 2020. Available online: https://www.osti.gov/biblio/1762451 (accessed on 21 November 2021).
120. Makieła, Z.; Stuss, M.M.; Borowiecki, R. *Sustainability, Technology and Innovation 4.0*; Routledge: New York, NY, USA, 2021.
121. Blaskova, M.; Blasko, R.; Borkowski, S.; Rosak-Szyrocka, J. Searching correlations between communication and motivation. *Commun. Sci. Lett. Univ. Zilina* **2016**, *18*, 28–35.
122. Hauer, G.; Harte, P.; Kacemi, J. An Exploration of the Impact of Industry 4.0 Approach on Corporate Communication in the German Manufacturing Industry. *Int. J. Supply Chain Manag.* **2018**, *7*, 125–136.
123. Maarit Lipiäinen, H.S.; Karjaluoto, H.E.; Nevalainen, M. Digital channels in the internal communication of a multinational corporation. *An Int. J. An Interna* **2014**, *19*, 275–286. [CrossRef]
124. Rajput, S.; Singh, S.P. Industry 4.0 Model for circular economy and cleaner production. *J. Clean. Prod.* **2020**, *277*, 123853. [CrossRef]
125. Saniuk, S.; Grabowska, S. The Concept of Cyber-Physical Networks of Small and Medium Enterprises under Personalized Manufacturing. *Energies* **2021**, *14*, 5273. [CrossRef]
126. Trauer, J.; Pfingstl, S.; Finsterer, M.; Zimmermann, M. Improving Production Efficiency with a Digital Twin Based on Anomaly Detection. *Sustainability* **2021**, *13*, 155. [CrossRef]
127. Wit, B.; Dresler, P.; Surma-Syta, A. Innovation in Start-Up Business Model in Energy-Saving Solutions for Sustainable Development. *Energies* **2021**, *14*, 3583. [CrossRef]
128. Mastny, L. Renewable Energy and Energy Efficiency in China: Current Status and Prospects for 2020. *Worldwatch Pap.* 2010, pp. 1–48. Available online: https://www.semanticscholar.org/paper/Renewable-energy-and-energy-efficiency-in-China-%3A-Mastny/3f6de6d5627a42d8dccd362900a5971d77b5f424#citing-papers (accessed on 21 November 2021).
129. Campbell, R.J.; Levine, L. Renewable Energy: A pathway to Green Jobs? In *A Green United States. Pathways, Policies and Issues*; Williams, C.L., Ed.; Nova Science Publishers: Hauppague, NY, USA, 2010; ISBN 9781617615993.
130. Saxe, D. Suggestions on green energy. *Pollut. Eng.* **2009**, *41*, 10.
131. Graczyk, A.M.; Graczyk, A.; Żołyniak, T. System for Financing Investments in Renewable Energy Sources in Poland. In *Proceedings of the Finance and Sustainability, Proceedings of the 2nd Finance and Sustainability Conference, Wroclaw, Poland, 12–13 December 2018*; Daszyńska-Żygadło, K., Bem, A., Ryszawska, B., Jaki, E., Hajdikova, T., Eds.; Spinger: Cham, Germany, 2020; pp. 153–166.
132. Trzaska, R.; Migasiewicz, K.; Wilczynski, M. Competencies, skills, attributes of the network leader. *Transform. Bus. Econ.* **2019**, *18*, 728–744.
133. Huang, C.T.W.; Kleiner, B.H. New developments concerning managing mergers and acquisitions. *Manag. Res. News* **2004**, *28*, 57–64. [CrossRef]
134. Brandoni, C.; Polonara, F.; Ciriachi, G.; Marchetti, B. Employment impact of renewable energy generation on sustainable communities. In Proceedings of the Summer School Francesco Turco, 11–13 September 2013; pp. 346–351.
