A Review of Uncertain Decision-Making Methods in Energy Management Using Text Mining and Data Analytics

Madjid Tavana 1,2,*, Akram Shaabani 3, Francisco Javier Santos-Arteaga 4 and Iman Raeesi Vanani 3

1 Distinguished Chair of Business Analytics, Business Systems and Analytics Department, La Salle University, Philadelphia, PA 19141, USA
2 Business Information Systems Department, Faculty of Business Administration and Economics, University of Paderborn, 33098 Paderborn, Germany
3 Department of Industrial Management, Faculty of Management and Accounting, Allameh Tabataba’i University, Tehran 14896-84511, Iran; Shaabani_akram@atu.ac.ir (A.S.); imanraeesi@atu.ac.ir (I.R.V.)
4 Faculty of Economics and Management, Free University of Bolzano, Bozen, 39100 Bolzano, Italy; fsantosarteaga@unibz.it

* Correspondence: tavana@lasalle.edu; Tel.: +1-215-951-1129

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Abstract: The managerial and environmental studies conducted in the energy research area reflect its substantial importance, particularly when optimizing and modifying consumption patterns, transitioning to renewable sources away from fossil ones, and designing plans and systems. The aim of this study is to provide a systematic review of the literature allowing us to identify which research subjects have been prioritized in the fields of energy and sustainability in recent years, determine the potential reasons explaining these trends, and categorize the techniques applied to analyze the uncertainty faced by decision-makers. We review articles published in highly ranked journals through the period 2003–2020 and apply text analytics to cluster their main characteristics; that is, we rely on pre-processing and text mining techniques. We analyze the title, abstract, keywords, and research methodology of the articles through clustering and topic modeling and illustrate what methods and fields constitute the main focus of researchers. We demonstrate the substantial importance of fuzzy-related methods and decision-making techniques such as the Analytical Hierarchy Process and Technique for Order Preferences by Similarity to Ideal Solutions (TOPSIS). We also show that subjects such as renewable energy, energy planning, sustainable energy, energy policy, and wind energy have gained relevance among researchers in recent years.

Keywords: uncertainty; decision-making; energy; sustainability; text analytics

1. Introduction

Energy is an important pillar of economic activity and product development, and plays a strategic role in national and economic security [1]. Energy is also an essential tool for global economic growth, with environmental protection gaining relevance in recent years [2]. Energy sustainability is a long-term view of natural resource constraints [3]. Renewable, clean, and efficient energy, such as wind and geothermal power, solar energy, hydropower, and biomass, constitute fundamental determinants of future sustainability [4].

The planning, operation, and management of energy have long been of interest to decision-makers, particularly when dealing with energy demand and the optimal allocation of resources. In order
to help decision-makers select optimal decisions, design energy policies, and support sustainable approaches to energy in uncertain environments, various decision-making tools have been introduced by researchers—and subsequently applied by managers. The purpose of the current paper is to provide an overview of the main decision-making methods implemented to deal with sustainability and energy subjects under uncertainty through the period 2003–2020. We aim to determine the main topics highlighted by researchers and the techniques applied to analyze them within the field of energy. In particular, the main questions we address and try to answer through the current paper can be summarized as follows:

Q1- What type of research has been performed in the fields of energy and sustainability in recent years?
Q2- What are the main trends observed and the potential reasons for their emergence?
Q3- Which techniques have been used to formalize and analyze the uncertainty faced by decision-makers?

The remainder of this paper is organized as follows. In Section 2, we present a general overview of the energy literature, together with the main decision making and text mining methods. Data collection and analytics are introduced in Section 3. Section 4 describes the pre-processing and text mining results. Section 5 discusses potential managerial and policy implications. Section 6 concludes.

2. Literature Review

2.1. Energy Research Methods

Energy—in its various forms, namely, renewable, non-renewable, and fossil—is generally defined as a material resource used in industrial and agricultural production, transportation, and national defense [1]. The energy literature has focused on its environmental impact, particularly climate change, global warming, and the transition to renewable forms of energy.

For instance, [5] assessed renewable energy technologies to generate electricity using fuzzy Technique for Order Preferences by Similarity to Ideal Solutions (TOPSIS) and proposed effective and efficient solutions for the development of clean and sustainable energy. Similarly, [6] proposed a process for selecting electricity generation technologies considering qualitative and quantitative criteria and political and social dimensions.

Quantitative and qualitative criteria have been defined to evaluate technologies designed for energy planning ([7,8]) and storage [9]. Ref. [10] designed a framework to rank renewable energy supply systems. Ref. [11] suggested an approach for increasing the sustainability of energy systems while considering economic and environmental dimensions.

Given the considerable amount of research published on energy-related topics, we concentrate on the main decision-making methods implemented to deal with uncertain environments and the text mining techniques that will be applied to analyze the publications selected in the current paper.

2.2. Decision-Making Methods Dealing with Uncertainty

Multi-criteria decision making (MCDM) techniques encompass multi-attribute decision making (MADM) and multi-object decision making (MODM) models. MADM methods are used to solve problems involving selection from among a finite number of alternatives, while MODM methods are used to solve problems with decision variable values that are determined in a continuous or integer domain. These methods aim at helping decision-makers in complex environments, so that they can define optimal selection criteria and rank the alternatives accordingly [12,13].

Multi-criteria decision aid (MCDA) provides a suitable framework of analysis in complex problems and conflicting situations while focusing mainly on MADM methods [14,15]. MCDA encompasses several comparative methods, including AHP, ELECTRE, PROMETHEE, and rough set theory [16]. We summarize below the main characteristics of the main MCDM methods implemented in the energy literature when decision-makers are subject to uncertain evaluation constraints.
2.2.1. Analytical Hierarchy Process

The Analytic Hierarchy Process (AHP) is an MCDM technique proposed by [17]. It is generally applied to rank alternatives using paired comparisons [18,19]. The AHP has been implemented across a wide variety of research areas such as supply chain [20], business and marketing [21], supplier selection [22], engineering and manufacturing [23], environmental management [24], human resources management [25], and sustainable energy [26].

2.2.2. Analytic Network Process

The ANP method was introduced by [27] to extend the AHP approach [28]. In particular, this method analyzes the decision process taking place across different hierarchical levels and considers the interdependencies existing among the elements being ranked [29].

2.2.3. Technique for Order Preferences by Similarity to Ideal Solutions

Ref. [30] introduced the Technique for Order Preferences by Similarity to Ideal Solutions (TOPSIS) to solve problems where the alternatives are classified according to their relative distances from the positive and negative ideal solutions [31]. Among the multiple applications of TOPSIS, we must highlight those related to the selection of sustainable suppliers [32], banking [33], sustainable supply chain risk management [34], the evaluation of wind turbines [35], and the design of prioritizing barriers [36].

2.2.4. Best–Worst Method

The Best–Worst Method (BWM) is an MCDM technique that specifies the relative importance of criteria by performing pairwise comparisons between the best, the worst, and the rest of the criteria [37,38]. The BWM was introduced by [39] and has been applied to evaluate organizational performance [40], identify and assess the demands of users for smart products [41], evaluate school performance [42], and assess road safety [43].

2.2.5. MULTIMOORA

Multi-objective optimization with ratio analysis (MOORA) was proposed by [44] as an MCDM method to solve complex decision-making problems. MULTIMOORA creates a ranking based on the results obtained from three methods: MOORA, reference point, and the full multiplicative form of multiple objectives [45]. MULTIMOORA has been applied to research problems dealing with sustainable energy [46], personnel selection [47], barriers to renewable energy acceptance [48], risk prioritization in failure modes [49], and site selection of sustainable landfills [50].

