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Analysis of artificial intelligence-based technologies and approaches on sustainable entrepreneurship

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ABSTRACT

Research in the field of entrepreneurship has grown dramatically in the last decade and currently covers a wide variety of topics and concerns. Development in the field of artificial intelligence has a positive and negative impact on sustainable development. The current debate on sustainable development emphasizes the relevance of the environment, behavioral goals, and economic models to achieve sustainable goals, particularly in impoverished nations. However, recently, researchers have proposed the use of algorithms and models based on artificial intelligence (AI) to achieve sustainable development goals. In this context, this study intends to shed light on AI's crucial role in aiding sustainable development. To accomplish this goal, we collected data from Scopus (1994–2022). This includes a total of 482 research articles. The investigation shows the most essential patterns of study, enabling the visual mapping of Thematic Maps to suggest several new research paths. The results in the paper indicates that there is a positive relation between AI and environment development on sustainable entrepreneurship.

1. Introduction

Entrepreneurship and sustainability development have been brought together to create a new field "sustainable entrepreneurship". Even though it has been widely disseminated in recent years (Dean and McMullen, 2007). An important milestone in sustainable development was established in 1987 by the WCED, which is being used by governments, corporations, and civil society groups worldwide to help create a more sustainable world (Whalen, 1987). It's been reported by researchers as well. It is sustainable development when current requirements are met without jeopardizing the capacity of future generations to satisfy their own (Goel and Joshi, 2017; Yunis et al., 2020). However, for some researchers, it can be sued to solve environmental and social issues (Fahs and Abou-Faycal, 2018; Gerlach, 2003; Schaltegger et al., 2016); but for some researchers, it is the need for economic development (Boons and Lüdeke-Freund, 2013; Crals and Vereeck, 2005). Moreover, some authors believe that sustainable entrepreneurialism can only be achieved through the overall development of the environment and economy with the help of people (Schaltegger and Wagner, 2011). However, researchers are still unable to completely define the concept of sustainable entrepreneurship (Belz and Binder, 2017; Schaltegger et al., 2016; Lumpkin et al., 2013). It is essential to know about sustainable development to grasp the notion of sustainable enterprise (Hossain, 2021; Mansour et al., 2022). Increasing the number of people who start their own businesses is critical for the progress of a country. In terms of creating jobs, boosting the economy, launching new businesses, and influencing social change and evolution, the success of entrepreneurship is critical for all nations (Yaşlıoğlu and Yaşlıoğlu, 2020). Fig. 1 represents the factors that affect sustainable entrepreneurialism.

Academics and practitioners see sustainability as a multifaceted term. As a result of bringing together the principles of sustainability and

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Fig. 1. Sustainable development.

entrepreneurship, it generally assumed that the goods or services being given would be good for the natural world; people's right to life; and society. The idea of sustainable entrepreneurialism, which is based on conventional entrepreneurialism, is based on the idea that sustainable goods would provide economic advantage or profits (Dean and McMullen, 2007; Kuhlman and Farrington, 2010; Yaşlıoğlu and Yaşlıoğlu, 2020). Educators in sustainable entrepreneurship help people to learn how to make the most of the resources they now have while also minimizing the impact they have on the ability of future generations to use those resources (Hermes and Rimanoczy, 2018). "protection of the environment, life support, and community in the pursuit of perceived chances to bring into existence future goods, processes, and services for gain, where gain is generally considered to encompass economic and non-economic advantages to people, the economy, and society" (Shepherd and Patzelt, 2011). This concept highlights that sustainable entrepreneurship is not just about starting new sustainable businesses but also about reforming and managing existing businesses so that they are sustainable as well. As a result, sustainable entrepreneurship can occur in start-ups, small and medium enterprises (SMEs), and large corporations to varying degrees. Sustainability and fairness are the goals of sustainable entrepreneurship, as Hall et al. (2010) points out, and this is why it is so important.

