sustainability

MDPI

Review

The Fourth Industrial Revolution and the Sustainability Practices: A Comparative Automated Content Analysis Approach of Theory and Practice

Vasja Roblek [1], Oshane Thorpe [2], Mirjana Pejic Bach [3,*], Andrej Jerman [4] and Maja Meško [5,6,*]

1 Faculty of Organisation Studies in Novo Mesto, 8000 Novo Mesto, Slovenia; vasja.roblek@gmx.com
2 College of Media and Mass Communication, American University in the Emirates, Dubai 503000, UAE; Oshane.thorpe@aue.ae
3 Faculty of Economics, University of Zagreb, 100000 Zagreb, Croatia
4 LPP, 1000 Ljubljana, Slovenia; andrejjerman1@gmail.com
5 Faculty of Management, University of Primorska, 6000 Koper, Slovenia
6 Faculty of Organizational Sciences, University of Maribor, 4000 Kranj, Slovenia
* Correspondence: mpejic@net.efzg.hr (M.P.B.); maja.mesko@fm-kp.si (M.M.)

Received: 23 September 2020; Accepted: 13 October 2020; Published: 15 October 2020

Abstract: (1) Background: The article provides a methodologically coherent analysis of technological development in the context of the fourth industrial revolution or Industry 4.0 and its impact on changes in sustainable development policy. (2) Methods: Using a Comparative Automated Content Analysis (ACA) approach, the article compares recent scientific work on sustainable development and the fourth industrial revolution with the discourse in the news media on sustainable development and industry 4.0. (3) Results: The scientific literature focuses more on changes in business models, production processes, and technologies that enable sustainable development. Newspaper and magazine articles write more about sustainable or green investments, sustainable standards, and sustainable reporting. The focus is on topics that are directly relevant to current sustainable business development and the promotion of research and development of clean and smart technologies and processes. (4) Conclusions: The ACA allows a more systematic comparison of different data sources. The article provides a starting point for sustainable development professionals to gain useful insights into a specific context with the help of the ACA.

Keywords: sustainability; industry 4.0; sustainable investment; corporate social responsibility; sustainable standards; sustainable reporting; smart manufacturing; renewable energy; cleaner production

1. Introduction

In the second decade of the 21st century, humanity is confronted with the emergence of the Fourth Industrial Revolution or Industry 4.0 (IR 4.0) and the demand to implement the 17 Sustainable Development Goals (SDGs) set out in Agenda 2030 for Sustainable Development. The Agenda balances and links the three dimensions of sustainable development—economic, social, and environmental—and stipulates that the SDGs must be adopted in all countries of the world by 2030 [1].

Most of the scientific literature described I4.0 primarily from a technical point of view [2], but there are less researched topics like organizational management [3–5], as well as the ecological and social aspects within I4.0. Researchers such as Birkel et al. [6] point out that there are still rare integrative researches of economic, ecological, and social aspects. It is tough to simultaneously maintain economic profitability whilst improving the environmental, as well as the social aspects of industrial value

creation. Thus, the challenges and potential of I4.0 appear in stark contradiction to the three-dimensions mentioned in the Triple Bottom Line. The I4.0 concept raises fears of job losses and growing inequality. Therefore, an interdisciplinary, integrative study of I4.0 is required, which does more than merely balance the ecological and social potential, but also connects them to market success [7,8].

To this end, a comparative study between the current peer-reviewed academic articles and the less rigorous news media can serve to identify the themes that are of importance and aid in the understanding of I4.0. An enquiry of this nature, therefore, delves deep to identify changes in sustainable development policy, and with the gathered knowledge can provide guidelines for further research that will later further contribute to the theoretical and practical development of sustainable policies.

The method of content analysis in the media, whether it is done manually or through the aid of natural language processing artificial intelligence, is an incredibly exciting area, since it offers a wealth of sources to be analyzed. It is also essential as we cannot divorce ourselves from the impact of journalistic discourse in the present day. Therefore, in this paper, journalistic discourse will be extrapolated from newspaper reports (articles or "newspaper story").

According to van Dijk's [9] newspaper report refers to "the kind of text that provides information about recent events". Rea [10] also added to this definition, by stating that "Information about recent events that are of interest to large enough group or that can affect the lives of large enough groups of people".

The comparative research delves into the opportunities offered by I4.0, including, but not limited to, improvement of various production processes, which includes robotization, as well as how I4.0 has stimulated research on the possibilities and effects outside the smart factories themselves [11,12]. There are 10 major global trends in I4.0, most of which already exist but have been improved, in terms of the features introduced: Demographic shifts, urbanization, knowledge growth, deindustrialization, market globalization compared to protectionism, advanced business models, technology convergence, increase robotics, cybersecurity, climate changes, and global sustainability [13,14]. The immediate sustainability result of I4.0 is manufacturing-economic sustainability. The digitalization of the manufacturing industry influences manufacturing efficiency, supply chain mergers, energy efficiency, the emergence of business model innovation, cost-saving, financial sustainability, human resource skills development, and corporate profitability. It is vital to replace fossil fuels with renewable energy, which also aids in the decarbonization of the society. I4.0 is eventually crucial for promoting and enabling environmental protection and emission reduction [15]. There are a large number of articles, both empirically and theoretically based, which span cases of scientific research in the case of academic journal articles and others can be found in newspapers and magazines. In this research, an alternative approach was chosen that was capable of efficiently and successfully categorizing vast quantities of data and enabled the reader to obtain appropriate explanations of the research phenomenon understandably. For the topic under discussion, an automated content analysis method (ACA) was used to identify the key themes and the concepts of interest to researchers [16,17].

This paper consists of six chapters. First, the introduction, followed by the research method, which includes data collection and literature selection. The fourth chapter provides data analysis and the results of the ACA. The paper concludes with a discussion of results and conclusions, which include a comparative analysis of findings, research limitations, and propose research in the future.

2. Content Text Analyses Methods

2.1. Introduction of a Classical Content Analysis

Content analysis is traditionally located in the field of quantitative methods, though it has mixed methodology applications. In the early applications of this method, research results were usually expressed in quantitative form. When formulating the first more precise definition of the method, Berelson [18] had in mind what was most often represented in practice and also influenced the

perception of content analysis as a quantitative method. According to Berelson [19] "content analysis is a research technique for the objective, systematic and quantitative description of the manifest content of communication". The understanding of the method as quantitative is also a consequence of the necessity to collect data through research, which are used to solve existing problems, i.e., they are socially conditioned. The content analysis "experiences its own experience" [18]. Content analysis flourished when it became instrumental in practice (during the Second World War and the so-called Cold War when it was used to study enemy propaganda).

Discussion of quantitative and qualitative approach in the content analysis began in the middle of the last century, after the appearance of the first methodological study on content analysis- Berelson's text about the content analysis [19]. Kracauer [20], the first proponent of qualitative content analysis, reacted to Berelson's view of the method, which leads Schreier [21] to the conclusion that the qualitative form of the procedure was developed from his quantitative form. The debate on quantitative and qualitative content analysis was one of the three main topics at the Allerton House Conference in 1955 [22], and at the end of the same decade, George [23] published a text advocating the application of the procedure in qualitative form.

Following the mentioned attempts to affirm the qualitative application of the analysis of the media content, a decades-long silence follows. However, the debate was revived at the beginning of the 21st century. Schreier [21] points out that silence was only present in the English-speaking world, especially in the United States and England. However, the qualitative content analysis continued to develop in the rest of Europe, primarily in Germany, by the turn of the 21st century, the discussion was revived in the English-speaking literature. Mayring [24] stood out in terms of influence, and his work became the standard literature on the qualitative application of the methodology [21].

The content analysis thus was developed to determine what can be investigated and how the inquiry can be undertaken using the approach. Based on the existing definitions, two phases can be observed in determining the qualitative content analysis. In the first years, when the application of the method in a qualitative form was advocated, it was defined by comparison with the quantitative form, whereas the more recent definitions deal exclusively with the specifics of qualitative content analysis, and in very brief terms [25]. The difference between older and newer definitions is not surprising, since the former arose at the time when the qualitative content analysis was confirmed as a form of research procedure and the latter when its status was no longer questioned. At the same time, we should not lose sight of the fact that a sharp dividing line between qualitative and quantitative content analysis cannot be drawn. Krippendorff [26] was questioned about the distinction between these two forms of procedure in terms of their usefulness and validity.

Newer determinations are, as already indicated, focused on the specifics of qualitative content analysis, without comparison with the quantitative form of the procedure. Besides, the definitions are concise, without a more thorough consideration of the peculiarities of the qualitative form of the procedure at the level of determination. For Hsieh and Shannon [27], qualitative content analysis is "a research method for subjectively interpreting the content of textual data through the systematic classification of coding processes and the identification of topics or patterns". Similarly, Schreier [21] defines qualitative content analysis as the process by which "systematic description of the meaning of qualitative data" is performed in a relevant context.

Classic content analysis is based on manual text content analysis; this means that the researcher manually (personally) checks different sources and identifies ideas and topics based on his perceptions and views. Manual analysis restricts the process of text content research itself, as the researcher is limited by the time and physical ability to analyze the content, so it leads to the inevitable limitation of the scope of a sample text. The limitation is perceived as insufficient sampling (biased), which reduces the efficiency and effectiveness of the results of the analysis [26].

2.2. Automated Content Analyses

Technological developments have led to the development of automatic text analysis, which is specifically designed to use information technology to extract statistically manipulative information about the presence, intensity, and/or frequency of thematic and/or stylistic features of texts [28,29]. From a methodological perspective, automatic text analysis has several very significant advantages. Since a computer performs the analysis based on a predefined algorithm, the data obtained in this way are objective, verifiable, and reproducible. Moreover, the use of this method minimizes the measurement error that is a consequence of the individual differences between assessors and allows maximum methodological equivalence of different studies using the same text analysis program. Furthermore, the data collected in this way do not show any methodological differences from explicit methods that are frequently used in management (e.g., expert assessments, assessments by stakeholders, questionnaires, among others) [30].

The authors used Leximancer 5.0 to analyze content comparisons of texts based on ACA, which is used in this research for the content analyses of the articles, based primarily on probabilistic models generated by algorithms [17,31]. ACA represents a text-mining tool [28], and it is used for the analysis of text using AI/machine learning techniques. This subsect of computer science focuses on identifying patterns, to also generate predictions and to identify and define thematic/themes in the selected text collection (terms) [32]. The ACA enables researchers to simultaneously analyze a large body of text for themes and similar concepts [33]. This ability makes ACA comparable to the classification model in remote sensing found in the feature-or object method [34]. The method finds terms that have a high probability of being linked based on their repetitive proximity in the literature. The concepts are gleaned from the repetition across multiple texts and are found to be closely related [35]. The concepts are subsequently used in the categorization of the literature. This process is far more complicated than word sense and wordnet because it does not merely only count frequency but also takes into account the semantics and natural language complexities found in English such as synonyms, co-decision frequencies, and sentence structure [36].

According to Smith and Humphreys [37], the process is aiming to replicate in software the method for "transforming lexical co-occurrence information from natural language into semantic patterns in an unsupervised manner". The program is based on semantic and relational co-occurrence information extraction. It uses different algorithms for each phase, which are statistical. A characteristic of the algorithms is that they use nonlinear dynamics and machine learning. Smith and Humphreys [37] also validated the Leximancer according to the typology presented by Krippendorff [26] (face validity, stability (including sampling validity of members, reproducibility (including sampling validity of representatives and predictive validity), which also covers structural validity in the case of concept network comparisons, correlative validity (also including semantic validity), and (5) functional validity).

In recent years, various researchers have established a rigorous procedure for characterizing various content (e.g., research literature, journal articles, corporate sustainability reports, government policy, etc.) with the topic of sustainable development, technological transformation, and need for sustainability processes. Such papers are:

- Amini, Bienstock, and Narcum [38]: Status of corporate sustainability: A content analysis of Fortune 500 companies;
- Cheng and Edwards [16]: A comparative automated content analysis approach on the review of the sharing economy discourse in tourism and hospitality;
- Kim and Kim [39]: Sustainable Supply Chain Based on News Article and Sustainability Reports: Text Mining with Leximancer and DICTION;
- Lock and Araujo [40]: Visualizing the triple bottom line: A large-scale automated visual content analysis of European corporations' website and social media images;
- Nunez-Mir et al. [28]: An automated content analysis of forestry research: are socioecological challenges being addressed?

- Paolone, F., Sardi, A., Sorano, E., and Ferraris, A. [41]: Integrated processing of sustainability accounting reports: a multi-utility company case study;
- Pucihar [17]: The digital transformation journey: content analysis of Electronic Markets articles and Bled eConference proceedings from 2012 to 2019;
- Roblek et al. [42]: The interaction between internet, sustainable development, and emergence of Society 5.0;
- Sullivan et al. [43]: Using industrial ecology and strategic management concepts to pursue the Sustainable Development Goals;
- Keller et al. [44]: News media coverage of climate change in India 1997–2016: Using automated content analysis to assess themes and topics.