2.2.6. Complex Proportional Assessment

Complex Proportional Assessment (COPRAS) is a MADM method proposed by [51] that computes solutions by considering the best solution ratio [52]. COPRAS has been applied to partner-selection problems [53], and the analysis of renewable energy sources [54], including the design of strategies in wind farms [55] and site selection [56].

2.2.7. Weighted Aggregated Sum Product Assessment

The Weighted Aggregated Sum-Product Assessment method or WASPAS was defined by [57] combining two MCDM methods, namely, the weighted sum and weighted product models. WASPAS has been applied to assess renewable energy alternatives [58], sustainable production strategies [59], and the selection of suppliers [60].
2.2.8. PROMETHEE and FPROMETHEE

The preference ranking organization method for enrichment evaluation or PROMETHEE builds on comparisons between difficult to discern alternatives [61,62]. PROMETHEE was introduced by [63] and developed by [64,65], as a decision-making method for solving MCDA problems [66]. The fuzzy PROMETHEE technique integrates the PROMETHEE method and fuzzy number logic [67]. It was introduced by [68], and developed by [69,70].

PROMETHEE has been applied to airport location [71], sustainability assessment [72], engineering design processes [73], material selection [74], site selection for waste-to-energy plants [75], and the ranking of websites for renewable energy [76]. FPROMETHEE has been applied to site selection [62], supplier selection problems [77], start-up businesses selection [78], the evaluation of outsourcing risks [79], industrial robot selection [80], and the ranking of energy projects [70].

2.3. Text Mining Methods

Text mining consists of extracting information from textual data on which to perform subsequent analyses [81]. Textual data is categorized as unstructured (word documents, videos, and images) or semi-structured (coded in XML or JSON), and text mining focuses on text processing both types of data [82]. Text mining encompasses a wide variety of algorithms and techniques for analyzing text, such as natural language processing (NLP), a sub-field of computer science, artificial intelligence, and linguistics commonly applied to analyze text [83].

Text mining consists of the following stages: collecting data, pre-processing data or data cleaning, and implementing analytical processing techniques involving text categorization, clustering, and classification [84]. Applications of text mining include research areas as diverse as biology and biomedicine [85], health care [86], and consumer behavior [87]. The different techniques used for text mining include information recovery, extraction of information, text clustering, topic modeling, and text classification [88].

2.3.1. Text Clustering

Text clustering is a standard text mining method consisting of a multivariate statistical technique that groups texts into clusters with similar themes to be used for information recovery, summarization and classification [89]. Several types of unsupervised text clustering learning algorithms have been defined in the literature, including hierarchical, k-means, and partitioning and probabilistic clustering [83]. Recent applications of text clustering include reverse engineering [90], vehicle marketing [91], supply chains [92], logistic optimization [93], and the analysis of manufacturing capability [94].

2.3.2. Topic Modeling

Topic modeling defines probabilistic clustering algorithms [83] aimed at extracting and uncovering hidden or latent semantic patterns and structures, called topics, from unstructured text documents [95,96]. This technique interprets data using topic labels [97] which are created from the words contained in text documents [95]. The main algorithms used in topic modeling focus on latent semantics and Dirichlet processes, the Latent Dirichlet Allocation (LDA) algorithm being one of the most commonly applied techniques. The “latent” quality of the LDA algorithm is relevant to the structural findings in text documents. Moreover, since LDA uses unsupervised learning, it is useful for finding semantic patterns in massive textual data [95]. Topic modeling has been recently used for identifying and assessing challenges in business [98], finding hidden topics and trends in educational technologies [99], and forecasting technology in the field of healthcare [100].
2.3.3. Text Classification

A common application of machine and deep learning is text classification, which uses neural networks to allocate text to different classes based on the characteristics of the text [101]. This technique is generally employed for sentiment and web page classification, and personalized news recommendation [102]. Standard classification algorithms include Naïve Bayes, Nearest Neighbor, Decision Tree Classifiers, and Support Vector Machines [83]. Text classification is currently being applied to image processing [103,104], medical diagnosis [105], tag recommendation [106], healthcare [107], and the analysis of incidents [108].

3. Research Framework

3.1. Data Collection

We concentrate on studies conducted in the fields of energy, sustainability, uncertainty, and decision making. Our research has focused on the titles, abstracts, keywords, and research methods of articles retrieved from several online databases such as ScienceDirect (Elsevier), IEEE Xplore, Taylor and Francis, Emerald, Springer, and Google Scholar. As already stated, the keywords used in the search include decision making, uncertainty, energy, and sustainability. When collecting the data, we considered papers published between 2003 and 2020. The data collection process is summarized in Figure 1.

A total of 210 articles were retrieved from the search, among which we selected 120 articles published in scholarly and academic journals and excluded 90 articles published in professional journals and proceedings. The number of articles and journal specifications are presented in Table 1. We have identified the decision-making methods applied in these studies and followed a text analytics approach, which has been performed on the titles, keywords, abstracts, literature review, research methods, findings, and discussion and conclusion sections of the corresponding articles.

![Figure 1. Article collection process.](image_url)

Table 1. Count of the papers gathered.

| Journal Name                                      | Number | Impact Factor | h-Index | Q  |
|--------------------------------------------------|--------|---------------|---------|----|
| Renewable and Sustainable Energy Reviews         | 48     | 10.556        | 222     | Q1 |
| Energy                                           | 13     | 5.537         | 158     | Q1 |
| Energy Policy                                    | 11     | 4.88          | 178     | Q1 |
| Renewable energy                                 | 9      | 5.439         | 157     | Q1 |
| Sustainability                                   | 8      | 2.592         | 53      | Q2 |
| Energy Conversion and Management                 | 7      | 7.181         | 163     | Q1 |
| Energy economics                                 | 3      | 4.151         | 120     | Q1 |
| International Journal of Energy Sector Management| 3      | 1.14          | 17      | Q2 |
| Sustainable Energy Technologies and Assessments  | 2      | 3.456         | 25      | Q1 |
| Sustainable Cities and Society                   | 2      | 4.624         | 34      | Q1 |
| International Journal of Environmental Science and Technology | 1     | 2.031         | 61      | Q2 |
| Expert Systems with Applications                 | 1      | 4.292         | 162     | Q1 |
| Applied Soft Computing Journal                   | 1      | 4.873         | 110     | Q1 |
| Energy and Buildings                             | 1      | 4.495         | 147     | Q1 |
| Smart and Sustainable Built Environment          | 1      | 1.04          | 10      | Q2 |
| Energy Strategy Reviews                          | 1      | 2.633         | 22      | Q1 |
| Journal of Modern Power Systems and Clean Energy | 1      | 2.848         | 23      | Q1 |
| Energy Sources, Part B: Economics, Planning, and Policy | 1   | 1.093         | 28      | Q2 |
| Management of Environmental Quality: An International Journal | 1 | 1.4          | 29      | Q3 |
| European Journal of Operational Research         | 1      | 3.806         | 226     | Q1 |
### 3.2. Data Analytics

The data collected has been analyzed, applying both text pre-processing and text mining methods. Text mining allows us to extract information from a wide range of text documents using techniques such as data mining, computational statistics, machine learning, and NLP. The text mining research process is described in Figure 2.