The previous paragraphs explain the concepts of sustainable development and its dependence on other factors such as environmental conditions. However, with recent developments in the field of artificial intelligence (Fatemidokht et al., 2021; Cvitić et al., 2021; Ren et al., 2021) to solve many research problems (Alsmirat et al., 2019; Mishra et al., 2021; Elgendy et al., 2021), many researchers recommend techniques for sustainable development based on artificial intelligence (Akl et al., 2021; Azar et al., 2018). In this context, we conducted this detailed survey to analyze the effect of artificial intelligence (Tarhini et al., 2022; Sharma et al., 2022) on sustainable development. The main objective of this survey is to find the answer to the following research questions:

- What are the recent research themes related to the integration of sustainable development and artificial intelligence.
- what are recent work in the field of sustainable development related to AI
- How sustainable development is related to environmental change.

The remainder of the paper is organized as follows. Section 2 presents the literature survey. Section 3 presents the relation between sustainable development and environmental variables. Sections 4 and 5 present the research methodology and results. Section 6 presents the theoretical and practical implications. Finally, Section 7 concludes the paper.

2. Literature survey

A recent research on AI-based Sustainable Entrepreneurship is described in this section. A wide number of industries have been affected by the rise of artificial intelligence. Consider how AI is predicted to impact global productivity, equality, and many other aspects of our lives in the next few years. Because of this, researchers are recommending the use of artificial intelligence (AI) for sustainable growth (Bibri, 2020; Subotić et al., 2021; Wang et al., 2020).

The authors (Saheb et al., 2022) proposed a new approach to topic modeling that combines LDA, BERT, and clustering. The authors analyzed the content of linked scientific articles to determine the primary academic issues, subtopics, and interrelated topics in sustainable AI in energy research using computational analyses. There were eight main themes that emerged from the suggested investigation. The authors of the report also made 14 suggestions for possible directions for further research. In another study, for the 17 Sustainable Development Goals, the authors (Hsu et al., 2022) used a combinatorial fusion approach to merge a topic model classifier with a semantic link classifier. The authors use rank-score characteristic function and cognitive diversity of the models to describe and analyze each unique model. In this work, the authors used a combination of scores and a combination of ranks to assess the classification results of the combination of model scores and combination of ranks. To achieve their aim of study, the authors (Li, 2022) of this work constructed a sustainable development assessment system of urban and rural spatial resources using artificial intelligence technology, which they then used to properly choose and standardize the evaluation variables and indicators to correctly assess urban and rural spatial planning. In this study, urban-rural spatial standards are examined and a method is developed to assess their applicability. The article also defines the criteria to assess its suitability. The results of the experiment reveal that the planning strategy is highly adaptable to the environment and reasonable. Furthermore, in this article (Liu et al., 2022), the authors also intend to design a way that can use the best AI approaches to help decision-making for long-term operations based on lifecycle data. Reinforcement learning, in particular, can be used to assist decision making at various points in the life of an artificial intelligence (AI) system. Afterward, a generalized method is presented to apply reinforcement learning to decision support based on lifetime data, such as operating and maintenance data. Using a case study of multinational automotive manufacturing, the strategy has been shown to be effective. In this research, artificial intelligence technologies and techniques are evaluated as potential candidates for new sustainable business intelligence applications (Ligeza et al., 2021). There are several basic aspects that define the functional features, strengths, and influence of chosen technologies on the long-term growth of Business Intelligence. Technology from the past and the present was analyzed in terms of the most important aspects. The final results show that novel AI applications in BI may have a significant effect. The findings of this research could have a significant impact on management's ability to choose and combine AI-related technologies effectively. It is a good starting point for future conversations about how to make progress in certain areas, as well as the apparent synergistic effect and the potential for implementation.

3. Environment and entrepreneurship sustainability

Entrepreneurship has evolved in recent years, and researchers are now claiming that it is interconnected with every aspect of our world. It

is infused with social ideals associated with economic growth and also with environmental development. In another way, the growth of a business or a company is one of the reasons behind it (Galindo-Martín et al., 2020; Sarkodie and Strezov, 2019; İyigün, 2015; Hall et al., 2010). Some researchers assume that the development of entrepreneurial activity leads to the degradation of environmental conditions (Bator, 1958; Cropper and Oates, 1992; Pigou, 1932); however, some researchers do things opposite to that (Cohen and Winn, 2007; York and Venkataraman, 2010; Dean and McMullen, 2007).