The next chapter provides the research design.

3. Research Design

3.1. Data Collection

This research presents an insight into the studies about the relations between I4.0, emerging changes to the economy, production, sustainability, and the environment. The study analyzed academic journal articles published from 2010 to June 2020 as well as newspapers and magazines articles published between 2015 and 2020. I4.0 is influential on the development of new technology and business models as well as on social change. In order to know the problems and the current situation, which also affects society, not only corporations, it is necessary to observe and analyze news articles that reflect a broader spectrum of trending events, or "what is going on" (colloquially) [45]. In this way, "hot themes" from a particular area are to be designed and presented to the public and achieve an "agenda-setting" effect [46]. Newspaper articles bring to the attention of the public those news items that are of interest to them at the time, and that could influence changes in regulatory policy and practice [47,48]. The purpose of academic scientific articles is to present new scientific findings and thus to provide the scientific and professional public with access to further knowledge in a particular scientific field [49].

Literature Selection

The literature selection was prepared in the three-step screening process. First, the papers were searched by keywords on Industry 4.0, 4th Industrial revolution, sustainability, clean production, sustainable development, environment, green investment, smart factory, and sustainable corporate responsibility on the WOS database. In the second phase, only peer-review papers were selected. The third step includes manual review and selection of peer review papers titles, abstracts, and conclusions.

The research platform Web of Science was used for the search of Science Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI), and Arts abd Humanities Citation Index (A & HCI) to identify relevant papers. The Boolean keyword combination used for this research are as follows, (TS = (Industry 4.0 * and sustainability) and language: (english) and document types: (Article)Indexes = SCI-EXPANDED, SSCI, A & HCI). The research focused on collecting a decade of data. Therefore, the time frame of 1990 to 2020 was used. The results of the search were limited to the articles published in the refereed journals only. The peer review was limited to scientific journals written in English and was therefore not intended to provide a comprehensive assessment of the totality of the state of the subject.

The research paper uses ACA for comparison and analysis of the current knowledge of the particular topic and to identify research gaps for preparing future researches [50]. The literature review is prepared according to the Prisma 2009 technique. The process is presented in Figure 1 [51].

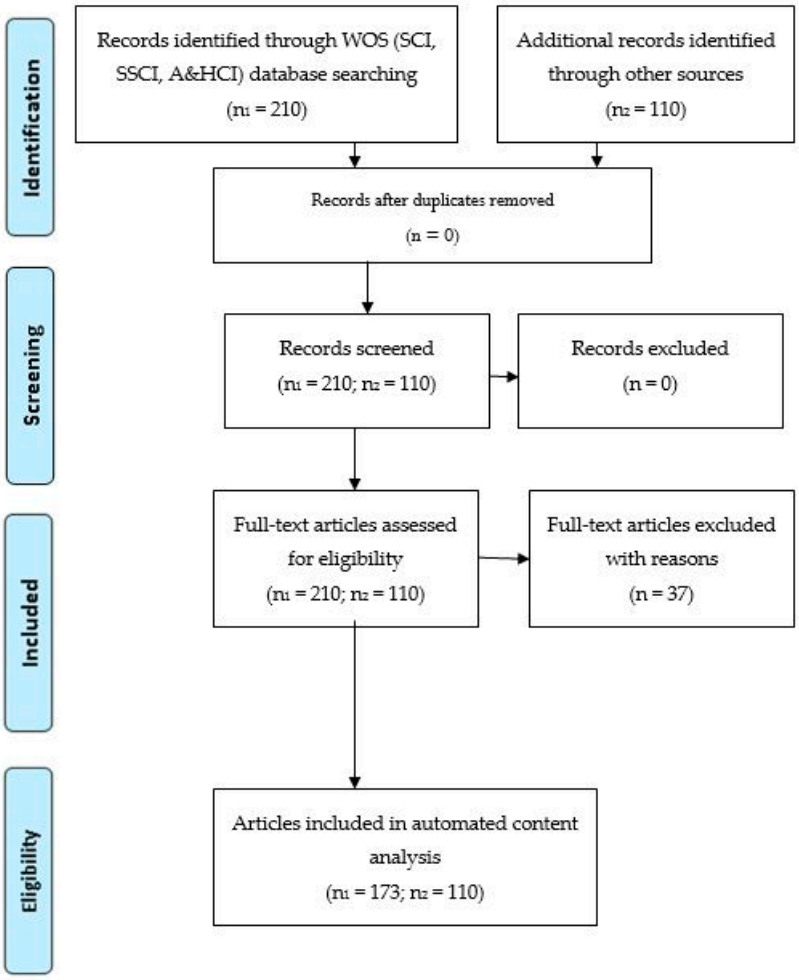

Figure 1. Prisma 2009 flow diagram.

A search of the Web of Science yielded 210 articles published in 92 peer-reviewed journals, the authors' analysis utilized data from Clarivate Analytics, in the Web of Science database. Review of the abstracts as well as the full texts was undertaken, unearthing 37 irrelevant articles, i.e., those where the main text was incongruent with the inquiry into the Industry 4.0 impact on sustainability were subtracted from the sample and analysis, which resulted in a final sample of 173 articles published across 77 journals.

Among the leading scientific journals that have published research with I4.0 and sustainability/sustainable development in the last 10 years (the first article was published in 2010), are Journal of Cleaner Production, International Journal of Production Research, Journal of Manufacturing Technology Management, Sustainability, Process Safety and Environmental Protection, Computers Industrial Engineering, Production Planning Control, International Journal of Production Economics, Technological Forecasting and Social Change, and Journal of Business Research. Most of the papers came from the WOS categories of the environmental sciences (35), green sustainable science technology (31), and environmental studies (24). These categories are followed by the engineering industrial (22), engineering manufacturing (15), engineering environmental (12), operations research management science (11), management (9), computer science interdisciplinary application (8), and energy fuels (6).

The newspapers and magazine articles were taken from the ProQuest recent newspapers database and global news stream. These two databases are considered to deliver complete news coverage. The ProQuest recent newspapers include 50+ current edition digitized newspapers, and global news

stream contains indexed and entirely stored articles from more than 2500 national, regional, national, and international English newspapers [52]. The option to eliminate duplicate news has been added to the search. When saving, essential information about the source of the article (issue date, the title of the newspaper) was automatically captured. The search returned 110 articles from magazines and newspapers in the English language. All articles were published between 1 January 2015 and 16 June 2020. Among the leading newspapers and magazines selected were The Times, The Wall Street Journal, The New York Times, The Financial Times, The Economist, Reuters, and The Guardian.

3.2. Data Analysis

The text mining approach was used in the research, with the aid of ACA [53]. The data analysis was completed using the very proficient natural language processing tool Leximancer 5.0.

Unlike previously rudimentary ACA tools that merely count frequency, Leximancer analyzes the meanings in text extracts utilizing its algorithms, which firstly extrapolate the critical concepts. The resulting concepts are used to conduct qualitative analyses; it additionally uses the quantitative method with new sets of algorithms for the phrases [54].

As a high-level natural language processing software, Leximancer starts with no pre-conceptions about the data that is inputted. Therefore, the analysis is data-driven, reducing inherent bias as the analysis emerges from the data itself. The process is underpinned by Bayesian theory; without the need for human intervention in the analysis of the data, the iterative approach is entirely unsupervised [37]. As such, "fragmented pieces of evidence" in documents "can be used to predict what is happening in a system" [55]. Leximancer shows its results through the usage of heat maps for relevant themes. Themes are color-coded for convenience, where the most important themes are conveniently shown in hot colors, and the warmer colors denote less critical themes [56]. Through the Leximancer visualizer output, concepts that are nearby to each other on the heat map have a significant semantic relationship [37,57].

The analysis was carried out in four steps. The first step involved the selection of the document, the second step involved the generation of concept seeds, the third step involved the creation of a thesaurus, and the fourth step enabled the generation of the results. It should be noted that the parameters can be changed based on the needs of the research. In detailed research, all the words that were not meant for the content of the research were excluded. Leximancer already contains a stop word list for individual words (e.g., a, an, me, you, via). The remaining words were manually removed from further analysis (e.g., "paper", "article", "study", "research", "methodology", "author information", "acknowledgement", and "references in journal articles").

In comparing the text with Leximancer, two fundamental crossroads were faced. Both types of data were not similar in many ways. The first crossroad faced was the issue of a comparative equivalence [16], which is significant, as peer-reviewed academic journal articles, as well as newspapers, have a niche readership in mind (i.e., the general public vs. academics). To this end, the concepts generated by Leximancer are context-dependent with variations in their definitions and scopes from both sources (one often employs figurative language, while the other tends to be more literal). To ensure that the analysis shows consistency across the two different types of literature, the authors examined each concept and manually linked it to the original text to understand its context. Concepts were reworded where needed. The second issue is the different sizes of the samples [58].

Differences in sample size can affect the final comparison of the data. When one does an ACA, concepts are systematically chosen to characterize the entire dataset, therefore it is not unfounded that a source (journal article) that is lengthier will contribute more data than a shorter one (newspaper article). Similarly, when the Leximancer thesaurus algorithm discovers a reoccurring concept, primarily if that concept occurs in multiple sources, the concept will be contributed to mainly in part by the more comprehensive source, thus conflating the importance of specific concepts based on a small sample of large sources, making comparison difficult. There are two solutions to this problem. The first is to create a unique and separate project file for each data source and compare the results, as ACA tools (Leximancer) will avoid mixing two different mental models. The second solution is to increase the

number of automatically discovered concepts, which would create a large net that feeds the software with a large enough set of concepts that would reduce the bias towards lengthy journal articles. The results are discussed in the following section [54].

In the next subchapter, the research results are presented.

4. Results

4.1. The Thematic Concerns in the Scientific Journal's Articles

Leximancer generated a total of 20 concepts and five themes from the titles, abstracts, and keywords of 173 articles published in 77 journals. The authors used the slider % visible concepts to 100% and changed the number of concepts visible on the map from 50% (automatically) to 100%. The theme size was moved from 33% (automatic) to 61%. A theme is defined as a group or cluster of concepts that are correlated based on certain commonalities or connections. The commonality is gleaned from the proximity of concepts (represented by colored circles) on the concept map. The names of the themes are taken from the concept that is the most prominent in the group of interrelated concepts [17]. Table 1 presents the themes, hits, and related concepts.

Table 1. Themes and concepts in the journals in the years from 2010 to June 2020.

Theme	Hits	Concepts
Sustainability	435	sustainability, industry, manufacturing, management, supply, data, industrial, waste
Technologies	252	technologies, energy, systems, efficiency
Model	239	model, process, production, business, development
Environmental	114	environmental, performance, economic
Emissions	38	emissions, carbon, consumption

Source: Authors' work.

Figure 2 represents the diagram generated by the software, visualizing the concepts of interrelated terms. Themes on a Leximancer concept map are visualized using the heat map concept. Therefore, like on a heat map, fiery colors (red, orange) denote the most important themes, while cool colors (blue, green) denote those less critical [54]. The four most important themes generated are "sustainability", "technologies", "model", and "environmental".

Figure 2 shows that the circles of specific themes overlapping with the circles of other themes, thus forming cross-sections that contain individual concepts, which thus fall into both overlapping themes. For example, there is an overlap among »sustainability« other themes »environmental«, »model«, and »technologies«, whilst »technologies« overlap with »emissions«, »model«, and »sustainability«. The »environmental« theme overlaps with »sustainability« and »model«. There is an overlap among the themes »model«, »environmental«, »sustainability«, and »technologies«. The theme »emissions« overlaps with the themes »technologies« and »model«. Additionally, Figure 2 shows that the concepts »waste«, »production«, »process«, and »efficiency« can be found in two themes, with an intersection of the themes »sustainability« and »model«. The concepts »social« and »performance« lies between the intersection of the themes »environmental« and »sustainability«. The concept "potential" lies between the intersection of the theme's "development" and "services". The concepts »manufacturing«, »internet of things«, »industrial«, and »digital« lie between the intersection of the themes »sustainability« and »technologies«. The concept »consumption« lies between the intersection of the themes »technologies« and »emissions« and the concepts »business«, »demand«, »efficiency«, »process«, »waste«, and »development« lie between the intersection of the themes »technologies« and »model«.