![Figure 2. Research methodology.](image_url)
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4. Findings

In this section, we present the pre-processing, frequency words, and text mining results for the 120 articles collected on decision-making methods in the field of energy management under uncertainty. As an intuitive introduction to the set of results presented through the next sections, Figure 3 depicts the names of the main authors contributing to the research area analyzed.
4.1. Pre-Processing and Frequency Words

The purpose of the pre-processing stage is to prepare the articles for analysis via text mining. In this stage, we removed all unnecessary punctuations, numbers, and “stop words.” All words have been converted to lower case, tokenized, and lemmatized. Figure 4 describes the four steps performed on the abstracts of the articles.

The next step implements frequency words and word cloud analysis to the title, abstract, keywords, literature review, research methodology, findings and discussion, and conclusion sections of the articles, both separately and collectively. We used frequency words and word cloud to determine whether the selected articles were suitable for analysis regarding the subject and objectives of the research performed. The results obtained, illustrating the number of times different words appear in each of these sections, are presented in Table 2. Note that, together with the standard words expected to arise from the analysis, such as “energy”, “decision”, “sustainable”, and “multicriteria”, the main approaches followed in dealing with uncertainty are found to rely on “fuzzy” methods. Moreover, we observe a clear prevalence of AHP and TOPSIS among the techniques implemented to study the corresponding problems.

![Pre-Processing Diagram](image-url)

**Figure 4.** Text pre-processing of the abstracts.
Table 2. Separate word frequency.

| Words/Title       | Freq. | Words/Abstracts Freq. | Words/Keywords Freq. | Words/Literature Review Freq. | Words/Methodology Freq. | Words/Finding and Discussion Freq. | Words/Conclusion Freq. |
|-------------------|-------|-----------------------|----------------------|-------------------------------|------------------------|------------------------------------|------------------------|
| 'energy'          | 80    | 'energy' 538          | 'energy' 102         | 'energy' 2069                 | 'energy' 811           | 'energy' 1050                      | 'energy' 900           |
| 'decision'        | 25    | 'decision' 152        | 'decision' 49        | 'criteria' 494                | 'fuzzy' 514            | 'criteria' 411                      | 'criteria' 245         |
| 'renewable'       | 25    | 'renewable' 130       | 'fuzzy' 45          | 'fuzzy' 488                   | 'criteria' 503         | 'decision' 222                      | 'renewable' 199        |
| 'sustainable'     | 21    | 'criteria' 108        | 'making' 34          | 'decision' 476                 | 'method' 485           | 'renewable' 208                     | 'decision' 181         |
| 'multicriteria'   | 19    | 'fuzzy' 101          | 'multicriteria' 27    | 'renewable' 428                | 'decision' 445         | 'alternatives' 191                  | 'fuzzy' 137            |
| 'making'          | 18    | 'method' 99          | 'renewable' 23       | 'wind' 360                    | 'ahp' 240              | 'weights' 189                      | 'sustainable' 122      |
| 'fuzzy'           | 18    | 'analysis' 88        | 'sustainable' 18     | 'power' 345                   | 'analysis' 238         | 'fuzzy' 171                        | 'alternatives' 99      |
| 'analysis'        | 17    | 'sustainable' 71     | 'planning' 17        | 'planning' 313                | 'alternative' 218      | 'analysis' 170                      | 'mcdm' 98              |
| 'planning'        | 16    | 'planning' 64        | 'topsis' 14          | 'mcdm' 306                    | 'power' 204            | 'wind' 169                         | 'policy' 98            |
| 'decision making' | 10    | 'decisionmaking' 64  | 'optimization' 14    | 'system' 308                  | 'mcdm' 1175            | 'ranking' 166                      | 'environmental' 92     |
| 'multicriteria'   | 9     | 'alternatives' 64    | 'ahp' 13            | 'analysis' 295                | 'function' 165         | 'solar' 148                        | 'decisionmaking' 78    |
| 'uncertainty'     | 8     | 'multicriteria' 57   | 'decisionmaking' 13  | 'environmental' 265           | 'renewable' 156        | 'power' 145                        | 'planning' 76          |
| 'topsis'          | 8     | 'making' 56          | 'sustainability' 13  | 'alternatives' 253            | 'optimization' 148     | 'efficiency' 145                    | 'resources' 70         |
| 'optimization'    | 8     | 'policy' 51          | 'policy' 10         | 'ahp' 251                     | 'objective' 136        | 'economic' 133                      | 'ahp' 69               |
| 'decision'        | 6     | 'makers' 45          | 'programming' 9      | 'decisionmaking' 207          | 'data' 135            | 'policy' 118                        | 'topsis' 64            |
| 'ahp'             | 5     | 'mcdm' 41           | 'mcdm' 7            | 'optimization' 196            | 'evaluation' 133       | 'criterion' 116                     | 'uncertainty' 58       |
| 'mcdm'            | 5     | 'ahp' 37           | 'analytical' 7       | 'optimal' 165                 | 'topsis' 130           | 'mcdm' 101                         | 'making' 53            |
| 'sustainability'  | 4     | 'uncertainty' 38     | 'multiobjective' 5    | 'making' 159                  | 'planning' 129         | 'sustainable' 91                    | 'sustainability' 49    |
| 'decisionmaking'  | 4     | 'optimization' 36    | 'uncertainty' 3       | 'sustainable' 155            | 'criterion' 127        | 'optimal' 87                        | 'optimization' 45      |
We now consider the overall word frequency, whose results are presented in Table 3. As was the case with the different sections of the documents, the words “energy”, “criteria”, “decision” “MCDM”, “sustainable”, together with “fuzzy” and “TOPSIS”, are among the most frequently used ones in the 120 articles. In this regard, the results validate the fact that appropriate articles have been selected for text analytics. Additional representations of the word clouds and frequencies for the different sections of the articles analyzed can be found in Figures 5–12.

| Words/Title         | Frequency | Words/Title | Frequency |
|---------------------|-----------|-------------|-----------|
| ’energy’            | 5602      | ’optimization’| 509       |
| ’criteria’          | 1780      | ’making’    | 480       |
| ’decision’          | 1533      | ’topsis’    | 457       |
| ’fuzzy’             | 1485      | ’ranking’   | 439       |
| ’renewable’         | 1186      | ’multicriteria’ | 375    |
| ’mcdm’              | 736       | ’uncertainty’| 307       |
| ’planning’          | 709       | ’criterion’  | 350       |
| ’sustainable’       | 537       | ’sustainability’ | 322  |
| ’decisionmaking’    | 532       | ’programming’| 277       |
| ’policy’            | 527       | ’uncertain’  | 229       |

Figure 5. “Title” word cloud.

Figure 6. “Abstract” word cloud.

Figure 7. “Keyword” word cloud.
Figure 8. “Research methodology” frequency.

Figure 9. “Literature review” frequency.

Figure 10. “Finding and discussion” frequency.
Figures 5–7 and 11 highlight the prominent use of words such as “decision-making”, “MCDM”, “fuzzy”, and “sustainable”, together with the corresponding techniques applied, namely, “AHP”, “TOPSIS”, “ELECTRE”, and “MULTIMOORA”, within the title, abstract and keywords of the papers. Similarly, Figures 8–10 and 12, illustrate that the words “energy”, “fuzzy”, “wind”, “power”, “planning”, “economic”, “environmental”, “AHP”, “MCDM”, “TOPSIS”, “ELECTRE”, and “programming” are used between 100 and 6000 times within these papers.