3.1. Effect of entrepreneurship on environment

Social, economic, and environmental values are the three fundamental philosophies of sustainable business development (Mourad et al., 2020; Dhahri and Omri, 2018). In recent years, researchers have focused their efforts on the development of sustainable entrepreneurship, focusing on these three pillars of sustainable intermediate ship development. They have discovered that the development of sustainable intrapreneurship requires a balance of economic and social growth (Thompson et al., 2011). The author in (Gu and Zheng, 2021) attempted to illustrate the environment's models in relation to entrepreneurship. In this work, the author attempted to depict the link between economics, environmental development, and entrepreneurship in this work. The author wrote the study, which is mostly focused on China. The purpose of this study is to determine the link between the environment and the economy using the Kuznet curve. According to this curve, the environment and economy have a U-shaped connection; as the economy grows, the environment first declines, reaches a trough, and then begins to climb again. The Kuznet curve (Kuznets, 1955) was proposed in 1995, providing a link between income disparity and economic growth, and subsequent research has shown a direct link between environmental development and economic growth (Adu and Denkyirah, 2017; Dinda et al., 2000; Buehn and Farzanegan, 2013; Brock et al., 2010). In Youssef et al. (2018) the authors try to represent the relationship between environmental development and sustainable entrepreneurs with the help of the Kuznet curve. The authors used data from African nations and proved that there is a positive relationship between environmental resources and sustainable enterprise. Also, the authors in (Tamazian et al., 2009) try to show that the EKC curve can efficiently measure sustainable development and many real-world factors. In addition, there are several other authors who illustrate the relationship between environment and change in international commerce (Al-Mulali et al., 2015; Omri, 2013; Omri et al., 2015), human growth (Costantini and Monni, 2008; Gürlük, 2009), and financial development (Omri et al., 2015; Sinha et al., 2017). Many authors are trying to find a relationship between different environmental parameters and sustainable entrepreneurship growth, more problems with their hypothesis are represented in Table 1.

3.2. Effect of environment on sustainable entrepreneurship

Sometimes environmental conditions have a negative effect on sustainable entrepreneurship development; the effect of the COVID-19 epidemic on negative economic growth is an example of this situation. Many researchers have tried to find the relationship between economic development and sustainable entrepreneurialism during environmental crises or epidemic conditions (Acs et al., 2012; Aghion, 2017; Galindo and Méndez, 2014; Galindo-Martín et al., 2021b, 2021a). COVID-19 pandemics have a negative impact on economic growth and employment, among other things, which has affected nations that have been able to overcome the effect of the global economic crisis. COVID 19, like other economic factors, has had a negative influence on entrepreneurialism. Several businesses have gone out of business as a consequence of restrictions on travel enforced by governments in an effort to stop the spread of illness. Owing to decreased demand, firms that continue to operate do so at reduced profits, and many are concerned about the future due to fresh coronavirus outbreaks brought on by the disease's increased virulence. Due to the impact of COVID-19 on the economy and jobs, officials devised a strategy to mitigate its negative impacts. As has been the case in previous crises, they enhance growth-promoting forces. Experts believe that entrepreneurialism is a key aspect in promoting development. It has become necessary to integrate environmental issues into economic growth analyzes due to the current state of the economy. Sustainable development, according to some scholars, would be hampered by the scarcity of natural resources (Demirel and Kesidou, 2019; Acs et al., 2012; Hall et al., 2010; Galindo-Martín et al., 2020). In this context, the authors conduct a theoretical and empirical examination of entrepreneurial activity based on the Venture Facilitation method (Jana, 2020) which the authors conducted in (Galindo-Martín et al., 2021b), which also considers the experience of the OECD. The authors are interested in experimentally testing how the present economic crisis impacts entrepreneurial activity, with an emphasis on financial variables, government policies, and the supply side of things. Therefore, the authors present a model based on structural equations to address this problem. It was selected for its efficiency in the case of complicated causal models with small samples (Wong, 2013) because it allows for links between numerous variables, both observable and latent, and estimates effects that are both direct and indirect (Henseler et al., 2009). Rather than being exploratory, these models are confirmatory, since they combine theoretical knowledge and assumptions with empirical data to facilitate statistical confirmation of hypotheses, and they may include formative and reflective factors (Hair et al., 2019). Taking into account the endogenous variable of entrepreneurialism, the authors of this study developed two models, A and B, to perform the empirical estimate. Model B uses a desegregated version of the Global Entrepreneurship Index (GEI) sub-index to examine how much weight each of the indicators has. Both models used the same seven variables: Entrepreneurship, Sustainable Development, growth of the money supply, interest Rate, fiscal factor, Business Expectations, and Competitiveness.