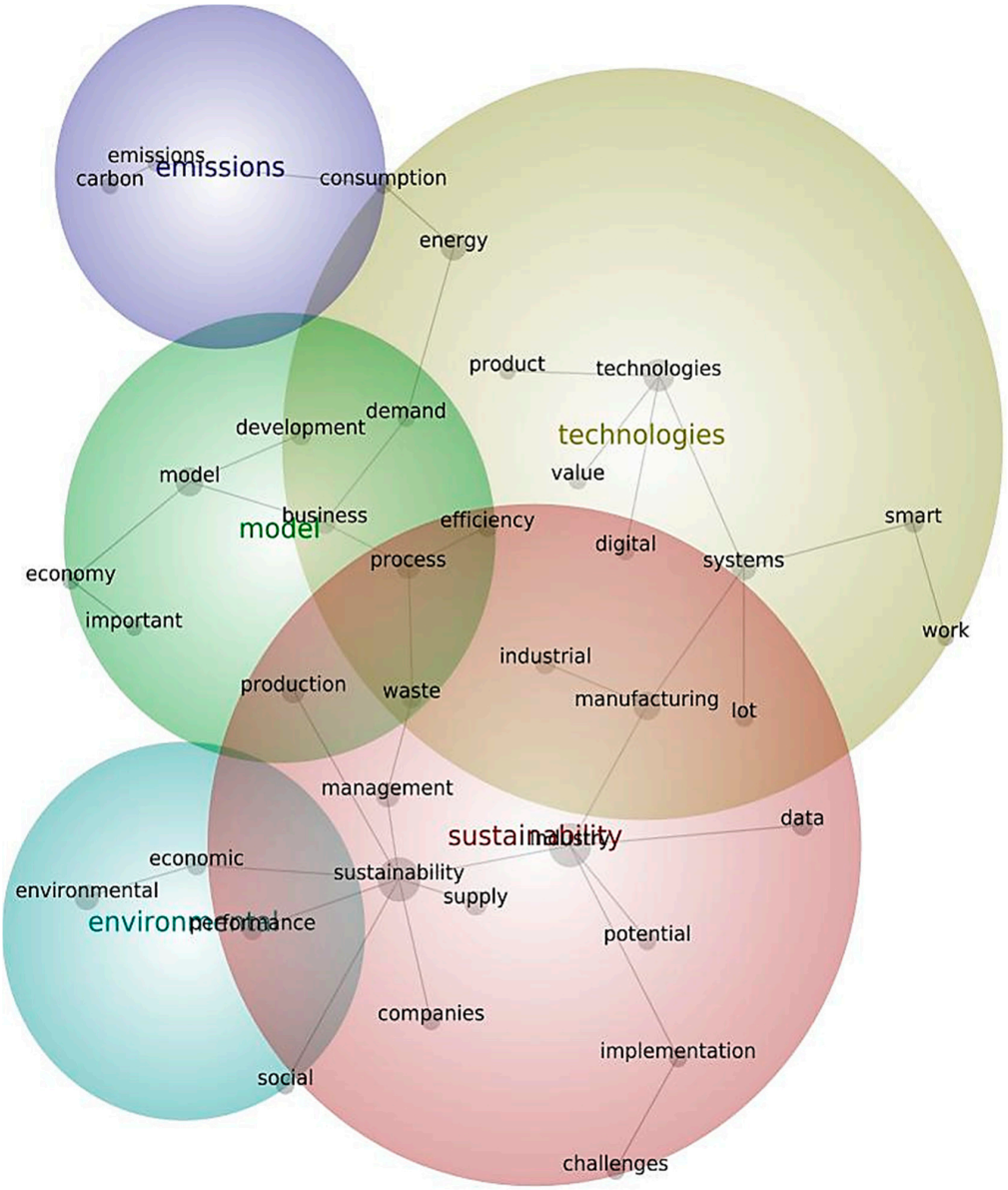

Figure 2. Concept map of the chosen scientific journal papers published between 2010 and June 2020 Source: Authors' work.

4.2. The Thematic Concerns in the Newspapers and Magazines Articles

The authors used the slider % visible concepts to 100% and changed the number of concepts visible on the map from 50% (automatically) to 100%. The theme size was moved from 33% (automatic) to 53%. A theme is defined as a group or cluster of concepts that are correlated based on certain commonalities or connections. The commonality is gleaned from the proximity of concepts (represented by colored circles) on the concept map. The names of the themes are taken from the concept that is the most prominent in the group of interrelated concepts for each theme. The number of hits found in the excerpts was calculated based on the frequency of occurrence and the correlation to the concepts [17]. Table 2 presents the themes, hits, and related concepts.

Figure 3 represents a detailed view of the concept map. The four themes with the most significant number of hits have »sustainability«, »energy«, »businesses«, and »companies«.

Figure 3 shows that the circles of specific themes overlapping with the circles of other themes. For example, there is an overlap among the generated theme »sustainability«, »energy«, and »businesses«. There is also a thematic overlap among »businesses«, »sustainability«, and »energy«. The theme

»energy« overlaps with the themes »sustainability«, »businesses«, »companies«, »oil«, and »world«. The theme »companies« overlaps with the theme »energy«. The theme »world« overlaps with the themes »energy« and »oil« and the theme »oil« overlaps with the themes »world« and »energy«. It can also be seen in Figure 3 that the concept »data« intersects with »sustainability« and »business«, whilst »industry« can be found between the thematic of » business« and »energy«. The concept of »policy« is situated between the intersection of the themes »world« and »energy«. The concept »carbon« lies between the intersection of the themes »oil« and »energy«, and the concept »supply« lies between the intersection of the themes »companies« and »energy«.

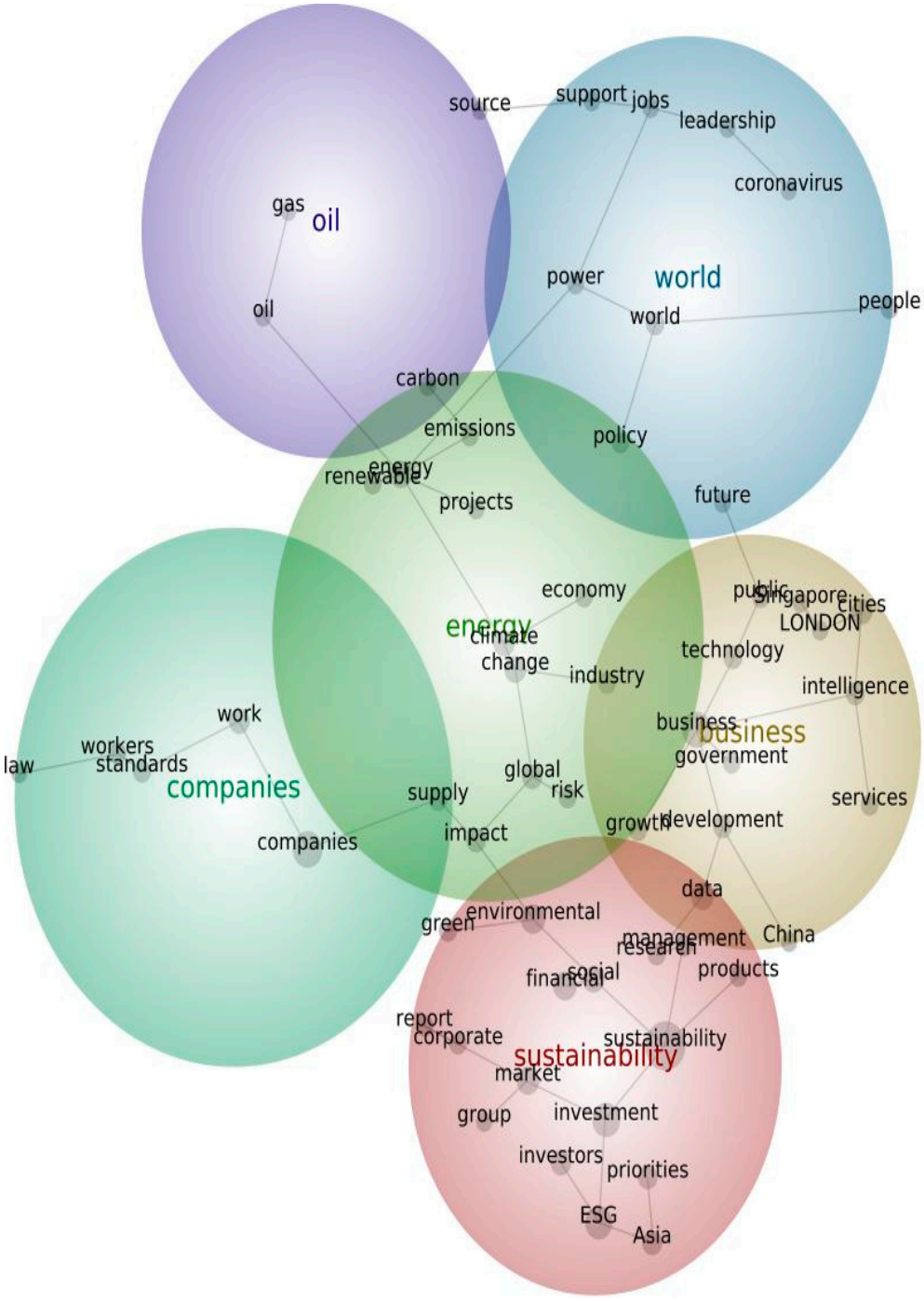

Figure 3. Concept map of the chosen newspapers and journals articles published between 2015 and June 2020.

Table 2. Themes and concepts in the journals in the years from 2015 to June 2020.

Theme	Hits	Concepts
Sustainability	1825	sustainability, investment, ESG, environmental, financial, market, social, investors, Asia, priorities, green, research, management, report, corporate, products
Energy	1098	energy, change, climate, global, impact, supply, industry, renewable, risk, economy, emissions
Business	991	business, data, cities, technology, development, intelligence, government, growth, services
Companies	681	companies, work, standards, workers
World	394	world, people, power
Oil	98	oil

Source: Authors' work.

5. Discussion

5.1. Research Theme through the Research Source Characteristics

In the first part of this chapter, papers from the scientific journals are analyzed, followed by papers from the newspapers and journals are analyzed.

5.2. Research Theme from Scientific Journals Articles

Based on the primary concepts that can be derived from the analysis of scientific journal articles, it can be concluded that the five themes (see Figure 2), regarding the treatment of I4.0 and sustainability with a focus on technology, clean production, and the environment are: Sustainability, technologies, model, environmental, and emissions.

The manufacturing sector (theme sustainability and technology) is undergoing fundamental transformations [59] focusing on reducing greenhouse gas emissions and waste generation by implementing the low-carbon and recycling technologies in order to enhance sustainability [60]. I4.0 affects the sustainability aspect of manufacturing, but not only the ecological aspect (i.e., renewable energy, resource efficiency), but also technical, social, and organizational aspect of sustainability [61]. The central paradigm within the technical aspect of I4.0 is the Internet of Things, which is evolving together with the Internet of Space on the Internet of Everything. Internet of Things plays a crucial role in connecting a variety of everyday objects to the Internet. Internet of Things applications have become indispensable in the areas of communication, service provision, information, and process management. IoT applications play a pivotal role in the development of smart cities, more proper healthcare, efficiency in agriculture, as well as industry and production. For example, the implementation of information and technology systems in agriculture through the intensive use of data can improve agricultural productivity [62]. Informatization in I4.0 creates effective monitoring and control of the material world utilizing information technology. The unbridled growth and development in the devices that are connected in the IoT applications, as well as the heterogeneity of and lack of uniformity of network technologies, raise concerns about the sustainability of Internet of Things. Solutions are sought by introducing a decentralized Internet of Things platform, and controlling the Internet of Things environment during implementation, monitoring the quality of the system, and making efficient use of available resources. Therefore, solutions must be tendered to ensure the Internet of Things, as well as the Industrial Internet of things and all its applications, will have longevity [63].

The basis of the development paradigms of I4.0 is the digitalization, informatization, and connection of industrial and other social processes. The development and establishment of data analysis, machine learning, and artificial intelligence, as well as business operations, is crucial for the implementation of the processes, which will also affect the emergence of the potential of all

three dimensions of sustainability (Triple Bottom Line concept of sustainability). I4.0 enables the Triple Bottom Line by improving productivity and product quality [64]. The technological transformation enables the emergence of the cyber-physical principles, which arose as a result of the informatization processes of transformation in manufacturing, logistics, and supply chain [65]. In recent years, manufacturing and research in this field are oriented towards digitalization, informatization, data analysis [66,67], and the exposure of the digital twins [68], which can help to identify real-time events and predict future events.