4.2. Text Mining Analysis

Through the text mining stage, text clustering and topic modeling have been applied to validate (and reinforce) the results obtained in the pre-processing stage. The k-means unsupervised learning clustering algorithm was applied to the title, keywords, abstracts, and research methodology sections. One of the main features of this technique is its capacity to segment and categorize within clusters. As an illustrative example, Figure 13 shows the clustering results for the “Title” section.
Figure 13. K-means clustering of titles.
The whole set of clustering results are presented in Table 4. As shown in this table, most decision-making methods applied in the articles are related to MADM, MODM, and MCDA. The main analytical techniques implemented within the energy management field include AHP and TOPSIS, together with standard MCDM techniques ranging from PROMETEE to MULTIMOORA. A significant subset of the literature follows a fuzzy approach to deal with uncertainty; the main methods considered including fuzzy interference systems, fuzzy rough sets, fuzzy cognitive maps, and rough theory.

| Words       | Clusters 1                                                                 | Keywords                                                                                                           |
|-------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Title       | (AHP, TOPSIS, FAHP, MULTIMOORA, VIKOR, Optimization, Multi-objective, Game theory, Uncertainties, ANP, Fuzzy, Robust, Programming, Bayesian, Multi-attribute, Cognitive map) | (Delphi-AHP, Fuzzy, TOPSIS, AHP, VIKOR, Goal programming, MULTIMOORA, Multi-criteria)                              |
| Keywords    | (MCDM, AHP TOPSIS, DSS, ROBUST, Delphi, VIKOR, Multicriteria, SWOT, Shannon Entropy, Game theory, uncertainty, fuzzy, PROMETHEE, COPRAS, MOLTIMOORA) | (Multi-objective, Optimization, Multi-criteria, Decision-making, uncertainty, modelling, optimized, Multicriteria, MCDM, MOLTIMOORA, Optimization, Bayesian, multiple, uncertainties, MCDM, MADM, ELECTRE, ARAS) |
| Abstract    | (Fuzzy TOPSIS, VIKOR, MOLTIMOORA, Optimization, Multi-objective, Genetic algorithm, Single, Objective, Optimization, Fuzzy logic, ELECTRE iii, MADM, AHP, Multi-attribute, FCM, robustness, uncertainties, Goal programming, ANN, DEA, TODIM, FPROMETHEE, Fuzzy Rough, Delphi Group decision-making, Robust, Linear programming, FAHP) | (Optimization, AHP, TOPSIS, SWOT, VIKOR, Delphi, Fuzzy, Multi-criteria, Decision-making, MCDA, FANP, ISM, ELECTRE, PROMETHEE, FPROMETHEE) |
| Research Methodology | (Fuzzy, AHP, SWOT, Group decision-making, Cognitive map, TOPSIS) | (AHP, Multi-criteria, MCDM, Uncertainty, ELECTRE iii, Game-theoretic, Optimization, MADM, Goal programming, Multi-objective, Fuzzy logic, MCDA, FCM, Robustness, VIKOR, Mathematical, Shannon entropy, PROMETHEE, ANP, Programming, Goal programming, Dynamic programming) |

Topic modeling was applied to the title, keywords, and research methodology sections. The corresponding results obtained are presented in Table 5. Key topics relate to multicriteria, decision-making, and optimization approaches, along with AHP, TOPSIS, and FPROMETHEE as the main solution techniques. We must also note that subjects such as renewable and power energy have also been highlighted through topic modeling.

Finally, we use VOS-viewer software to depict the main decision-making methods and topics considered in energy management under uncertainty. Figure 14 shows that most research has been conducted on renewable energy, energy planning, and sustainable energy. Figure 15 highlights MCDM, optimization, programming, and fuzzy logic, as the most-used analytical methods. The results also show that the MCDM methods most widely applied through the 2018–2020 period include AHP, MULTIMOORA, BWM, DEMATEL, and PROMETHEE, together with fuzzy goal programming and fuzzy TOPSIS.
Table 5. Topic modeling using the Latent Dirichlet Allocation (LDA) Algorithm.

| Topic | Topic Words |
|-------|-------------|
| **Title** |
| Topic 1 | (’hierarchy’, ’analytic’, ’fuzzy’, ’using’, ’selection’) |
| Topic 2 | (’fuzzy’, ’forecasting’, ’planning’, ’decision-making’, ’multi-objective’) |
| Topic 3 | (’multicriteria’, ’decision-making’, ’TOPSIS’) |
| Topic 4 | (’prioritizing’, ’optimization’, ’multiple’, ’sustainable’, ’renewable’) |
| Topic 5 | (’review’, ’optimization’, ’AHP’) |
| Topic 6 | (’decision’, ’review’, ’TOPSIS’, ’uncertainty’, ’qualitative’) |
| **Keywords** |
| Topic 1 | (’technologies’, ’decision-making’, ’renewable’, ’multicriteria’, ’programming’) |
| Topic 2 | (’planning’, ’renewable’, ’multiple’, ’development’, ’sustainable’) |
| Topic 3 | (’analytic’, ’hierarchy’, ’programming’, ’making’, ’VIKOR’) |
| Topic 4 | (’sustainable’, ’production’, ’multicriteria’, ’optimization’, ’systems’) |
| Topic 5 | (’analysis’, ’power’, ’fuzzy’, ’uncertainty’, ’optimization’) |
| Topic 6 | (’policy’, ’assessment’, ’analytic’, ’methods’, ’renewable’) |
| Topic 7 | (’sustainable’, ’distributed’, ’fuzzy’, ’DEA’, ’multi-objective’) |
| **Research Methodology** |
| Topic 1 | (MCDM, ’Alternatives’, ’Programming’, ’ranking’, PROMETHEE, ’Uncertainty’, ’Optimal’) |
| Topic 2 | (FCM) |
| Topic 3 | (DEA, FAHP, FPROMETHEE) |
| Topic 4 | (Rough) |
| Topic 5 | (Fuzzy, AHP, optimization, TOPSIS, decision-making, multicriteria, ANP) |
| Topic 6 | (Shannon entropy) |
| Topic 7 | (TODIM, MADA, PROMETHEE ii) |
| Topic 8 | (MOORA) |
5. Discussion and Policy Implications

We have addressed three main questions through the paper, whose answers follow from the text mining analysis applied to the literature reviewed. Figure 16 summarizes the main results obtained through the word cloud and word frequency analyses, together with the clustering and topic modeling techniques. As shown in this figure, subjects such as renewable energy, energy planning, sustainable energy, energy policy, and wind energy have gained relevance among researchers in recent years.

The decreasing availability of traditional energy sources—such as petroleum—as well as the emission of greenhouse gases and their effect on the climate change phenomenon have shifted the focus of the academic literature towards renewable energy sources. The use of renewable energy sources, which can be re-produced and easily replaced by nature shortly after consumption, leads to a reduction in emissions and environmental pollution—together with their associated health costs—and a subsequent increase in economic welfare. Renewable energy sources are available in all geographical areas, implying that developing countries can mitigate their strategic dependence on petroleum and its subsequent price fluctuations.