Table 1
Different approaches relating environmental parameters and sustainable development.

Approach	Methology
(Apergis and Ozturk, 2015)	Inverted "U" reatin between CO2 and percapita income
(Stokey, 1998)	Inverted "U" reatin between income and pollution
(Culas, 2007)	Inverted "U" reatin between income and deforsetaion
(Gu and Zheng, 2021)	Inverted "U" reatin between three wast parameters and income
(Shen and Xu, 2000)	Inverted "U" reatin between three wast parameters and GDP
(Sinha et al., 2017)	"N" Relation beteen carbon emission and income
(Grossman and Krueger, 1991)	Relaion between growth of economy and quality of environment
(Feng, 2008)	Postive "U" relation between pollution and technology
(Youssef et al., 2018)	EKC model between environment and entrepreneureship
(Tamazian et al., 2009)	EKC model between different real ord issues and sustaniable entrepreneureship
(York and Venkataraman, 2010)	Positive relation between environment and development

4. Research methodology

The impact of artificial intelligence and machine learning on long-term development was examined in great depth in a comprehensive review of the literature in this field. The review process was guided by the PRISMA technique. For the systematic and repeatable examination and synthesis of current research materials, systematic reviews are another research technique. Step-by-step instructions for writing this paper are as follows: Selection of the database, adjustment of the research criteria, coding of recovered data, and evaluation of the

information were all part of this procedure. We use the Scopus database, as it contains the vast majority of standard publications. The map incorporates articles published in English between 1994 and 2022 to reflect the current state of research around the world. The data was collected in April 2022 using the Scopus bibliographic database. We use the following query to collect information about the article from the Scopus database.

((TITLE-ABS-KEY (entrepreneurship) OR TITLE-ABS-KEY (business)) AND TITLE-ABS-KEY ("Sustainable") AND TITLE-ABS-KEY ("artificial intelligence")) AND (LIMIT-TO (LANGUAGE, "English"))

5. Results and discussion

Inquiry into a topic's bibliographies may provide information on how the subject has progressed and suggest new avenues of investigation. An aerial view of a certain location gives an overview of several aspects. This section provides an overview of scientific output throughout time, as well as a breakdown by subject area and publication venue of the most frequently referenced papers, institutions, and authors. The results of the research are also examined to determine the most significant trends in the development of sustainable development. AI and machine learning are a hot topic. Table 1 summarizes the information in our database. Table 2 shows that our data set comprises 305 publications published between 1994 and 2022, with a total of 20,902 references for these 305 articles. We can also state that the influence of AI and ML on sustainable development is a fascinating issue, as there are many writers who worked on it during this period, since there were 1484 distinct authors who published articles.

5.1. Analysis of source impact

In this part, we examine the sources of the publications. There are many metrics that can be used to compare the productivity and influence of sources: number of citations; number of publications; H index; G index; and M index. Consequently, in Table 3, the top ten most productive sources are shown. Table 3 shows that the JOURNAL OF CLEANER PRODUCTION is the most cited source, with the most citations.