Manufacturing companies are also faced with the need to reorganize their supply chains in line with United Nations Sustainability Goals and market situation (e.g., in doing so, they are following various practices such as lean, green, circular, and I4.0, which lead in finding value chain partners that meet both sustainability criteria and the required technological know-how [69]. Regarding manufacturing (economic aspect) that is continuously monitoring energy consumption, environmentally sound manufacturing (e.g., implementing technologies that enable cleaner production, use of renewable energy, and reduction of pollution from changing polluting raw materials with alternative environmentally friendly materials (ecological) [70,71] leads to a safer working environment, less intensive workload, job enrichment, and social equality (social) [72]. It can be concluded that due to sustainable production, I4.0 is proven to be beneficial for societal development [59]. For example, I4.0 can improve social welfare with corporate sustainability activities [73]. The organizational aspect of sustainability starts with the organizational culture comprising sustainability vision, mission, and values [74]. It is also important that business strategies are sustainable [75] and that the main drivers of I4.0 can generate high triple bottom line profits (environmental-economic-social) in emerging markets as it is becoming a significant factor in emerging markets because they still use unsustainable approaches: Child labor, exploitation of workers, use of fossil fuels, and inadequate environmental legislation allowing the use of obsolete, ecologically questionable technologies and raw materials [76].

For these reasons, I4.0 is reshaping business models and production processes of the organizations fundamentally [77] (theme model). The traditional business model in the manufacturing sector is changing. Production processes are oriented toward energy optimization, reuse, and recycling of wasted materials [78]. Adopting a novel approach to business modelling is, therefore, mainly focused on business process automation (adaption of I4.0) and principles of circular economy [79]. Digital and connected manufacturing technologies are the main enabling factors for new business models.

Moreover, I4.0 requires that the business models of other organizations within the ecosystem are in equilibrium [80]. Digital platforms are an essential business model within I4.0 platforms, and they are emerging in different sectors, including retail, education, healthcare, transport, aggrotech, fintech, and real estate. These platforms are characterized by the fact that they change the labor market with the emergence of non-standard forms of work, from platform work to freelance work. Platform work is characterized by mass work, which can also be offered from home. The emergence of digital platforms for working from home becomes particularly crucial during the outbreak of COVID-19 when quarantine forced many people to stay at home. This period showed how important digital platforms are for global achievements (e.g., work, study, health, businesses) and how they can be used better and sustainably [81].

For a company, business models represent a form of timely reaction to market requirements. The markets are changing fast, and companies are managed and organized, and their supply chains are also changing. Markets are becoming more dynamic with the new digital technologies, as evidenced by the fact that the average lifetime of a company listed in the S & P 500 has fallen from 60 to 18 years. Companies can thus establish themselves in a short time [82]. Business models are also being adapted concerning the way production processes and supply chain organization are designed. For example, the digitalization of production processes, together with the connection of smart devices and systems, enables real-time control and enables fast, decentralized decision-making [83]. The advantages of virtual and augmented reality technologies are increasingly used to optimize production processes. Simulations aim to prevent the occurrence of bottlenecks in advance and to save

time. Shorter production lines are also to be achieved through additive production [84]. Sustainable business models promote transparency and change consumer behavior by involving consumers more closely in the creation of new products and services. I4.0 thus encouraged a shift from mass production to personal (individual) centralized manufacturing. The manufacturing transformation encourages factories to use digital and information technologies (mass data, cyberspace, artificial intelligence) and to adapt their methods of advertising, delivery and customer service, product design, manufacturing, or testing [82].

Economic performance, such as production efficiency and labor productivity, tends to be the immediate outcome of I4.0, which will transform future manufacturing and business models for sustainability [15] (theme environmental). The transformation will change the dominant linear economic model into economic sustainability. One example is the utilization of renewable sources of energy as well as existing underutilized sources of energy (e.g., geothermal energy), which in the long run will invariably be instrumental in development. The possibility is endless, as local economies and the value they generate can also benefit (fiscal returns, cost reduction, increase in purchasing power, job creation, increased tax revenues); other benefits also include social, ecological, and ethical aspects, all as a result of an increase in revenue retention in the region [85]. The mining industry represents the second case where the introduction of sustainable environmental criteria has a notable impact on the economy, environment, water pollution, as well as the varying social issues found within the mining environment. For these reasons, it is essential for the global mining industry in terms of how it will deal with sustainability. Ranängen and Lindman [86] for example, based on research in the Nordic mining industry, recommend that it should follow sustainable guidelines in the areas of "corporate governance, fair business practices, economic aspects, human rights, labor practices, society and the environment."

The manufacturing sector is a high polluter of greenhouse gases, mainly carbon emissions (theme emissions), which affect global environmental sustainability and contributes to extreme weather conditions and pollution [87]. In order to reduce air pollution, some countries implemented carbon tax levies (for this reason, organizations have the motive to implement the green technologies (e.g., energy-saving and low-carbon technologies) [88,89]. The pollution is only one of the reasons why it is vital to introduce new business models in industries like shoes, textiles, or metals. Notably, the labor shortage is rectified, as well as the need to control costs and reduce the deleterious effects that the product has on the environment, especially with carbon emissions. Though the list is more complex, these are essential factors in the shifting perspective of the footwear industry, which has led to the adaptation of better production models. Hence, the output leads to better quality and highly competitive products. At the same time, all manufacturing industries require higher costs for them to introduce carbon tax rates that all companies should aim to invest in low-carbon technologies [89]. In the field of corporate sustainability, raising the importance of sustainable reporting, which includes information on the environment, society, and governance (ESG), is becoming increasingly important in the financial markets. There is a risk that by reporting on sustainability, companies are planning a speculative effect on the value of their shares at the time of publication. The last challenge is a challenge for policymakers in formulating rules for ESG reporting. The aim of the shift in policy seeks to incentivize transparency as value-relevant; the findings have indirectly pointed in the same direction as the ESG. Thus, reporting is likely having the benefit of an improvement in market efficiency and strengthening of the growing confidence of the various stakeholders: Investors, companies, institutions, and practitioners in the materiality of ESG information [90].

5.3. Research Theme from Newspapers and Magazines Articles

After conducting an ACA of (see Figure 3) magazine and newspaper articles with the content on I4.0 and sustainability, focusing on technology, clean production, and the environment, it is possible to identify and explain the most critical and recent global socio-economic and technological trends.

Concern for the environment and people's demands for environmental protection (theme world) came to the fore with the development of socially responsible movements in the 1960s. Nevertheless,

the natural and urban environment is increasingly threatened by the effects of weather. In Singapore, for example, they face rising sea levels and rising tropical temperatures. The outbreak of the COVID-19 pandemic in 2020 confronted the city with an increase in waste of up to 40% of normal levels. At the time of the pandemic, people stayed at home, which led to an increase in the amount of waste, which consisted mainly of food packaging waste. However, the COVID-19 pandemic in 2020 became an indicator of the impact of human lifestyle and business activities on the environment. Declining economic activity and increased homeworking have led to falling carbon dioxide emissions. Analysts have made conservative estimates that there could be a 4% fall in carbon dioxide emissions in 2020 compared to 2019 owing mostly in part to the global pandemic. However, even if this reduction had remained constant each throughout the decade, we would still fall short of the 7.6% annual reduction that has been predicted to meet the 1.5-degree Celsius global warming target. Based on these results, we see that even repeated shutdowns of countries cannot slow down climate change. How can this be achieved through individual measures such as reduction, reuse, and recycling? The second problem, which is also evident in Singapore, is that their government is trying to develop sustainability-oriented environmental programs. At the same time, other Asian neighboring countries are not aware of the environmental problems because they have no regulated legislation in the field of environmental protection and even less suitable environmental projects supported by local governments [91].

Based on the theme of sustainability, it can be stated that the policy of investing in sustainable projects in the ESG sector represents an important measure of confidence of companies in sustainable projects, and investors in research and development capacities of companies and countries that promote sustainable investments [92]. Over the last decade, passive assets and responsible investment have stimulated the growth of passive sustainable funds. They have promoted active equity activities with passive fund providers not only in Europe and the United States (US), but this investment area is also gaining ground in Asian countries. In the period after 2015, the US even denies the importance of sustainable environmental protection and rejects United Nations Agenda 21. The US government administration did this because, in their opinion, it was prepared to weaken the economic interests of both companies and the state (e.g., Trump administration withdraws from the US Paris Climate Agreement, stops Obama's Clean Power Plan and the reopening of coal mines, reduces the importance of toxic air pollution regulations) [93].

The European Union (EU) is aware of the importance of developing a green investment. The EU is, therefore, encouraging the issuance of green bonds, which are playing an increasing role in financing the investments needed to make the low-carbon transition a success. However, due to internal disagreements between members on whether nuclear energy is a sustainable energy source, there are currently no standard European rules for green investment in the EU. These rules will define what is considered a sustainable investment. The rules will, therefore, cover all types of energy, including nuclear energy. Coal investments will be excluded from any sustainability definitions following the rules. The rules will make it possible to communicate how investors deal with assets such as green bonds, bank loans, and investment products. The rules will help to eliminate the so-called "greenwashing" that occurs when countries and companies want to show their environmental capabilities in a better light than they are. Once the rules are adopted, it is expected that more capital will be redirected to activities that are consistent with the Paris climate convention. The rules are expected to take effect in 2021 [94].

The upturn in ESG in Asia in recent years has been driven by increased regulatory pressure in the context of environmental protection targets (e.g., China). Analysts see another reason in the increasing investment by Japanese and Thai state pension funds in sustainable projects, as they have identified potential growth in ESG approach in the region. It was the state pension funds that also increased the interest of other investors in the region in ESG. National and multilateral development banks have also taken significant steps in the field of ESG by adopting new recommendations as policy. Regulation of the ESG has also been undertaken by capital market regulators (both government agencies and the stock exchange themselves) [95]. Over the past three years, both investors and companies in the region

have become aware of the importance and promotion of principles of responsible investment (PRI), as the significant problem with ESG is the often-subjective investment ratings. As a result, there have been frequent abuses in recent years in cases of nonsufficient corporate reporting on sustainable development. Investors point to the problem of lower quality and inadequate data, which makes it impossible to make well-considered investment decisions [96].

In Asia, despite the extremely fragmented regulatory environment, they perceive the importance of the ESG approach to promote values and ethical principles, but not the financial value or returns themselves. ESG, therefore, has led to the increase of ethical investment practices, which has provided a framework for sustainability that not only focuses on the damage to the planet as a whole, but passes on that responsibility to corporations as well. These practices have bolstered the influence of non-financial factors, such as social and environmental factors, on the stock market and the company's goodwill. It has become essential for ESG to influence risk-adjusted returns [97]. However, time will tell, based on an analysis of stock market indices and the value of company shares, whether the choice of ESG strategy has contributed to better business results. The companies have to ensure that their sustainable corporate reports include quality data about their exposure to climate change risks. In the field of sustainable corporative reporting, it is expected that initiatives such as the EU's taxonomy will provide a better definition of sustainability and thus help companies to ensure the right data for reporting. It is also expected that the Global Task Force on Climate-Related Financial Disclosures will control the corporate sustainability reporting, which will reduce investment risks and stabilize the ESG market in the future [98]. Awareness of the importance of sustainability and corporate social responsibility is also in line with customer expectations and attitudes. Research on consumer behavior shows that consumers do not reject products or services based on price and quality preferences. Modern consumers are increasingly aware of the importance of social and moral values, and the consequences of this awareness are visible in the extraordinary growth of the global market for organic and environmentally friendly products, which have well-known and socially responsible members of the supply chain [99,100]. Socially responsible companies work without plastic packaging and sell products without animal testing, without leather (except in the form of reuse), without genetically modified food, without palm oil and its environmentally deleterious reputation, the aim is to offer completely natural products for the health of their customers. Consumerism is, thus increasingly associated with people's social-ethical behavior and awareness [101].

Regarding themes of energy, oil, and companies, the following can be concluded. In 2019 and 2020, global investment companies, banks, and state pension funds (e.g., Credit Suisse, Deutsche Bank, the Dutch Fund) announced a reduction or even a withdrawal of investments from fossil fuel production (thermal coal mining, oil production from tar sands). Companies have become aware of the importance of sustainable financing and are shifting their investments to sustainable projects [74,75]. The use of renewable energies and clean energy is increasing, but the demand for oil and gas is expected to continue for decades to come. The change in the field of reducing the carbon intensity of energy is taking place as a result of pressure from investors, growing consumer awareness, and governments adopting stricter environmental legislation due to climate change. For example, California will ban the use of diesel trucks from 2045 [102].