Governments are investing heavily in renewable energy sources, given their strategic importance as economic development factors. The subsequent planning policies should aim at reducing energy costs and their impact on the environment, with special emphasis being placed on the sustainability problems triggered by intergenerational tradeoffs. That is, planning is conditioned by sustainability, with renewability complementing the development of both policies. Planning, sustainability, and renewability require specific information from the corresponding research fields. In this regard, information ambiguity and uncertainty conditions have increased the importance of decision-making methods as problem-solving tools.
Several other studies have analyzed the main trends exhibited by the literature in the fields of sustainable and renewable energy and MCDM. For example, [109] reviewed the MCDA methods applied to evaluate sustainable energy sources, with AHP emerging as the preferred decision-making technique. [110] focused on multi-objective planning. They found that the main methods implemented were multi-objective evolutionary algorithms in 2009, MCDM in 2007–2008, and multi-attribute analysis through the 2003–2009 period. [111] reviewed the literature on sustainable energy systems and suggested optimization modeling methods as a good evaluation tool. [112] analyzed 27 papers published within the 2003–2015 period to validate the problem-solving capabilities of MCDM techniques. [113] identified PROMETHE, AHP, and ELECTRE III as the main MCDM methods applied in the field of sustainable renewable energy. [114] concluded that AHP, ANP, and DEA were the most popular MCDM techniques used to solve green energy planning and scheduling problems through the 1957–2017 period.

The main difference between the current paper and other competing reviews is given by the overall scope of our approach to the fields of energy and decision-making. Most studies focus on investigating a unique problem, while we have performed an extensive analysis of the energy research field so as to identify the main techniques implemented to deal with uncertainty within the corresponding decision-making (MCDM, MODM, MADM, and MCDA) scenarios.

6. Conclusions

We have performed a systematic review of the literature within the fields of energy and decision-making under uncertainty. A general keyword approach was initially applied to identify what methods were being implemented within the main academic indexes and publishers (Science direct, Emerald Xplore, Taylor and Francis, IEEE, Springer, and Google Scholar). After selecting 120 articles
from high impact journals, Python 3.8.3 was used to analyze the corresponding texts. To prepare the articles for text mining, we pre-processed all the articles and applied frequency words and word cloud analysis to their main sections. Clustering and topic modeling in text mining was then used to examine the main research methods employed.

Researchers tend to rely on fuzzy reasoning to deal with uncertainty across different MCDM methods, dominated by AHP and TOPSIS. In the field of energy, most research focuses on renewable energy, energy planning, and sustainable energy. In recent years, due to global warming and the overuse of non-renewable resources, the attention given to renewable energy and sustainability topics has increased. In this regard, it is necessary to properly plan energy consumption and develop suitable policies at national and international levels.