The significance of the source can be determined based on factors other than quality and quantity, such as subject matter. Sankey diagrams are used in Fig. 2 to illustrate this requirement. Sankey diagrams have traditionally been used to depict the transfer of energy or materials in networks and processes. Quantitative information on flows, interactions, and transformations is shown in these diagrams. A weighted network connects each node in a Sankey diagram, and the incoming weight of each weighted node is equal to its outgoing weights. The first, second, and third rows in show the source, keywords, and nations, respectively. In other words, this Sankey diagram may readily express the fundamental themes in which the corresponding source publishes articles using this Sankey diagram depiction. According to the rules of the Sankey diagram, most sources publish articles on *sustainability management* and *artificial intelligence*.

Table 2
Database information.

Description	Results
Database information	
Time period	1994:2022
Total sources	305
Documents	482
References	20,902
TYPE of document	
Article	184
Book	7
Book chapter	32
Conference paper	197
Conference review	31
Editorial	2
Note	1
Review	28
Keywords	
Keywords plus (ID)	3011
Author's keywords (DE)	1517
Author details	
Authors	1484
Authors of single-authored documents	68
Authors of multi-authored documents	1416

Table 3
Source impact.

Element	H index	G index	M index	TC	NP	PY start
Journal of Cleaner Production	8	8	0.615	474	8	2010
Sustainability (Switzerland)	11	19	2.2	389	25	2018
Environmental Modeling and Software	1	1	0.083	218	1	2011
Water Resources Management	5	5	0.357	196	5	2009
Technological Forecasting and Social Change	4	4	1.333	163	4	2020
Journal of Scheduling	1	1	0.058	131	1	2006
International Journal of Production Research	3	4	0.3	109	4	2013
Journal of Business Research	2	2	0.667	99	2	2020
International Journal of Health Geographics	1	1	0.2	91	1	2018
Procedia Manufacturing	1	1	0.167	87	1	2017
Energies	1	1	0.333	82	1	2020
Computer	1	1	0.2	80	1	2018
International Journal of Information Management	1	1	0.333	73	1	2020
International Journal of Management Education	2	2	0.667	62	2	2020
Journal of Industrial and Production Engineering	1	1	0.5	56	1	2021
Technology in Society	2	2	0.2	52	2	2013
Applied Sciences (Switzerland)	2	2	0.667	48	2	2020
Sensors (Switzerland)	2	2	0.25	48	2	2015
Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	5	6	0.217	47	8	2000

5.2. Author and countries distribution

In this part, we provide statistical information on the authors who are actively involved in the investigation of the influence of AI and ML on sustainable development. There are a variety of methods for identifying the most prolific writers on a certain topic. One way to classify writers is based on the number of citations they have received. The author's stats are shown in Fig. 3a. According to Fig. 3a, the authors who are actively involved in the area include: CHATTERJEE P, HASHEMKHANI ZOLFANI S,YAZDANI M, ZAVADSKAS EK, ASCOUGH JC, CHEN S, CHEW J, CUDDY S, EL-SAWAH S, ELMAHDI A, HAASE D.

The biblomatrix's distribution of researchers according to countries is also an important and helpful feature. Researchers in a country are judged on this criterion. Fig. 3b shows the distribution of nations according to the total number of articles published and the authors who wrote them. It can be seen in Fig. 3b, which shows which countries have the highest frequency of published articles, that the top 10 countries with the most articles are.