Global markets are changing due to the emergence of new clean technologies, sustainable materials, work standards, and the awareness of customers and companies of the sustainability of production and consumption. Companies (from the food industry to the fashion industry) are preparing plans to reduce their carbon dioxide emissions, eliminate disposable plastics in packaging and sustainably sell more products (e.g., digital platforms) [103]. In the field of agriculture, too, increasing attention is being paid to sustainable principles. For example, farmers are moving from conventional to ecological practices, which involves reducing the excessive use of fertilizers and thus preventing nutrient depletion of the soil. They are investing more and more in technology and work processes, with the result that pesticides and fertilizers are being displaced from production processes. Drones with sensitive sensors and software are already being used in the agricultural sector, which can predict potential problems

due to the health of the soil or the plants themselves, vegetables, and vines. The results of using cleaner technologies and smarter equipment are healthier soils, healthier agricultural products, higher yields per hectare, and a significantly reduced ecological footprint [104].

It is predicted that the development of sustainable measures will have an impact on future commercial success. The sustainably conscious have set themselves the goal of becoming "carbon neutral" along the entire value chain (production, packaging, logistics). Companies are increasingly turning to the use of renewable energies and are switching their logistics to electric vehicles and drones for delivery. Carbon netting, which results from the integration of sustainability standards into business processes, thus enables the financing of emission reductions in other areas, such as the prevention of deforestation. Due to the growing demand for sustainable and ethically produced products and services, companies have begun to create brands that emphasize product relevance under international standards for social, environmental, and animal welfare practices [103,105].

The technological development in I4.0 requires oil companies to diversify their investments and reinvest in solar power generation in recent years (after a failed investment cycle at the beginning of the 21st century), buy companies to sell electricity to electric vehicles, take over power utilities, and even invest in projects such as floating wind farms [106]. However, it is also necessary to be aware of the consequences of the transformation in the field of abandoning internal combustion engines and replacing them with electric vehicles and probably also with hydrogen-powered vehicles and other options that are still being developed in the laboratories today. Leaders in the automotive industry face the challenge of building the car of the future. They are expected to act responsibly in the context of change, the consequences of which will be visible in the short term as the disappearance of traditional roles in the automotive industry and its supply chains. Supply chains could be reduced by 20 to 30%, which in turn would mean a loss of 20 to 30% of jobs. It is estimated that by the end of the I4.0 (around 2030), one-third of the workforce in the automotive industry will become redundant. In terms of production, this will be the most significant change in history. Companies will also need to redesign their supply chain management, procurement, and human resources management [107].

Chocolate manufacturers are one such example. They are aware that consumers are increasingly demanding products of ethical origin from chocolate products. They are therefore strengthening all their sustainability programs, which have so far had only a negligible impact on reducing child labor in cocoa production in West Africa. The company Nestle decided in 2019 to invest in the promotion of sustainable cocoa extraction in the supply chain in West Africa. The company will begin to reduce the number of underage children working in cocoa supply chains. Together with the International Cocoa Initiative, it aims to eliminate child labor in Côte d'Ivoire by 2025. In doing so, they expect government support to promote the training of farmers and other programs to address this problem [108]. Humankind has been used to these consequences of industrial transformation since the last three industrial revolutions. All three past industrial revolutions have made it possible to create more jobs than technological developments have eliminated. More significant growth was achieved, which led to a reduction in the poverty rate and enabled people to lead a better life. The question is, however, what will the industrial revolution bring to society, which will have or already has a strong influence on production, which today accounts for 70% of GDP on a global scale? Governments, together with companies, will probably have to find solutions for workers in sustainable social policy programs, whose training and experience will become irrelevant due to advanced technological developments [109]. In 2020, for example, Mercedes Benz announced the layoff of only 15,000 employees by 2022, which is due to the digital transformation of production and the attempt to adapt production processes to the production of electric cars. The entire automotive industry announced the layoff of 80,000 employees for a short period of three years (2020–2023). As we can see, the social and economic impact of the digital transformation will be decisive. In the entire value chain (not only in the automotive industry but also in other sectors), the middleman will become superfluous [107].

The introduction of sustainability into the traditional concept of business operations is based on a thematic approach (theme business). For example, sustainability is connected to climate change, diversity, and the awareness of corporate leaders that human rights must be respected (these are the rights of employees in global supply chains). In Europe and Asia (especially in China), both business schools and companies are increasingly aware of the importance of taking sustainability into account in business. Business schools so try to the introduce the new technologies and products that do not pollute the environment and use renewable energy and through sustainable business models (e.g., circular economy, green transformation, social entrepreneurship) that include business ethics. On the other hand, the US does not pursue sustainable concepts and does not invest in the training of professionals in this field [110]. The People's Republic of China, however, has addressed the problem of how to solve environmental problems resulting from rapid economic growth. With increasing investment in research and development, they want to become world leaders in the development of environmental technologies. China has overtaken the USA as a leader in the production of and exporter of technologies that are more environmentally friendly.

Additionally, China joins Europe and North America for the large share of patent applications in the space of environmentally conscious technology and lead all the above in the development of batteries, automobile production, and solar technologies [111]. The China Corporate Responsibility and Sustainability Council notes, however, that China is still confronted with social and economic constraints resulting from its rapid economic development. For example, a large number of people moved from the countryside to more than 10 million cities, which are now confronted with unregulated sewage, traffic problems, too high levels of pollution of the atmosphere and water resources, etc. China needs to address social and environmental issues sustainably. Otherwise, it will increase costs and damage the reputation and growth of companies in China [112].

The importance of digitizing the human environment and business became even more critical when the outbreak of COVID-19 showed that human life must be further digitized. The need to establish creative online content and online business services are increasingly coming to the fore. The most digitized cities are London, Paris, San Francisco, Los Angeles, and Singapore. Part of the answer of what is a smart city probably lies in the Internet of Things, which is part of the idea of smart technologies or even a link between them. Remote-controlled operations, technological innovations, and self-propelled cars are only a part of the whole story. Internet of Things provides more data that can help improve many aspects of our daily lives. They can even help create jobs. For example, according to Forbes, Barcelona has saved €75 million a year as well as created employment for 47,000 in technology development by taking strategic steps in the provision of high-speed Internet connections, smart lighting, smart irrigation, and parking management. In Amsterdam, the city uses the Internet of Things-based infrastructure to monitor traffic flow, energy consumption, and public safety using real-time data. In Boston and Baltimore, the development of smart garbage bins create efficiency by utilizing smart technology to indicate how full they are, which is relayed to the sanitary worker for more efficient collection route mapping [113].

The appearance of COVID-19 will have a lasting effect and have a notable impact on ensuring that sustainable cities and smart cities are not mutually exclusive. The concept of a smart city is a model of developing a sustainable city. When we talk about the emergence of the sustainable cities, their development may take longer if it is based on the use of traditional planning tools, without the necessary high-tech solutions that are part of the smart city. A smart city (e.g., green Vienna or Lisbon projects) has become more sustainable (e.g., sensors controls the energy and water consumption and provide better living conditions (more green areas), which it achieves by implementing high-tech solutions in the urban fabric. The emergence of COVID-19 is changing public transport in the cities, and in spring 2020, cities have launched projects to promote walking and cycling. With the increase in e-bikes, scooters, and transport, the focus has shifted to reach. Mayors around the world are already taking the opportunity to redesign lanes for pedestrians and cyclists. It is expected that the car-sharing model will expand in cities. The relationship between illness and density is also perceived as complex.

Some high-density cities, such as Seoul, Taiwan, and Singapore, have suppressed mainly the virus. In other lower-density cities, such in the Italian region Lombardy and U.S. country Louisiana, the virus has spread rapidly. London now has a much lower rate of infection than the north-east of Great Britain [114].

A study published in The Economist [115] shows that on a global level, residents not only want to be informed about the course of these processes but also want to participate in the formulation of urban development policies. At the global level, companies involved in these projects also expect cities to draw up long-term development plans. The main differences between the population's expectations of urban development occur at the micro-level. In cities such as Los Angeles, San Francisco, Dubai, and Zurich, residents need to develop a smart city initiative that supports the development of citizen participation processes in the preparation and adoption of the city budget. In London, Riyadh, Stockholm, and Sydney, residents expect more long-term planning. In less developed cities like Johannesburg and Mumbai, people want to create initiatives that promote the development of small businesses. In São Paulo and Singapore, residents want to ensure fairer access to smart services, while in Hong Kong São Paulo and Singapore, residents are most in favor of better protection of personal data.

5.4. The Comparison of the Analysis's Results

The analyses of both types of literature, both scientific and professional, show that there are common topics they write about, which are related to the field of clean production, emissions, renewable energy, climate change, sustainable investments and corporate sustainability. An urgent global issue that extends all over the world is the promotion of energy-saving technologies and reduction of carbon dioxide emissions [60].

We also looked for differences in the topics covered by the literature of different types. We found that the scientific literature focuses more on changes in business models, production processes, and technologies that enable sustainable development. Newspapers and magazines articles write more about sustainable or green investment, sustainable standards, and sustainable reporting. It is going for themes that are directly important for current sustainable business development and encouraging the research and development of cleaner and smarter technologies and processes.

The relevant and current theme nowadays is oriented towards COVID-19 and its impact on the economy and society. The newspapers and some latest research journals include articles of the COVID-19 outbreak and its effect on the economy and the environment. Indeed, the outbreak of the virus brings new thinking about the reorganization of the complex relationships between consumers, businesses, and the state [116]. The question is whether, in rescuing the economy, we will unreasonably seek to return to the old patterns as quickly as possible, or whether we will use the moment to reshape and restructure the national economy. It offers a unique opportunity to solve two crises at once, with prudent behavior and wise action [117]. The response to the health and economic crisis can be enhanced by tackling the environmental crisis, which can also disrupt the food chain [118]. The latter, however, first requires an ambitious restructuring plan that transitions from a linear to a circular economy. The ideas of green transformation are not entirely new at such times [119]. During the previous crisis, state aid for the car giants was made conditional on their moving to stricter emission standards. However, the current situation allows the implementation of much more ambitious plans compared to then, as the social climate is much more favorable today than it was in 2008 [120]. Companies will have to thoroughly rethink their existing business models, organizational structure, and the way they work during and after the crisis. Intertwined global supply chains, marketing approaches that respond to pre-crisis consumer habits, and mandatory physical presence in the workplace are just some of the critical factors already under discussion and the reason for the forthcoming transformation of the business environment. The coming year or two will bring many new insights into labor productivity as one of the critical factors in production. Management discussions will revolve around the possibilities and opportunities of the digital transformation of

companies. Internal policies will adapt to the new situation in the areas of business travel, contractual relations, and security. The wait for state aid will not solve several challenges, so companies must use this time to make a radical transformation. The latter requires a thorough reflection on the strategy of the company and its role in society as a whole, the business and profit model, and, last but not least, the role of employees in this process [121,122].

Finally, the role of the states themselves is, and remains, extremely important. They will bear a considerable part of the financial burden of the crisis, so timely planning and smart conditioning of measures are crucial. Rescuing companies cannot and should not be aimed at returning to a pre-crisis state. The latter is not only impossible because the world has changed considerably in a few months, but also pointless because we could miss one of the few opportunities for an extensive, green, circular transformation of the economy. State-sponsored financial instruments should, therefore, be based on the principles of green financing, grants should include a commitment to meet ambitious environmental standards, and measuring the success of a national rescue package should be based not only on traditional macroeconomic indicators, but also on broader social and environmental impacts [123]. Sustainable development and recycling must become more than just theoretical concepts, which means that they must be operationalized through sector-specific and fact-based measures. Countries can build on existing commitments and solutions; within the EU these include, for example, the efforts of European climate and energy policy or reporting and taxonomy standards for sustainable activities in the EU [124].

6. Conclusions

We conducted an ACA of scientific journals papers and newspaper and magazines papers with the content on I4.0 and sustainability, focusing on technology, clean production, and the environment. According to the comparison of the analyzed themes between both research, groups of papers were identified and explained the most critical and recent global socio-economic and technological trends.

The results revealed that there is some overlapping between the concepts that emerged from the newspaper and scientific journal papers, such as various aspects of sustainability. However, newspaper papers also investigated some concepts that are substantially different from scientific journal papers, and these are mostly related to business and corporate issues. The analyses research found out that common topics mentioned in the newspaper and scientific journal papers covered clean production, emissions, renewable energy, climate change, sustainable investments, and corporate sustainability. According to the content analyses, it can be concluded that an urgent global issue that extends all over the world is the promotion of energy-saving technologies and reduction of carbon dioxide emissions [60].

The results of the ACA of the scientific journals papers show that their thematic is focused more on changes in business models, production processes, and technologies that enable sustainable development. The themes of newspapers and magazines papers are more focused on sustainable or green investment, sustainable standards, and sustainable reporting. They are going for themes that are directly important for current sustainable business development and encouraging the research and development of cleaner and smarter technologies and processes.