135. Piwowar-Sulej, K. Pro-environmental organizational culture: Its essence and a concept for its operationalization. *Sustainability* **2020**, *12*, 4197. [CrossRef]
136. Osmundsen, K.; Bygstad, B. Making sense of continuous development of digital infrastructures. *J. Inf. Technol.* **2021**. [CrossRef]
137. Kauko, H.; Rohde, D.; Knudsen, B.R.; Sund-Olsen, T. Potential of Thermal Energy Storage for a District Heating System Utilizing Industrial Waste Heat. *Energies* **2020**, *13*, 3923. [CrossRef]
138. Sus, A.; Organa, M. Dynamics and the Dynamism of Strategy in Inter-organizational Network-Research Project Assumptions. In *Contemporary Challenges in Cooperation and Coopetition in the Age of Industry 4.0*; Zakrzewska-Bielawska, Z., Staniec, I., Eds.; Springer International Publishing: Cham, Germany, 2020; pp. 313–330.
139. Piwowar-Sulej, K. Human Resource Management in the Context of Industry 4.0. *Organ. Zarządzanie Kwart. Nauk.* **2020**, *1*, 103–113.
140. Ishfaq, K.; Anjum, I.; Pruncu, C.I.; Amjad, M.; Kumar, M.S.; Maqsood, M.A. Progressing towards Sustainable Machining of Steels: A Detailed Review. *Materials* **2021**, *14*, 5162. [CrossRef]
141. Jasińska, K.; Jasiński, B. Clustres under Industry 4.0 Conditions—Case Study: The Concept of Industry 4.0 Cluster in Poland. *Transform. Bus. Econ.* **2019**, *18*, 802–823.
142. Kasztelan, A. On the Road to a Green Economy: How Do European Union Countries 'Do Their Homework'? *Energies* **2021**, *14*, 5941. [CrossRef]
143. Rabiej, M. *Statistical Analyzes with Statistica and Excel [Analizy Statystyczne z Programami Excel i Statistical]*; Helion: Gliwice, Poland, 2018; ISBN 978-83-283-3922-4.
144. Jiménez-Marín, G.; Zambrano, R.E.; Galiano-Coronil, A.; Ravina-Ripoll, R. Business and energy efficiency in the age of industry 4.0: The hulten, broweus and Van Dijk sensory marketing model applied to spanish textile stores during the COVID-19 crisis. *Energies* **2021**, *14*, 1966. [CrossRef]
145. Young, T.M.; Nanthakumar, A.; Nanthakumar, H. On the Use of Copula for Quality Control Based on an AR(1) Model. *Mathematics* **2021**, *9*, 2211. [CrossRef]
146. Sobczak, E.; Bartniczak, B.; Raszkowski, A. Implementation of the no poverty sustainable development goal (SDG) in Visegrad Group (V4). *Sustainability* **2021**, *13*, 1030. [CrossRef]
147. Brodny, J.; Tutak, M.; Bindzár, P. Assessing the Level of Renewable Energy Development in the European Union Member States. A 10-Year Perspective. *Energies* **2021**, *14*, 3765. [CrossRef]
148. Mićić, L. Digital Transformation and Its Influence on GDP. *Economics* **2017**, *5*, 135–147. [CrossRef]

149. Falas, Ł.; Świątek, P.; Schauer, P.; Trzaska, R. Practical implementation of Internet of Things service systems architecture. In Proceedings of the 25th International Conference on Systems Engineering (ICSEng), Las Vegas, NV, USA, 22–24 August 2017; Volume 2017, pp. 291–298.
150. Osmundsen, K.S. Competences for digital transformation: Insights from the Norwegian energy sector. In Proceedings of the Annual Hawaii International Conference on System Sciences (HICSS 2020), Maui, Hawaii, 7–10 January 2020; Volume 2020, pp. 4326–4335.
151. Johnson, O. Promoting green industrial development through local content requirements: India's National Solar Mission. *Clim. Policy* **2016**, *16*, 178–195. [CrossRef]
152. Shell Global Digital Transformation in the Energy Industry. Available online: https://www.shell.com/energy-and-innovation/digitalisation/digital-transformation.html (accessed on 2 November 2021).