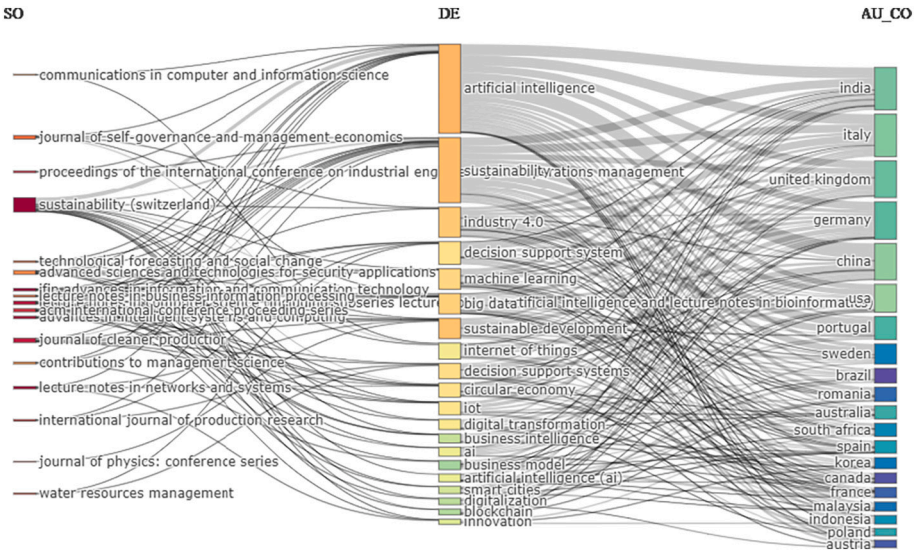
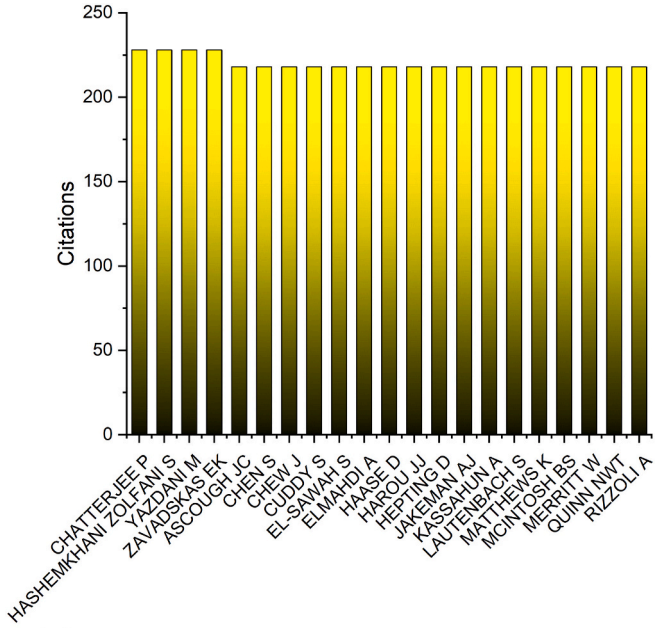
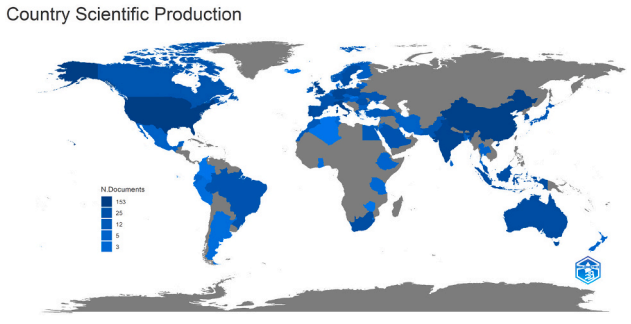


Fig. 2. Source distribution according to keywords.



a: Authors citation



b: Country Distribution

Fig. 3. Distribution of authors and country.

5.3. Analysis of distribution of articles

In this part, we go into more depth on how research publications are distributed among scientists. However, not all articles published in the field of study are of high quality and contain useful information. As a result, we found highly referenced publications on AI and machine learning for sustainable development to compile the material for this article. Table 4 shows the specifics of this type of paper.

5.4. Analysis of trending research topics

In this part, we examine the current research orientations and trends. To begin, we look at how the paper's keywords are distributed. The primary topic of the paper is represented by its keywords. Increasing the size of each term in Fig. 4a corresponds to an increase in its frequency in our database of studies. As a result of the research in Fig. 4a, the following are the most significant keywords:

- artificial intelligence (98)
- sustainability (59)
- sustainable development (29)
- industry 4 0 (27)
- big data (24)
- machine learning (20)
- decision support systems (19)
- decision support system (17)
- circular economy (16)
- IoT (15)
- digital transformation (13)

Scholars' research interests may be seen via the use of these popular terms. Since most of the papers deal with AI and sustainability, we may conclude that the vast majority of researchers are focusing their efforts on these issues. Keyword growth is also a good parameter to analyze the research trend. Fig. 4b and c represents evolution and growth of keywords. From Fig. 4b, it is clear that two important keywords; *artificial intelligence* and *sustainability* show exponential growth during 1994 to 2022. This means that most researchers are working on these research topics. Moreover, from Fig. 4c, it is clear that before 2005 artificial intelligence and sustainable development were the only research topics. However, after 2005 researchers started working in many different fields such as *decision support system*, *water supply*, *business models*, *risk assessment*, *information system*, *management science*. Finally, between

Table 4
Highly cited articles.