Based on the ACA results, we find that the digital transformation in both manufacturing and the products themselves (e.g., electric cars) and the requirements to adapt the business to and operation of products following the United Nations Sustainability Goals lead to a reorganization of their supply chains, what has positive and negative consequences for society itself. The positive consequences are particularly important for developing countries, where strict environmental protection criteria are not enforced, and companies' sustainability standards are not met, leading to non-compliance with both occupational safety and child labor. The negative consequences are visible or will be visible in the reduction of jobs because the digital transformation will result in the middleman becoming redundant. Here, both scientists and governments are facing a solution to the consequences of the digitalization of companies, for which it will be necessary to find a social consensus, which will have to be supported

by concrete research both among companies and the public [125]. This research should focus on finding solutions to mitigate the effects of both digitization and the requirements of the United Nations Sustainability Goals, which include new sustainable policy programs that will offer various new forms of employment in the Universal Basic Income (UBI). Thus, in Germany in August 2020, they started a test phase under which 120 citizens will receive €1200 a month for three years [126]. It can be concluded that future researches should be focused on monitoring of the CSR and sustainable development impact on the economy. It will also be necessary to take into account the issues related to COVID-19, which has a significant impact on changes in the field of work organization, economics, and the operation of the company itself and citizen wellbeing, especially in cities that have to be transformed not only in smarter and more sustainable ways [127], but also safe from crime, natural disasters, pandemic, and other catastrophes [128,129]. The virus pandemic is leading to a faster digital transformation, and various digital platforms are increasingly being developed to enable work and education from home [130]. In the health industry, service digitalization becomes important for the monitoring of the patient from home, and it also enabled control and transparency of medical-epidemiological research and mental health service, which is especially important in pandemic time [131,132]. In the field of public administration, communication with the city administration is established, and their concerns are reported. Online citizens' participation in discussion about cities policies and budgeting is enabled. More and more administrative procedures can be done online, such as business registration, dog registration, information about historical certificates or registration, citizens id cards have been expanded, and e-voting is enabled [133,134]. We think that more research will be needed on adapting people to new conditions, such as working from home, as well as research on trust and security in digital business and the implementation of administrative procedures and e-democracy.

The next important question is how we will gain energy in the future? As we can see, opinions are very divided across countries, and practice shows that countries that have opted for predominantly green energy are having increasing problems with electricity shortages because they are no longer producing enough to shut down nuclear and fossil fuel power plants to meet the needs of both industry and households [135]. Research also shows that Germany's renewable energy project failed because the German CO2 Emissions is 10 times higher than nuclear-powered in France [136].

In September 2020, we witnessed the electricity crisis in Germany, which was forced to import energy from countries such as Poland, Bosnia and Herzegovina, the Czech Republic, and Slovenia [137]. The paradox is that such an "energy green country" cannot produce sufficient quantities of electricity with green technology and must import it from countries where it is produced in nuclear and thermal power plants. The insecure energy supply, which depends on domestic green electricity, is threatened for the national economy [135,138,139]. In the field of energy, research is emerging on the applicability of new modular nuclear power plants and the very meaning of dependence on only the so-called green energy produced by solar power plants, windmills, etc.

Finally, let us mention a relatively new concept: Sustainable business finance. Within companies, sustainable reporting is becoming more critical. Companies must therefore add information on the environment, society, and governance (ESG) to their business reports. ESG information shows a picture of the company and is therefore becoming increasingly important for financial markets. Investors have become aware of the importance of sustainable development, which is increasingly gaining its place in the laws of individual countries, and among end customers, who are increasingly in demand for sustainable products and services [140,141]. In this field, it will be necessary to research sustainable reporting and, based on the analysis of company reports, to determine how this reporting changes over time and what information it contains. On the other hand, it will be necessary to analyze the responses of financial markets to insufficient sustainable reporting and the consequences for these companies.

The research paper limitation is based on the procedures of article selection, analytical methodology, and the purpose of the analyzed results. Thus, we acknowledge that the articles analyzed in the given selected period from a specific database possibly do not contain all scientific research and professional views on the selected research content, especially when only English-language articles were processed.

The main idea, however, is that the present analysis gives us an insight into the critical issues of Industry 4.0 and sustainable development. The limitations above represent the challenge that future researchers would need to overcome.

Author Contributions: The authors V.R., O.T., M.P.B., A.J., and M.M. contributed equally. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

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

References

1. United Nations. Transforming Our World: The 2030 Agenda for Sustainable Development. United Nations 2015. Available online: https://sustainabledevelopment.un.org/post2015/transformingourworld (accessed on 22 September 2020).
2. Ejsmont, K.; Gladysz, B.; Kluczek, A. Impact of Industry 4.0 on Sustainability—Bibliometric Literature Review. *Sustainability* **2020**, *12*, 5650. [CrossRef]
3. Piccarozzi, M.; Aquilani, B.; Gatti, C. Industry 4.0 in Management Studies: A Systematic Literature Review. *Sustainability* **2018**, *10*, 3821. [CrossRef]
4. Jerman, A.; Bach, M.P.; Bertoncelj, A. A Bibliometric and Topic Analysis on Future Competences at Smart Factories. *Machines* **2018**, *6*, 41. [CrossRef]
5. Jerman, A.; Erenda, I.; Bertoncelj, A. The Influence of Critical Factors on Business Model at a Smart Factory: A Case Study. *Bus. Syst. Res. J.* **2019**, *10*, 42–52. [CrossRef]
6. Birkel, H.S.; Veile, J.W.; Müller, J.M.; Hartmann, E.; Voigt, K.-I. Development of a Risk Framework for Industry 4.0 in the Context of Sustainability for Established Manufacturers. *Sustainability* **2019**, *11*, 384. [CrossRef]
7. Müller, J.M.; Däschle, S. Business Model Innovation of Industry 4.0 Solution Providers towards Customer Process Innovation. *Processes* **2018**, *6*, 260. [CrossRef]
8. Oztemel, E.; Gursev, S. Literature review of Industry 4.0 and related technologies. *J. Intell. Manuf.* **2018**, *31*, 127–182. [CrossRef]
9. Van Dijk, T.A. *News Analysis*; Routledge: Hillsdale, NJ, USA, 2013.
10. Reah, D. *The Language of Newspapers*; Routledge: London, UK, 1998.
11. Lööw, J.; Abrahamsson, L.; Johansson, J. Mining 4.0—The Impact of New Technology from a Work Place Perspective. *Min. Met. Explor.* **2019**, *36*, 701–707. [CrossRef]
12. Xu, S.; Stienmetz, J.; Ashton, M. How will service robots redefine leadership in hotel management? A Delphi approach. *Int. J. Contemp. Hosp. Manag.* **2020**, *32*, 2217–2237. [CrossRef]
13. Baldwin, R. *The Globotics Upheaval: Globalization, Robotics, and the Future of Work*; Oxford University Press: Oxford, UK, 2019.
14. Nuvolari, A. Understanding successive industrial revolutions: A "development block" approach. *Environ. Innov. Soc. Transit.* **2019**, *32*, 33–44. [CrossRef]
15. Ghobakhloo, M. Industry 4.0, digitization, and opportunities for sustainability. *J. Clean. Prod.* **2020**, *252*, 119869. [CrossRef]
16. Cheng, M.; Edwards, D. A comparative automated content analysis approach on the review of the sharing economy discourse in tourism and hospitality. *Curr. Issues Tour.* **2017**, *22*, 35–49. [CrossRef]
17. Pucihar, A. The digital transformation journey: Content analysis of Electronic Markets articles and Bled eConference proceedings from 2012 to 2019. *Electron. Mark.* **2020**, *30*, 29–37. [CrossRef]
18. Pool, I.D.S.; Berelson, B. Content Analysis in Communication Research. *Am. Sociol. Rev.* **1952**, *17*, 515. [CrossRef]
19. Berelson, B.R. Content analysis. In *Handbook of Social Psychology*; Lindsey, G., Ed.; Addison-Welsley: Reading, MA, USA, 1954; pp. 488–522.
20. Kracauer, S. The Challenge of Qualitative Content Analysis. *Public Opin. Q.* **1952**, *16*, 631. [CrossRef]
21. Schreier, M. *Qualitative Content Analysis in Practice*; Sage: London, UK, 2012.
22. Parker, E.B.; Holsti, O.R. Content Analysis for the Social Sciences and Humanities. *Am. Soc. Rev.* **1970**, *35*, 356. [CrossRef]

23. George, A.L. Quantitative and qualitative approaches to content analysis. In *Trends in Content Analysis*; Pool, I.D.S., Ed.; University of Illinois Press: Urbana, IL, USA, 1959; pp. 7–32.
24. Mayring, P. Qualitative content analysis. *Qual. Soc. Res.* **2000**, *1*, 12–19.
25. Kohlbachter, F. The use of qualitative content analysis in case study research. *Qual. Soc. Res.* **2005**, *7*, 1–23.
26. Krippendorff, K. Measuring the Reliability of Qualitative Text Analysis Data. *Qual. Quant.* **2004**, *38*, 787–800. [CrossRef]
27. Hsieh, H.-F.; Shannon, S.E. Three Approaches to Qualitative Content Analysis. *Qual. Health Res.* **2005**, *15*, 1277–1288. [CrossRef]
28. Nunez-Mir, G.C.; Iannone, B.V.; Pijanowski, B.C.; Kong, N.; Fei, S. Automated content analysis: Addressing the big literature challenge in ecology and evolution. *Methods Ecol. Evol.* **2016**, *7*, 1262–1272. [CrossRef]
29. Shapiro, G.; Markoff, J. A Matter of Definition. *Text Anal. Soc. Sci.* **2020**, *1*, 9–32. [CrossRef]
30. Mehl, M.R.; Gill, J.A. Computerized content analysis. In *Advanced Methods for Behavioral Research on the Internet*; Gosling, S., Johnson, J., Eds.; American Psychological Association Publications: Washington, DC, USA, 2010; pp. 34–59.
31. Blei, D.M. Topic modeling and digital humanities. *J. Dig. Hum.* **2012**, *2*, 8–11.
32. Usai, A.; Pironti, M.; Mital, M.; Mejri, C.A. Knowledge discovery out of text data: A systematic review via text mining. *J. Knowl. Manag.* **2018**, *22*, 1471–1488. [CrossRef]
33. McNamara, D.S.; Graesser, A.; McCarthy, P.M.; Cai, Z. *Automated Evaluation of Text and Discourse with Coh-Metrix*; Cambridge University Press: New York, NY, USA, 2014.
34. Blaschke, T. Object based image analysis for remote sensing. *ISPRS J. Photogramm. Remote. Sens.* **2010**, *65*, 2–16. [CrossRef]
35. Shelley, M.; Krippendorff, K. Content Analysis: An Introduction to its Methodology. *J. Am. Stat. Assoc.* **1984**, *79*, 240. [CrossRef]
36. Vaismoradi, M.; Turunen, H.; Bondas, T. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nurs. Health Sci.* **2013**, *15*, 398–405. [CrossRef]
37. Smith, A.E.; Humphreys, M.S. Evaluation of unsupervised semantic mapping of natural language with Leximancer concept mapping. *Behav. Res. Methods* **2006**, *38*, 262–279. [CrossRef]
38. Amini, M.; Bienstock, C.C.; Narcum, J.A. Status of corporate sustainability: A content analysis of Fortune 500 companies. *Bus. Strat. Environ.* **2018**, *27*, 1450–1461. [CrossRef]
39. Kim, D.; Kim, S. Sustainable Supply Chain Based on News Articles and Sustainability Reports: Text Mining with Leximancer and DICTION. *Sustainability* **2017**, *9*, 1008. [CrossRef]
40. Lock, I.; Araujo, T. Visualizing the triple bottom line: A large-scale automated visual content analysis of European corporations' website and social media images. *Corp. Soc. Responsib. Environ. Manag.* **2020**. [CrossRef]
41. Paolone, F.; Sardi, A.; Sorano, E.; Ferraris, A. Integrated processing of sustainability accounting reports: A multi-utility company case study. *Meditari Account. Res.* **2020**. [CrossRef]
42. Roblek, V.; Meško, M.; Pejic-Bach, M.; Thorpe, O.; Šprajc, P. The Interaction between Internet, Sustainable Development, and Emergence of Society 5.0. *Data* **2020**, *5*, 80. [CrossRef]
43. Sullivan, K.; Thomas, S.; Rosano, M. Using industrial ecology and strategic management concepts to pursue the Sustainable Development Goals. *J. Clean. Prod.* **2018**, *174*, 237–246. [CrossRef]
44. Keller, T.R.; Hase, V.; Thaker, J.; Mahl, D.; Schäfer, M.S. News Media Coverage of Climate Change in India 1997–2016: Using automated content analysis to assess themes and topics. *Environ. Commun.* **2020**, *14*, 219–235. [CrossRef]
45. Bednarek, M. *Evaluation in Media Discourse: Analysis of a Newspaper Corpus*; Continuum: London, UK, 2006.
46. McCombs, B.L. The Learner-Centered Model: Implications for Research Approaches. In *Interdisciplinary Handbook of the Person-Centered Approach*; Springer Science and Business Media LLC: New York, NY, USA, 2013; pp. 335–352.
47. Schmidt, A.; Ivanova, A.; Schäfer, M.S. Media attention for climate change around the world: A comparative analysis of newspaper coverage in 27 countries. *Glob. Environ. Chang.* **2013**, *23*, 1233–1248. [CrossRef]
48. Schweinsberg, S.; Darcy, S.; Cheng, M. The agenda setting power of news media in framing the future role of tourism in protected areas. *Tour. Manag.* **2017**, *62*, 241–252. [CrossRef]
49. Thetela, P. Evaluated entities and parameters of value in academic research articles. *Engl. Specif. Purp.* **1997**, *16*, 101–118. [CrossRef]