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**References**

1. He, Y.; Guo, S.; Cui, R. Energy strategy develop dominant decision-making based on AHP. In Proceedings of the 2011 International Conference on Mechatronic Science, Electric Engineering and Computer (MEC), Jilin, China, 19–22 August 2011; Institute of Electrical and Electronics Engineers (IEEE): Piscataway, NJ, USA, 2011; pp. 1706–1709.
2. Wu, Z.; Xu, J. Predicting and optimization of energy consumption using system dynamics-fuzzy multiple objective programming in world heritage areas. *Energy* 2013, 49, 19–31. [CrossRef]
3. Tannirandon, A.; Gerdsri, N. Energy planning for sustainable development—challenge and experience sharing from Thailand. In Proceedings of the IEEE International Conference on Management of Innovation and Technology (ICMIT), Bangkok, Thailand, 19–22 September 2016; pp. 115–120.
4. Sellak, H.; Oubbi, B.; Frikh, B. Energy planning under uncertain decision-making environment: An evidential reasoning approach to prioritize renewable energy sources. *Intell. Artif.* 2017, 20, 21. [CrossRef]
5. Boran, F.E.; Boran, K.; Menlik, T. The Evaluation of Renewable Energy Technologies for Electricity Generation in Turkey Using Intuitionistic Fuzzy TOPSIS. *Energy Sources Part B Econ. Plan. Policy* 2012, 7, 81–90. [CrossRef]
6. Streimikiene, D.; Sliogeriene, J.; Turskis, Z. Multi-criteria analysis of electricity generation technologies in Lithuania. *Renew. Energy* 2016, 85, 148–156. [CrossRef]
7. Kaya, T.; Kahraman, C. Multicriteria renewable energy planning using an integrated fuzzy VIKOR & AHP methodology: The case of Istanbul. *Energy* 2010, 35, 2517–2527. [CrossRef]
8. Sellak, H.; Oubbi, B.; Frikh, B.; Palomares, I. Towards next-generation energy planning decision-making: An expert-based framework for intelligent decision support. *Renew. Sustain. Energy Rev.* 2017, 80, 1544–1577.
9. Baumann, M.; Weil, M.; Peters, J.F.; Chibeles-Martins, N.; Moniz, A.B. A review of multi-criteria decision making approaches for evaluating energy storage systems for grid applications. *Renew. Sustain. Energy Rev.* 2019, 107, 516–534. [CrossRef]
10. Sengul, U.; Eren, M.; Shiraz, S.E.; Gezder, V.; Şengül, A.B. Fuzzy TOPSIS method for ranking renewable energy supply systems in Turkey. *Renew. Energy* 2015, 75, 617–625. [CrossRef]
11. Trivyza, N.; Rentizelas, A.A.; Theotokatos, G. A novel multi-objective decision support method for ship energy systems synthesis to enhance sustainability. *Energy Convers. Manag.* 2018, 168, 128–149. [CrossRef]
12. Mardani, A.; Zavadskas, E.K.; Khalifah, Z.; Zakuan, N.; Josuh, A.; Nor, K.M.; Khoshnoudi, M. A review of multi-criteria decision-making applications to solve energy management problems: Two decades from 1995 to 2015. *Renew. Sustain. Energy Rev.* 2017, 71, 216–256. [CrossRef]
13. Nabeeh, N.A.; Abdel-Basset, M.; El-Ghareeb, H.; Abouelfetouh, A. Neutrosophic Multi-Criteria Decision Making Approach for IoT-Based Enterprises. *IEEE Access* 2019, 7, 59559–59574. [CrossRef]
14. Sadok, W.; Angevin, F.; Bergez, J.-E.; Bockstaller, C.; Colomb, B.; Guichard, L.; Reau, R.; Doré, T. Ex ante Assessment of the Sustainability of Alternative Cropping Systems: Implications for Using Multi-criteria Decision-Aid Methods—A Review. *Sustain. Agricult.* 2009, 753–767.
15. Mousavi, M.M.; Lin, J. The application of PROMETHEE multi-criteria decision aid in financial decision making: Case of distress prediction models evaluation. *Expert Sys. App.* 2020, 159, 113438. [CrossRef]
16. Zopounidis, C.; Doumpos, M. Multi-criteria decision aid in financial decision making: Methodologies and literature review. *J. Multi-Criteria Decis. Anal.* 2002, 11, 167–186. [CrossRef]
17. Satty, T.L. The Analytic Process; McGraw-Hill: New York, NY, USA, 1980.
18. Tavana, M.; Zareinejad, M.; Di Caprio, D.; Kaviani, M.A. An integrated intuitionistic fuzzy AHP and SWOT method for outsourcing reverse logistics. *Appl. Soft Comput.* J. 2016, 40, 544–557. [CrossRef]
19. Papapostolou, A.; Karakosta, C.; Apostolidis, G.; Doukas, H. An AHP-SWOT-Fuzzy TOPSIS Approach for Achieving a Cross-Border RES Cooperation. *Sustainability* 2020, 12, 2886. [CrossRef]
20. Vishnu, C.R.; Sridharan, R.; Kumar, P.N.R. Supply chain risk inter-relationships and mitigation in Indian scenario: An ISM-AHP integrated approach. *Int. J. Log. Sys. Manag.* 2019, 32, 548–578. [CrossRef]
21. Leung, K.H.; Mo, D.Y. A Fuzzy-AHP Approach for Strategic Evaluation and Selection of Digital Marketing Tools. In Proceedings of the 2019 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), Macau, China, 15 December 2019; Institute of Electrical and Electronics Engineers (IEEE): Piscataway, NJ, USA, 2019; pp. 1422–1426.
22. Yücenur, G.N.; Vayvay, Ö; Demirel, N.Ç. Supplier selection problem in global supply chains by AHP and ANP approaches under fuzzy environment. *Int. J. Adv. Manuf. Technol.* 2011, 56, 823–833. [CrossRef]
23. Shabani, B.; Dukovski, V. Application of Decision Making Method (AHP) in Reverse Engineering and Additive Manufacturing Technologies; UBT: Pristina, Kosovo, 2019.
24. Ramos-Quintana, F.; Tovar-Sánchez, E.; Saldarriaga-Noreña, H.; Sotelo-Nava, H.; Sanchez-Hernandez, J.P.; Castrejón-Godínez, M.-L. A CBR–AHP Hybrid Method to Support the Decision-Making Process in the Selection of Environmental Management Actions. *Sustainability* 2019, 11, 5649. [CrossRef]
25. Chou, Y.-C.; Yen, H.-Y.; Dang, V.T.; Sun, C.-C. Assessing the Human Resource in Science and Technology for Asian Countries: Application of Fuzzy AHP and Fuzzy TOPSIS. *Symmetry* 2019, 11, 251. [CrossRef]
26. Wang, B.; Song, J.; Ren, J.; Li, K.; Duan, H.; Wang, X. Selecting sustainable energy conversion technologies for agricultural residues: A fuzzy AHP-VIKOR based prioritization from life cycle perspective. *Resour. Conserv. Recycl.* 2019, 142, 78–87. [CrossRef]
27. Saaty, R. The analytic hierarchy process—What it is and how it is used. *Math. Model.* 1987, 9, 161–176. [CrossRef]
28. Abdel-Baset, M.; Chang, V.; Gamal, A.; Smarandache, F. An integrated neutrosophic ANP and VIKOR method for achieving sustainable supplier selection: A case study in importing field. *Comput. Ind.* 2019, 106, 94–110. [CrossRef]
29. Alimezhad, A.; Khalili, J. ANP Method. In *New Methods and Applications in Multiple Attribute Decision Making (MADM)*; Springer: Berlin/Heidelberg, Germany, 2019; Volume 277, pp. 115–125.
30. Hwang, C.-L.; Yoon, K. *Multiple Attribute Decision Making*. *Lect. Notes Econ. Math. Sys.* 1981, 186.
31. Hasnain, S.; Ali, M.K.; Akhter, J.; Ahmed, B.; Abbas, N. Selection of an industrial boiler for a soyash production plant using analytical hierarchy process and TOPSIS approaches. *Case Stud. Therm. Eng.* 2020, 19, 100636. [CrossRef]
32. Memari, A.; Dargi, A.; Jokar, M.R.A.; Ahmad, R.; Rahim, A.R.A. Sustainable supplier selection: A multi-criteria intuitionistic fuzzy TOPSIS method. *J. Manuf. Syst.* 2019, 50, 9–24. [CrossRef]
33. Tašabat, S.E.; Özkan, T.K. Modified TOPSIS Method with Banking Case Study. In *Relating Information Culture to Information Policies and Management Strategies*; IGI Global: Hershey, PA, USA, 2020; pp. 189–224.
34. Abdel-Basset, M.; Mohamed, R. A novel plithogenic TOPSIS-CRITIC model for sustainable supply chain risk management. *J. Clean. Prod.* 2020, 247, 119586. [CrossRef]
35. Beskese, A.; Camci, A.; Temur, G.T.; Erturk, E. Wind turbine evaluation using the hesitant fuzzy AHP-TOPSIS method with a case in Turkey. *J. Intell. Fuzzy Syst.* 2020, 38, 997–1011. [CrossRef]
36. Ikram, M.; Sroufe, R.; Zhang, Q.; Zhang, Q. Prioritizing and overcoming barriers to integrated management system (IMS) implementation using AHP and G-TOPSIS. *J. Clean. Prod.* 2020, 254, 120121. [CrossRef]
37. Alimohammadiou, M.; Bonyani, A. Fuzzy BWANP multi-criteria decision-making method. *Decis. Sci. Lett.* 2019, 8, 85–94. [CrossRef]
38. Maghsoodi, A.I.; Mosavat, M.; Hafezalkotob, A.; Hafezalkotob, A. Hybrid hierarchical fuzzy group decision-making based on information axioms and BWM: Prototype design selection. Comput. Ind. Eng. 2019, 127, 788–804. [CrossRef]
39. Rezaei, J. Best-worst multi-criteria decision-making method. Omega 2015, 53, 49–57. [CrossRef]
40. Gupta, H. Assessing organizations performance on the basis of GHRM practices using BWM and Fuzzy TOPSIS. J. Environ. Manag. 2018, 226, 201–216. [CrossRef] [PubMed]
41. Chen, Z.; Lu, M.; Ming, X.; Zhang, X.; Zhou, T. Explore and evaluate innovative value propositions for smart product service system: A novel graphics-based rough-fuzzy DEMATEL method. J. Clean. Prod. 2020, 243, 118672. [CrossRef]