Paper	DOI	Total citations	TC per year	Normalized TC
(Yazdani et al., 2017)	https://doi.org/10.1016/j.jclepro.2016.10.095	228	38	8.1088
(McIntosh et al., 2011)	10.1016/j.envsoft.2011.09.009	218	18.1667	8.4206
(Geiger et al., 2006)	10.1007/s10951-006-5591-8	131	7.7059	4
(Elia et al., 2020)	10.1016/j.techfore.2019.119791	117	39	10.2696
(Hallstedt et al., 2010)	10.1016/j.jclepro.2009.12.017	113	8.6923	5.1152
(Di Vaio et al., 2020b)	10.1016/j.jbusres.2020.08.019	94	31.3333	8.2508
(Kamel Boulos et al., 2018)	10.1186/s12942-018-0144-x	91	18.2	6.8201
(Waibel et al., 2017)	10.1016/j.promfg.2017.02.094	87	14.5	3.0941
(Yigitcanlar et al., 2020)	10.3390/en13061473	82	27.3333	7.1975
(Shiroishi et al., 2018)	10.1109/MC.2018.3011041	80	16	5.9957
(Christodoulou and Deligianni, 2010)	10.1007/s11269-009-9441-2	75	5.7692	3.3951
(Nishant et al., 2020)	10.1016/j.ijinfomgt.2020.102104	73	24.3333	6.4075
(Di Vaio et al., 2020a)	10.3390/SU12124851	70	23.3333	6.1442
(Awan et al., 2018)	10.3390/su10124473	61	12.2	4.5717
(Y. Liu, 2013)	10.1080/00207543.2012.720392	59	5.9	4.358
(Tseng et al., 2021)	10.1080/21681015.2021.1950227	56	28	16.8675
(Goralski and Tan, 2020)	10.1016/j.ijme.2019.100330	55	18.3333	4.8276
(Chung and Lansey, 2009)	10.1007/s11269-008-9300-6	46	3.2857	3.8333
(Mahmoud et al., 2014)	10.1007/s11269-014-0681-4	45	5	6.5625
(Riera Pérez et al., 2018)	10.1016/j.scs.2017.12.038	42	8.4	3.1478

2015 and 2022, researchers working in the field of *decision making* are moving their work toward the development of *Internet of things*. Finally, Fig. 4d represents the trending keywords used by the researchers. From Fig. 4d, it is clear that the frequency of occurrence of the highest frequency of keywords *artificial intelligence* and *sustainable development* is in the year 2019.

Keyword theme diagrams were constructed using coword analysis. A thematic map is a visual representation of the relationships between several study areas. Characteristics of centrality and density are used to construct themed maps. To better grasp what is happening now and how far the research area has come, we divided the time period into three parts. The following are the specifics for each era's themes

- Fig. 5a depicts the general evolution of the research phrases related to that particular topic. There are two main themes two subthemes one emerging subject and two specialized themes in this collection of work. Fig. 5a shows that academics are using AI information management and big data to study sustainability IoT economics business development innovation and digital technologies
- Fig. 5b depicts the evolution of research phrases from 1994 to 2005. There are one motor theme and one basic theme in this collection of work. Fig. 5b shows that academics are mainly working on AI and possible development.
- Fig. 5c depicts the general evolution of the research phrases during 2005 to 2015. There are two motor themes, two basic themes, one niche theme, and two emerging themes in this collection of work. Fig. 5c shows that academics work in the field of business models and management systems.
- Fig. 5d depicts the general evolution of the research phrases during 2015 to 2022. There are two basic themes, one niche theme, and one emerging theme in this collection of work. Fig. 5d shows that academics are working to develop new models for the industry sector using the concepts of AI and sustainable development.