50. Evangelista, P.; Santoro, L.; Thomas, A. A Systematic literature review from 2000–2016. *Sustainability* **2018**, *10*, 1627. [CrossRef]
51. Moher, D.; Liberati, A.; Tetzlaff, J.; Altman, D.G.; Prisma Group. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Med.* **2009**, *6*, e1000097. [CrossRef]
52. Proquest. News & Newspapers. Available online: https://about.proquest.com/libraries/academic/news-newspapers/?page=2 (accessed on 18 August 2020).
53. Bach, M.P.; Krstić, Ž.; Seljan, S.; Turulja, L. Text Mining for Big Data Analysis in Financial Sector: A Literature Review. *Sustainability* **2019**, *11*, 1277. [CrossRef]
54. Leximancer. Leximancer User Guide. 2020. Available online: https://info.leximancer.com/ (accessed on 2 May 2020).
55. Watson, M.; Smith, A.; Watter, S. Leximancer Concept Mapping of Patient Case Studies. In *Lecture Notes in Computer Science*; Springer Science and Business Media LLC: Berlin, Germany, 2005; pp. 1232–1238.
56. Angus, D.; Rintel, S.; Wiles, J. Making sense of big text: A visual-first approach for analysing text data using Leximancer and Discursis. *Int. J. Soc. Res. Methodol.* **2013**, *16*, 261–267. [CrossRef]
57. Campbell, C.; Pitt, L.F.; Parent, M.; Berthon, P.R. Understanding Consumer Conversations around Ads in a Web 2.0 World. *J. Advert.* **2011**, *40*, 87–102. [CrossRef]
58. Esser, F.; Hanitzsch, T. (Eds.) *The Handbook of Comparative Communication Research*; Routledge: Abingdon, UK, 2013.
59. Beier, G.; Niehoff, S.; Ziems, T.; Xue, B. Sustainability aspects of a digitalized industry – A comparative study from China and Germany. *Int. J. Precis. Eng. Manuf. Technol.* **2017**, *4*, 227–234. [CrossRef]
60. Fujii, M.; Fujita, T.; Dong, L.; Lu, C.; Geng, Y.; Behera, S.K.; Park, H.S.; Chiu, A.S. Possibility of developing low-carbon industries through urban symbiosis in Asian cities. *J. Clean. Prod.* **2016**, *114*, 376–386. [CrossRef]
61. Beier, G.; Ullrich, A.; Niehoff, S.; Reißig, M.; Habich, M. Industry 4.0: How it is defined from a sociotechnical perspective and how much sustainability it includes—A literature review. *J. Clean. Prod.* **2020**, *259*, 120856. [CrossRef]
62. Lytos, A.; Lagkas, T.; Sarigiannidis, P.G.; Zervakis, M.; Livanos, G. Towards smart farming: Systems, frameworks and exploitation of multiple sources. *Comput. Netw.* **2020**, *172*, 107147. [CrossRef]
63. Mocnej, J.; Pekar, A.; Seah, W.K.; Papcun, P.; Kajati, E.; Cupkova, D.; Koziorek, J.; Zolotova, I. Quality-enabled decentralized IoT architecture with efficient resources utilization. *Robot. Comput. Manuf.* **2021**, *67*, 102001. [CrossRef]
64. Braccini, A.M.; Margherita, E.G. Exploring Organizational Sustainability of Industry 4.0 under the Triple Bottom Line: The Case of a Manufacturing Company. *Sustainability* **2018**, *11*, 36. [CrossRef]
65. Da Xu, L.; Xu, E.L.; Li, L. Industry 4.0: State of the art and future trends. *Int. J. Prod. Res.* **2018**, *56*, 2941–2962. [CrossRef]
66. Altay, N.; Gunasekaran, A.; Dubey, R.; Childe, S.J. Agility and resilience as antecedents of supply chain performance under moderating effects of organizational culture within the humanitarian setting: A dynamic capability view. *Prod. Plan. Control.* **2018**, *29*, 1158–1174. [CrossRef]
67. Papadopoulos, T.; Gunasekaran, A.; Dubey, R.; Altay, N.; Childe, S.J.; Fosso-Wamba, S. The role of Big Data in explaining disaster resilience in supply chains for sustainability. *J. Clean. Prod.* **2017**, *142*, 1108–1118. [CrossRef]
68. Frank, A.G.; Dalenogare, L.S.; Ayala, N.F. Industry 4.0 technologies: Implementation patterns in manufacturing companies. *Int. J. Prod. Econ.* **2019**, *210*, 15–26. [CrossRef]
69. Yadav, G.; Luthra, S.; Jakhar, S.K.; Mangla, S.K.; Rai, D.P. A framework to overcome sustainable supply chain challenges through solution measures of industry 4.0 and circular economy: An automotive case. *J. Clean. Prod.* **2020**, *254*, 120112. [CrossRef]
70. de Sousa Jabbour, A.B.L.; Jabbour, C.J.C.; Foropon, C.; Godinho Filho, M. When titans meet–Can industry 4.0 revolutionize the environmentally-sustainable manufacturing wave? The role of critical success factors. *Technol. Forecast. Soc. Chang.* **2018**, *132*, 18–25. [CrossRef]
71. Reddy, N.; Chen, L.; Zhang, Y.; Yang, Y. Reducing environmental pollution of the textile industry using keratin as alternative sizing agent to poly(vinyl alcohol). *J. Clean. Prod.* **2014**, *65*, 561–567. [CrossRef]
72. Stock, T.; Obenaus, M.; Kunz, S.; Kohl, H. Industry 4.0 as enabler for a sustainable development: A qualitative assessment of its ecological and social potential. *Process. Saf. Environ. Prot.* **2018**, *118*, 254–267. [CrossRef]

73. Kaymak, T.; Bektas, E. Corporate Social Responsibility and Governance: Information Disclosure in Multinational Corporations. *Corp. Soc. Responsib. Environ. Manag.* **2017**, *24*, 555–569. [CrossRef]
74. Kantabutra, S.; Ketprapakorn, N. Toward a theory of corporate sustainability: A theoretical integration and exploration. *J. Clean. Prod.* **2020**, *270*, 122292. [CrossRef]
75. Santana, M.; Cobo, M. What is the future of work? A science mapping analysis. *Eur. Manag. J.* **2020**. [CrossRef]
76. Luthra, S.; Kumar, A.; Zavadskas, E.K.; Mangla, S.K.; Garza-Reyes, J.A. Industry 4.0 as an enabler of sustainability diffusion in supply chain: An analysis of influential strength of drivers in an emerging economy. *Int. J. Prod. Res.* **2019**, *58*, 1505–1521. [CrossRef]
77. Ramakrishna, S.; Ngowi, A.; De Jager, H.; Awuzie, B.O. Emerging Industrial Revolution: Symbiosis of Industry 4.0 and Circular Economy: The Role of Universities. *Sci. Technol. Soc.* **2020**. [CrossRef]
78. Nascimento, D.L.M.; Alencastro, V.; Quelhas, O.L.G.; Caiado, R.G.G.; Garza-Reyes, J.A.; Rocha-Lona, L.; Tortorella, G. Exploring Industry 4.0 technologies to enable circular economy practices in a manufacturing context. *J. Manuf. Technol. Manag.* **2019**, *30*, 607–627. [CrossRef]
79. Munsamy, M.; Telukdarie, A.; Fresner, J. Business process centric energy modelling. *Bus. Process. Manag. J.* **2019**, *25*, 1867–1890. [CrossRef]
80. Kohtamäki, M.; Parida, V.; Oghazi, P.; Gebauer, H.; Baines, T. Digital servitization business models in ecosystems: A theory of the firm. *J. Bus. Res.* **2019**, *104*, 380–392. [CrossRef]
81. Kramer, A.; Kramer, K.Z. The potential impact of the Covid-19 pandemic on occupational status, work from home, and occupational mobility. *J. Vocat. Behav.* **2020**, *119*, 103442. [CrossRef]
82. Li, G.; Hou, Y.; Wu, A. Fourth Industrial Revolution: Technological drivers, impacts and coping methods. *Chin. Geogr. Sci.* **2017**, *27*, 626–637. [CrossRef]
83. Ritter, T.; Pedersen, C.L. Digitisation capability and the digitalization of business models in business-to-business firms: Past, present, and future. *Ind. Mark. Manag.* **2020**, *86*, 180–190. [CrossRef]
84. Obiso, J.J.A.; Himang, C.M.; Ocampo, L.A.; Bongo, M.F.; Caballes, S.A.A.; Abellana, D.P.M.; Deocaris, C.C.; Padua, R.R.A., Jr. Management of Industry 4.0–reviewing intrinsic and extrinsic adoption drivers and barriers. *Int. J. Tech. Manag.* **2019**, *81*, 210–257. [CrossRef]
85. Peura, P.; Haapanen, A.; Reini, K.; Törmä, H. Regional impacts of sustainable energy in western Finland. *J. Clean. Prod.* **2018**, *187*, 85–97. [CrossRef]
86. Ranängen, H.; Lindman, Å. A path towards sustainability for the Nordic mining industry. *J. Clean. Prod.* **2017**, *151*, 43–52. [CrossRef]
87. Lu, C.-J.; Yang, C.-T.; Yen, H.-F. Stackelberg game approach for sustainable production-inventory model with collaborative investment in technology for reducing carbon emissions. *J. Clean. Prod.* **2020**, *270*, 121963. [CrossRef]
88. Tsai, W.-H.; Lu, Y.-H. A Framework of Production Planning and Control with Carbon Tax under Industry 4.0. *Sustainability* **2018**, *10*, 3221. [CrossRef]
89. Tsai, W.-H.; Jhong, S.-Y. Production decision model with carbon tax for the knitted footwear industry under activity-based costing. *J. Clean. Prod.* **2019**, *207*, 1150–1162. [CrossRef]
90. Aureli, S.; Gigli, S.; Medei, R.; Supino, E. The value relevance of environmental, social, and governance disclosure: Evidence from Dow Jones Sustainability World Index listed companies. *Corp. Soc. Responsib. Environ. Manag.* **2019**, *27*, 43–52. [CrossRef]
91. Lali, L. Beyond the 3 Rs: How Can Singapore Move Forward on Sustainability? *The Business Times*, 30 May 2020. Available online: https://www.businesstimes.com.sg/brunch/beyond-the-3-rs-how-can-singapore-move-forward-on-sustainability (accessed on 6 July 2020).
92. Stevenson, D. Are ESG and Sustainability the New Alpha Mantra? *Financial Time*, 1 April 2020. Available online: https://www.ft.com/content/6cee0b48-7760-46a5-9759-243aaaff7f8a (accessed on 10 July 2020).
93. Gibbens, S. 15 Ways the Trump Administration Has Changed Environmental Policies. *National Geographics*, 1 February 2019. Available online: https://www.nationalgeographic.com/environment/2019/02/15-ways-trump-administration-impacted-environment/ (accessed on 9 July 2020).
94. Khan, M. Brussels Ramps up Emissions Goals as MEPs Declare 'Climate Emergency'. *Financial Time*, 28 November 2019. Available online: https://www.ft.com/content/cadca90e-11da-11ea-a7e6-62bf4f9e548a (accessed on 12 September 2020).