42. Ishizaka, A.; Resce, G. Best-Worst PROMETHEE method for evaluating school performance in the OECD’s PISA project. Socio-Econ. Plan. Sci. 2020, 100799. [CrossRef]
43. Omrani, H.; Amini, M.; Alizadeh, A. An integrated group best-worst method–Data envelopment analysis approach for evaluating road safety: A case of Iran. Measurement 2020, 152, 107330. [CrossRef]
44. Brauers, W.K.M.; Zavadskas, E.K. The MOORA method and its application to privatization in a transition economy. Control. Cybernet. 2006, 35, 445–469.
45. Hafezalkotob, A.; Hafezalkotob, A.; Liao, H.; Herrera, F. An overview of MULTIMOORA for multi-criteria decision-making: Theory, developments, applications, and challenges. Inf. Fusion 2019, 51, 145–177. [CrossRef]
46. Siksnelyte-Butkiene, I.; Zavadskas, E.K.; Bausys, R.; Streimikiene, D. Implementation of EU energy policy priorities in the Baltic Sea Region countries: Sustainability assessment based on neutrosophic MULTIMOORA method. Energy Policy 2019, 125, 90–102. [CrossRef]
47. Nabeeh, N.A.; Abdel-Monem, A.; Abdelmouty, A. A Hybrid Approach of Neutrosophic with MULTIMOORA in Application of Personnel Selection. Neutrosophic Sets Syst. 2019, 30, 1.
48. Asante, D.; He, Z.; Adjei, N.O.; Asante, B. Exploring the barriers to renewable energy adoption utilising MULTIMOORA- EDAS method. Energy Policy 2020, 142, 111479. [CrossRef]
49. Chen, Y.; Ran, Y.; Wang, Z.; Li, X.; Yang, X.; Zhang, G. An extended MULTIMOORA method based on OWGA operator and Choquet integral for risk prioritization identification of failure modes. Eng. Appl. Artif. Intell. 2020, 91, 103605. [CrossRef]
50. Rahimi, S.; Hafezalkotob, A.; Monavari, S.M.; Hafezalkotob, A.; Rahimi, R. Sustainable landfill site selection for municipal solid waste based on a hybrid decision-making approach: Fuzzy group BWM-MULTIMOORA-GIS. J. Clean. Prod. 2020, 248, 119186. [CrossRef]
51. Zavadskas, E.K.; Kaklauskas, A.; Sarka, V. The new method of multicriteria complex proportional assessment of projects. Techn. Econom. Develop. Econom. 1994, 1, 131–139.
52. Yazdani, M.; Alidoosti, A.; Zavadskas, E.K. Risk Analysis of Critical Infrastructures Using Fuzzy Copras. Econ. Res. Ekonomika Istraživanja 2011, 24, 27–40. [CrossRef]
53. Buyukozkan, G.; Gocer, F. A Novel Approach Integrating AHP and COPRAS Under Pythagorean Fuzzy Sets for Digital Supply Chain Partner Selection. IEEE Trans. Eng. Manag. 2019, 1–18. [CrossRef]
54. Ghose, D.; Pradhan, S.; Shabbiruddin, A. Fuzzy-COPRAS Model for Analysis of Renewable Energy Sources in West Bengal, India. In Proceedings of the 2019 IEEE 1st International Conference on Energy, Systems and Information Processing (ICESIP), Chennai, India, 4–6 July 2019; Institute of Electrical and Electronics Engineers (IEEE): Piscataway, NJ, USA, 2019; pp. 1–6.
55. Dhiman, H.S.; Deb, D. Fuzzy TOPSIS and fuzzy COPRAS based multi-criteria decision making for hybrid wind farms. Energy 2020, 202, 117755. [CrossRef]
56. Schitea, D.; Deveci, M.; Iordache, M.; Bilgili, K.; Akyurt, I.Z.; Iordache, I. Hydrogen mobility roll-up site selection using intuitionistic fuzzy sets based WASPAS, COPRAS and EDAS. Int. J. Hydrog. Energy 2019, 44, 8585–8600. [CrossRef]
57. Zavadskas, E.K.; Turskis, Z.; Antucheviciene, J.; Zakarevicius, A. Optimization of Weighted Aggregated Sum Product Assessment. Elektronika ir Elektrotechnika 2012, 122, 3–6. [CrossRef]
58. Ilbahar, E.; Cebi, S.; Kahraman, C. Assessment of Renewable Energy Alternatives with Pythagorean Fuzzy WASPAS Method: A Case Study of Turkey. In Advances in Intelligent Systems and Computing; Springer: Berlin/Heidelberg, Germany, 2019; pp. 888–895.
59. Keshavarz-Ghorabaee, M.; Govindan, K.; Amiri, M.; Zavadskas, E.K.; Antuchevičienė, J. An integrated type-2 fuzzy decision model based on waspas and seca for evaluation of sustainable manufacturing strategies. J. Environ. Eng., Landsc. Manag. 2019, 27, 187–200. [CrossRef]
60. Singh, R.K.; Modgil, S. Supplier selection using SWARA and WASPAS—A case study of Indian cement industry. Meas. Bus. Excell. 2020, 24, 243–265. [CrossRef]
61. Pusnik, M.; Sucic, B. Integrated and realistic approach to energy planning—A case study of Slovenia. Manag. Environ. Qual. Int. J. 2014, 25, 30–51. [CrossRef]
62. Wu, Y.; Tao, Y.; Zhang, B.; Wang, S.; Xu, C.; Zhou, J. A decision framework of offshore wind power station site selection using a PROMETHEE method under intuitionistic fuzzy environment: A case in China. Ocean Coast. Manag. 2020, 184, 105016. [CrossRef]
63. Makan, A.; Fadili, A. Sustainability assessment of large-scale composting technologies using PROMETHEE method. Eur. J. Oper. Res. 1986, 24, 228–238. [CrossRef]
64. Chen, T.-Y. A novel PROMETHEE-based method using a Pythagorean fuzzy combinative distance-based precedence approach to multiple criteria decision making. Appl. Soft Comput. 2019, 82, 105560. [CrossRef]
65. Kaya, B.Y.; Da˘ gdeviren, M. A combined approach for equipment selection: F-PROMETHEE method and zero–one goal programming. Expert Syst. Appl. 2011, 38, 11641–11650. [CrossRef]
66. Le Téno, J.; Mareschal, B. An interval version of PROMETHEE for the comparison of building products’ design with ill-defined data on environmental quality. Eur. J. Oper. Res. 1998, 109, 522–529. [CrossRef]
67. Geldermann, J.; Spengler, T.S.; Rentz, O. Fuzzy outranking for environmental assessment. Case study: Iron and steel making industry. Fuzzy Sets Syst. 2000, 115, 45–65. [CrossRef]
68. Goumas, M.; Lygerou, V. An extension of the PROMETHEE method for decision making in fuzzy environment: Ranking of alternative energy exploitation projects. Eur. J. Oper. Res. 2000, 123, 606–613. [CrossRef]
69. Keshavarz-Ghorabaee, M.; Govindan, K.; Amiri, M.; Zavadskas, E.K.; Antuchevičienė, J. An integrated type-2 fuzzy decision model based on waspas and seca for evaluation of sustainable manufacturing strategies. J. Environ. Eng., Landsc. Manag. 2019, 27, 187–200. [CrossRef]
70. Wu, Y.; Tao, Y.; Zhang, B.; Wang, S.; Xu, C.; Zhou, J. A decision framework of offshore wind power station site selection using a PROMETHEE method under intuitionistic fuzzy environment: A case in China. Ocean Coast. Manag. 2020, 184, 105016. [CrossRef]
71. Sennaroglu, B.; Celebi, G.V. A military airport location selection by AHP integrated PROMETHEE and VIKOR methods. Transp. Res. Part D: Transp. Environ. 2018, 59, 160–173. [CrossRef]
72. Makan, A.; Fadili, A. Sustainability assessment of large-scale composting technologies using PROMETHEE method. J. Clean. Prod. 2020, 261, 121244. [CrossRef]
73. Sylla, A.; Coudert, T.; Vareilles, E.; Geneste, L.; Aldanondo, M.; Ayachi, R. Possibility theory and PROMETHEE II for decision aid in engineering design process. IFAC PapersOnLine 2019, 52, 283–288. [CrossRef]
74. Gül, M.; Celik, E.; Gümus, A.T.; Gunerı, A.F. A fuzzy logic based PROMETHEE method for material selection problems. Beni-Suef Univ. J. Basic Appl. Sci. 2018, 7, 68–79. [CrossRef]
75. Wu, Y.; Wang, J.; Hu, Y.; Ke, Y.; Li, L. An extended TODIM-PROMETHEE method for waste-to-energy plant site selection based on sustainability perspective. Energy 2018, 156, 1–16. [CrossRef]
76. Andreopoulos, Z.; Koliouska, C.; Galariotis, E.; Zopounidis, C. Renewable energy sources: Using PROMETHEE II for ranking websites to support market opportunities. Technol. Forecast. Soc. Chang. 2018, 131, 31–37. [CrossRef]
77. Krishankumar, R.; Ravichandran, K.S.; Saeid, A. A new extension to PROMETHEE under intuitionistic fuzzy environment for solving supplier selection problem with linguistic preferences. Appl. Soft Comput. 2017, 60, 564–576. [CrossRef]
78. Afful-Dadzie, E.; Oplatková, Z.K.; Nabareseh, S. Selecting Start-Up Businesses in a Public Venture Capital Financing using Fuzzy PROMETHEE. Procedia Comput. Sci. 2015, 50, 63–72. [CrossRef]
79. El Mokrini, A.; Kafa, N.; Dafaoui, E.; El Mhamedi, A.; Berrado, A. Evaluating outsourcing risks in the pharmaceutical supply chain: Case of a multi-criteria combined fuzzy AHP-PROMETHEE approach. IFAC PapersOnLine 2016, 49, 114–119. [CrossRef]
80. Nasrollahi, M.; Ramezani, J.; Sadraei, M. A FBWM-PROMETHEE approach for industrial robot selection. Helijon 2020, 6, 03859. [CrossRef]
81. Hassani, H.; Beneki, C.; Unger, S.; Mazinani, M.T.; Yeganegi, M.R. Text Mining in Big Data Analytics. Big Data Comput. 2020, 4, 1. [CrossRef]
82. Bach, M.P.; Bertoncel, T.; Meško, M.; Krstić, Ž. Text mining of industry 4.0 job advertisements. Int. J. Inf. Manag. 2020, 50, 416–431. [CrossRef]
83. Allahyari, M.; Pouriyeh, S.; Assefi, M.; Safaei, S.; Trippe, E.D.; Gutierrez, J.B.; Kochut, K. A brief survey of text mining: Classification, clustering and extraction techniques. *arXiv 2017*, arXiv:1707.02919.