95. Wincuinas, J. Sustainable and Actionable: A Study of Asset-Owner Priorities for ESG investing in Asia. Available online: https://eiuperspectives.economist.com/sustainability/sustainable-and-actionable-study-asset-owner-priorities-esg-investing-asia (accessed on 9 July 2020).
96. Hay, G. Breakingviews—Sustainable Investing Will Wind up in the Dock. *Reuters*, 2019. Available online: https://www.reuters.com/article/us-global-sustainability-breakingviews-idUSKBN1YZ0PC (accessed on 7 July 2020).
97. Landrum, S. Millennials Driving Brands to Practice Socially Responsible Marketing. *Forbes Magazin*, 17 March 2017. Available online: https://www.forbes.com/sites/sarahlandrum/2017/03/17/millennials-driving-brands-to-practice-socially-responsible-marketing/ (accessed on 5 July 2020).
98. Wong, K. How to Be a More Conscious Consumer, Even If You're on a budget. *The New York Times*, 1 October 2019. Available online: https://www.nytimes.com/2019/10/01/smarter-living/sustainabile-shopping-conscious-consumer.html (accessed on 7 July 2020).
99. The Economist. Big Business is Beginning to Accept Broader Social Responsibilities. Available online: https://deliverchange.economist.com/article/big-business-beginning-accept-broader-social-responsibilities/ (accessed on 9 July 2020).
100. Jessop, S. Deutsche Bank Targets 200 Billion Euros of Sustainable Investment by 2025. *Reuters*, 2020. Available online: https://www.reuters.com/article/us-deutsche-bank-sustainability-idUSKBN22P132 (accessed on 7 July 2020).
101. Neghaiwi Hughes, B. Credit Suisse Sets Up Investment Banking Sustainability Advisory. *Reuters*, 2019. Available online: https://uk.reuters.com/article/uk-credit-suisse-gp-sustainability/credit-suisse-sets-up-investment-banking-sustainability-advisory-idUKKBN21L2Z6 (accessed on 9 July 2020).
102. Gitlin, M.J. California Set to Ban All Heavy Diesel Trucks and Vans by 2045. *Ars Technica*, 26 June 2020. Available online: https://arstechnica.com/cars/2020/06/california-set-to-ban-all-heavy-diesel-trucks-and-vans-by-2045/ (accessed on 9 July 2020).
103. Thomasson, E. Zalando to Push 'Sustainable' Fashion, Cut Emissions. *Reuters*. 2019. Available online: https://www.reuters.com/article/us-zalando-environment/zalando-to-push-sustainable-fashion-cut-emissions-idUSKBN1X90X8 (accessed on 9 July 2020).
104. Cobburn, C. Why Industry is Going Green on the Quiet. *The Guardian*, 8 September 2019. Available online: https://www.theguardian.com/science/2019/sep/08/producers-keep-sustainable-practices-secret (accessed on 9 July 2020).
105. Washington Post. Transcript: A World in Balance—Solutions for Sustainability. Available online: https://www.washingtonpost.com/blogs/post-live/wp/2017/11/16/transcript-a-world-in-balance-solutions-for-sustainability/ (accessed on 9 July 2020).
106. Vaughan, A. BP Aims to Invest More in Renewables and Clean Energy. *The Guardian*, 6 February 2018. Available online: https://www.theguardian.com/business/2018/feb/06/bp-aims-to-invest-more-in-renewables-and-clean-energy (accessed on 9 July 2020).
107. Sonnemaker, T. Mercedes-Benz Parent Company Daimler is Preparing to Lay Off 15,000 Workers as It Tries to Adapt to Electric Cars. *Business Insider*, 10 February 2020. Available online: https://www.businessinsider.com/mercedes-benz-parent-daimler-reportedly-planning-15000-layoffs-2020-2 (accessed on 9 July 2020).
108. Angel, M. Corrected-Nestle Invests $45 Mln a Year in Cocoa Sustainability. *Reuters*, 2019. Available online: https://in.reuters.com/article/nestle-cocoa-sustainability-idINL8N28J4Z0 (accessed on 8 July 2020).
109. Monaghan, A. Businesses Must Address Impact of Next Industrial Revolution, Says Siemens Boss. *The Guardian*, 16 July 2018. Available online: https://www.theguardian.com/business/2018/jul/15/global-workforce-will-be-decimated-by-fourth-revolution-says-siemens-boss (accessed on 8 July 2020).
110. Thomspon, J. Big Investors' Sustainability Push Drives Demand for Environmental Expertise. *Financial Time*, 2020. Available online: https://www.ft.com/content/362fdc36-3b97-11ea-b84f-a62c46f39bc2 (accessed on 9 July 2020).
111. Davidson, H. China on Track To Lead in Renewables as US Retreats, Report Says. *The Guardian*, 10 January 2018. Available online: https://www.theguardian.com/environment/2018/jan/10/china-on-track-to-lead-in-renewables-as-us-retreats-report-says (accessed on 9 July 2020).
112. Friedman, R. Sustainability: Moving the Conversation Forward. *The Economist*, 3 December 2018; Inteligence Unit. Available online: https://eiuperspectives.economist.com/sustainability/sustainability-moving-conversation-forward (accessed on 10 July 2020).

113. McFarlane, C. Are Smart Cities The Pathway To Blockchain And Cryptocurrency Adoption? *The Forbes*, 18 October 2019. Available online: https://www.forbes.com/sites/chrissamcfarlane/2019/10/18/are-smart-cities-the-pathway-to-blockchain-and-cryptocurrency-adoption/#7a10b7846093 (accessed on 5 July 2020).
114. Rogers, B. Cities are Not Dead—They Will Get Younger. *Financial Times*, 24 May 2020. Available online: https://www.ft.com/content/d4fff7a2-9b63-11ea-871b-edeb99a20c6e (accessed on 9 July 2020).
115. Gold, M. Accelerating Urban Intelligence: People, Business and the Cities of Tomorrow. *The Economist*, 27 April 2019; Intelligence Unit. Available online: https://eiuperspectives.economist.com/technology-innovation/accelerating-urban-intelligence-people-business-and-cities-tomorrow/white-paper/accelerating-urban-intelligence-people-business-and-cities-tomorrow (accessed on 7 July 2020).
116. Rudolph, C.W.; Allan, B.; Clark, M.; Hertel, G.; Hirschi, A.; Kunze, F.; Shockley, K.; Shoss, M.; Sonnentag, S.; Zacher, H. Pandemics: Implications for Research and Practice in Industrial and Organizational Psychology. *Ind. Org. Psy.* **2020**. [CrossRef]
117. Van den Heuvel, M. How COVID Turned a Spotlight on Weak Worker Rights. *The Harvard Gazzete*. 23 June 2020. Available online: https://news.harvard.edu/gazette/story/2020/06/labor-law-experts-discuss-workers-rights-in-covid-19/ (accessed on 15 September 2020).
118. Gustin, G. Think Covid-19 Disrupted the Food Chain? Wait and See What Climate Change Will Do. *Inside Climate News*, 7 July 2020. Available online: https://insideclimatenews.org/news/06072020/coronavirus-agriculture-food-chain-future-climate-change (accessed on 7 July 2020).
119. Ghisellini, P.; Cialani, C.; Ulgiati, S. A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *J. Clean. Prod.* **2016**, *114*, 11–32. [CrossRef]
120. Harari, Y.N. The World after Coronavirus. *The Financial Times*, 20 March 2020. Available online: https://www.ft.com/content/19d90308-6858-11ea-a3c9-1fe6fedcca75 (accessed on 17 July 2020).
121. Bapuji, H.; de Bakker, F.G.; Brown, J.A.; Higgins, C.; Rehbein, K.; Spicer, A. Business and Society Research in Times of the Corona Crisis. *Buss. Soc.* **2020**, *59*, 1067–1078. [CrossRef]
122. Hua, J.; Shaw, R. Coronavirus (Covid-19) "infodemic" and emerging issues through a data lens: The case of China. *Int. J. Environ. Res. Public Health* **2020**, *17*, 2309. [CrossRef] [PubMed]
123. Boot, A.W.A.; Carletti, E.; Kotz, H.-H.; Krahnen, J.P.; Pelizzon, L.; Subrahmanyam, M.G. Corona and Financial Stability 3.0: Try Equity—Risk Sharing For Companies, Large and Small. *SAFE Policy Lett.* **2020**, *81*. Available online: https://safe-frankfurt.de/policy-center/policy-publications/policy-publ-detailsview/publicationname/corona-and-financial-stability-30-try-equity-risk-sharing-for-companies-large-and-small.html/ (accessed on 4 September 2020).
124. Trippel, E. How green is green enough? The changing landscape of financing a sustainable European economy. *ERA Forum* **2020**, 1–16. [CrossRef]
125. Goerzen, A.; Iskander, S.P.; Hofstetter, J.S. The effect of institutional pressures on business-led interventions to improve social compliance among emerging market suppliers in global value chains. *J. Int. Bus. Policy* **2020**, 1–21. [CrossRef]
126. Payne, A. Germany is Beginning a Universal-Basic-Income Trial with People Getting $1400 a Month for 3 Years. *The Business Insider*, 2020. Available online: https://www.businessinsider.com/germany-begins-universal-basic-income-trial-three-years-2020-8 (accessed on 9 October 2020).
127. Grah, B.; Dimovski, V.; Peterlin, J. Managing Sustainable Urban Tourism Development: The Case of Ljubljana. *Sustainability* **2020**, *12*, 792. [CrossRef]
128. Bartoli, G.; Fantacci, R.; Gei, F.; Marabissi, D.; Micciullo, L. A novel emergency management platform for smart public safety. *Int. J. Commun. Syst.* **2013**, *28*, 928–943. [CrossRef]
129. Yigitcanlar, T.; Butler, L.; Windle, E.; DeSouza, K.C.; Mehmood, R.; Corchado, J.M. Can Building "Artificially Intelligent Cities" Safeguard Humanity from Natural Disasters, Pandemics, and Other Catastrophes? An Urban Scholar's Perspective. *Sensors* **2020**, *20*, 2988. [CrossRef]
130. Verma, S.; Gustafsson, A. Investigating the emerging COVID-19 research trends in the field of business and management: A bibliometric analysis approach. *J. Bus. Res.* **2020**, *118*, 253–261. [CrossRef]
131. Keesara, S.; Jonas, A.; Schulman, K. Covid-19 and Health Care's Digital Revolution. *N. Engl. J. Med.* **2020**, *382*, e82. [CrossRef]
132. Taylor, C.B.; E. Fitzsimmons-Craft, E.; Graham, A.K. Digital technology can revolutionize mental health services delivery: The COVID-19 crisis as a catalyst for change. *Int. J. Eat. Disord.* **2020**, *53*, 1015–1181. [CrossRef]

133. Roblek, V.; Pejić Bach, M.; Meško, M.; Bertoncel, T. Best practices of the social innovations in the framework of the e-government evolution. *Amfiteatru Econ.* **2020**, *22*, 275–302. [CrossRef]
134. Oni, A.; Oni, S.; Mbarika, V.; Ayo, C.K. Empirical study of user acceptance of online political participation: Integrating Civic Voluntarism Model and Theory of Reasoned Action. *Gov. Inf. Q.* **2017**, *34*, 317–328. [CrossRef]
135. Elavarasan, R.M.; Afridhis, S.; Vijayaraghavan, R.R.; Subramaniam, U.; Nurunnabi, M. SWOT analysis: A framework for comprehensive evaluation of drivers and barriers for renewable energy development in significant countries. *Energy Rep.* **2020**, *6*, 1838–1864. [CrossRef]
136. Stop This Thing. Available online: https://stopthesethings.com/2019/01/06/germanys-renewable-energy-fail-german-co2-emissions-10-times-higher-than-nuclear-powered-france/ (accessed on 10 October 2020).
137. Blackmon, D. Renewables Won't Save Us If the Electric Grid Is Not Ready. *Forbes*, 30 September 2020. Available online: https://www.forbes.com/sites/davidblackmon/2020/09/30/renewables-wont-save-us-if-the-electric-grid-is-not-ready/?fbclid=IwAR0u12ZVqn5kFh0Kd51_o65MKHTJvZojI070gc7iqJm62gAVGzAOa3oLTu8#31d8a1f87abf (accessed on 10 October 2020).
138. Bersano, A.; Segantin, S.; Falcone, N.; Panella, B.; Testoni, R. Evaluation of a potential reintroduction of nuclear energy in Italy to accelerate the energy transition. *Electr. J.* **2020**, *33*, 106813. [CrossRef]
139. Shellenberger, M. Renewables Threaten German Economy & Energy Supply, McKinsey Warns in New Report. *Forbes*, 5 September 2019. Available online: https://www.forbes.com/sites/michaelshellenberger/2019/09/05/renewables-threaten-german-economy-energy-supply-mckinsey-warns-in-new-report/#619733688e48 (accessed on 10 October 2020).
140. Masum, M.H.; Latiff, A.R.A.; Osman, M.N.H. Voluntary Reporting, Sustainable Reporting and Transition Economy. *Int. Bus. Account. Res. J.* **2020**, *4*, 81–88. [CrossRef]
141. Man, M.; Bogeanu-Popa, M.-M. Impact of Non-Financial Information on Sustainable Reporting of Organisations' Performance: Case Study on the Companies Listed on the Bucharest Stock Exchange. *Sustainability* **2020**, *12*, 2179. [CrossRef]

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).