84. Guerreiro, J.; Rita, P.; Trigueiros, D. A Text Mining-Based Review of Cause-Related Marketing Literature. *J. Bus. Ethic* 2013, 119, 111–128. [CrossRef]

85. Ananiadou, S.; McNaught, J. *Text Mining for Biology and Biomedicine*; Citeseer: State College, PA, USA, 2006.

86. Zhang, W.; Yoshida, T.; Tang, X.; Wang, Q. Text clustering using frequent itemsets. *Knowl.-Based Syst.* 2010, 23, 379–388. [CrossRef]

87. Prabhu, R.M.; Hema, G.; Chepure, S.; Gupta, M.N. Logistics Optimization in Supply Chain Management using Clustering Algorithms. *Scalable Comput. Pr. Exp.* 2020, 21, 101876. [CrossRef]

88. Pröllochs, N.; Feuerriegel, S. Business analytics for strategic management: Identifying and assessing corporate challenges via topic modeling. *Inf. Manag.* 2020, 151, 103855. [CrossRef]

89. Cheng, X.; Zou, D.; Cheng, G.; Xie, H. Detecting latent topics and trends in educational technologies over four decades using structural topic modeling: A retrospective of all volumes of Computers & Education. *Comput. Educ.* 2020, 151, 103070. [CrossRef]

90. Prabhu, R.M.; Hema, G.; Chepure, S.; Gupta, M.N. Logistics Optimization in Supply Chain Management using Clustering Algorithms. *Scalable Comput. Pr. Exp.* 2020, 21, 101876. [CrossRef]

91. Dahl, O.; Johansson, F.; Khoshkangini, R.; Pashami, S.; Nowaczyk, S.; Pihl, C. Understanding Association Between Logged Vehicle Data and Vehicle Marketing Parameters-Using Clustering and Rule-Based Machine Learning. In Proceedings of the 3rd International Conference on Information Management and Processing (ICIMP), Portsmouth, UK, 9–11 January 2020.

92. Agarwal, R. Decision-Making with Temporal Association Rule Mining and Clustering in Supply Chains. In *Asset Analytics*; Springer: Berlin/Heidelberg, Germany, 2019; pp. 459–470.

93. Prabhu, R.M.; Hema, G.; Chepure, S.; Gupta, M.N. Logistics Optimization in Supply Chain Management using Clustering Algorithms. *Scalable Comput. Pr. Exp.* 2020, 21, 101876. [CrossRef]

94. Sabbagh, R.; Ameri, F. A Framework Based on K-Means Clustering and Topic Modeling for Analyzing Unstructured Manufacturing Capability Data. *J. Comput. Inf. Sci. Eng.* 2019, 20, 1–36. [CrossRef]

95. Gurcan, F.; Cagiltay, N.E. Big Data Software Engineering: Analysis of Knowledge Domains and Skill Sets Using LDA-Based Topic Modeling. *IEEE Access* 2019, 7, 82541–82552. [CrossRef]

96. Fortune, U. Text Mining of Twitter Data: Topic Modelling. Ph.D. Thesis, African University of Science and Technology, Abuja, Nigeria, June 2019.

97. Kolini, F.; Janczewski, L.J. Clustering and Topic Modelling: A New Approach for Analysis of National Cyber security Strategies. *PACIS 2017*, 126.

98. Pröllochs, N.; Feuerriegel, S. Business analytics for strategic management: Identifying and assessing corporate challenges via topic modeling. *Inf. Manag.* 2020, 57, 103070. [CrossRef]

99. Chen, X.; Zou, D.; Cheng, G.; Xie, H. Detecting latent topics and trends in educational technologies over four decades using structural topic modeling: A retrospective of all volumes of Computers & Education. *Comput. Educ.* 2020, 151, 103855. [CrossRef]

100. Erzurumlu, S.S.; Pachamanova, D. Topic modeling and technology forecasting for assessing the commercial viability of healthcare innovations. *Technol. Forecast. Soc. Chang.* 2020, 156, 120041. [CrossRef]

101. Kim, J.; Jang, S.; Park, E.; Choi, S. Text classification using capsules. *Neurocomputing* 2020, 376, 214–221. [CrossRef]

102. Suri, J.S. State-of-the-art methods in healthcare text classification system AI paradigm. *Front. Biosci.* 2020, 25, 646–672. [CrossRef]
108. Sarkar, S.; Ejaz, N.; Kumar, M.; Maiti, J. Root Cause Analysis of Incidents Using Text Clustering and Classification Algorithms. In Lecture Notes in Electrical Engineering; Springer: Berlin/Heidelberg, Germany, 2019; pp. 707–718.

109. Wang, J.; Jing, Y.-Y.; Zhang, C.-F.; Zhao, J.-H. Review on multi-criteria decision analysis aid in sustainable energy decision-making. Renew. Sustain. Energy Rev. 2009, 13, 2263–2278. [CrossRef]

110. Alarcon-Rodriguez, A.; Ault, G.; Galloway, S. Multi-objective planning of distributed energy resources: A review of the state-of-the-art. Renew. Sustain. Energy Rev. 2010, 14, 1353–1366. [CrossRef]

111. Bazmi, A.A.; Zahedi, G. Sustainable energy systems: Role of optimization modeling techniques in power generation and supply—A review. Renew. Sustain. Energy Rev. 2011, 15, 3480–3500. [CrossRef]

112. Mardani, A.; Jusoh, A.; Zavadskas, E.K.; Cavallaro, F.; Khalifah, Z. Sustainable and Renewable Energy: An Overview of the Application of Multiple Criteria Decision Making Techniques and Approaches. Sustainability 2015, 7, 13947–13984. [CrossRef]

113. Kumar, A.; Sah, B.; Singh, A.R.; Deng, Y.; He, X.; Kumar, P.; Bansal, R. A review of multi criteria decision making (MCDM) towards sustainable renewable energy development. Renew. Sustain. Energy Rev. 2017, 69, 596–609. [CrossRef]

114. Bhowmik, C.; Bhowmik, S.; Ray, A.; Pandey, K. Optimal green energy planning for sustainable development: A review. Renew. Sustain. Energy Rev. 2017, 71, 796–813. [CrossRef]

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