6. Theoretical and practical implications

Several theoretical implications can be drawn from this work. First, it provided the evolution history of sustainable entrepreneurship over the years. This research analyzes the articles qualitatively and measures all development scenarios. Second, we analyze all highly cited articles published in the field of sustainable entrepreneurship to understand the need and requirement of the respective sector. According to our findings, the increase in interest in sustainable entrepreneurship is due in large part to the development and deployment of cutting-edge technologies. Furthermore, this research aims to identify the most current trends in the retail sector. To stay up to date on the latest developments in sustainable entrepreneurship research, we investigate the work of scholars around the world. Research found that AI, sustainability, sustainable development, industry 4.0, big data, and ML are the most important topics in the present literature. Therefore, new frameworks and methodologies are needed to deal with the issues raised by these subjects.

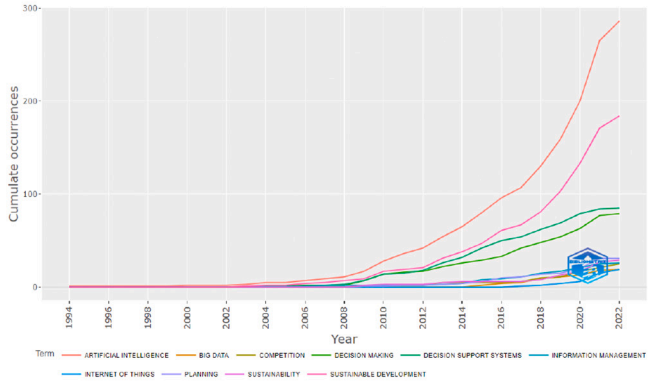
There is a wide scope of sustainable development in the entrepreneurship sector through the incorporation of artificial intelligence and other cutting-edge technologies. However, there are still many challenges to develop this field of research. Keeping up with the rapid pace of technological change is a constant struggle for countries today in an increasingly competitive world. Everyone from government officials to corporate leaders to nongovernmental organization activists, academics, and everyday individuals is increasingly worried about their countries' ability to compete in the new information economy. Engineers play a critical role in creating a long-term competitive edge for the nation by proposing inventive solutions to a wide range of technological and social problems. Because of this, it is crucial to consider how different it is to form theories of sustainable entrepreneurship. The lack of legislation to encourage sustainable development in entrepreneurship, the lack of understanding of the significance of sustainability, the lack of assistance from the education ministries and the lack of cooperation between the environmental, educational, health, agriculture, and other relevant ministries are all issues. Thus, there is a need for the development of new theories and techniques to integrate AI and other latest technologies with sustainable development in entrepreneurship.

7. Conclusion

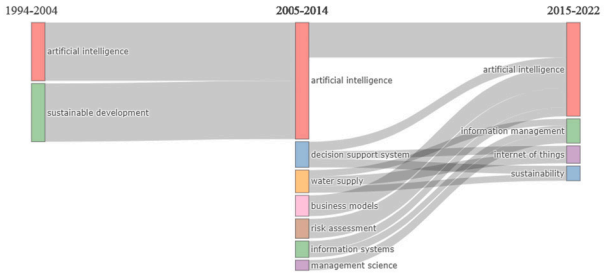
This research examine the present state of sustainable development in the context of artificial intelligence and machine learning. A benefit of this work is that it has been shared with academics and retailers alike, adding to their collective wisdom.

In this paper, a vast number of articles are covered (between 1994 and 2022). A broad variety of academic areas have documented the sustained growth of artificial intelligence and machine learning methods and algorithms. Some examples of research currently being carried out include artificial intelligence, sustainable development, industry 4 0, big data, machine learning, and decision support systems. Scholars are studying the topic of sustainable development in a wide variety of academic disciplines. This interest in sustainable development is evident in the contributions made by countries and institutions of various origins,

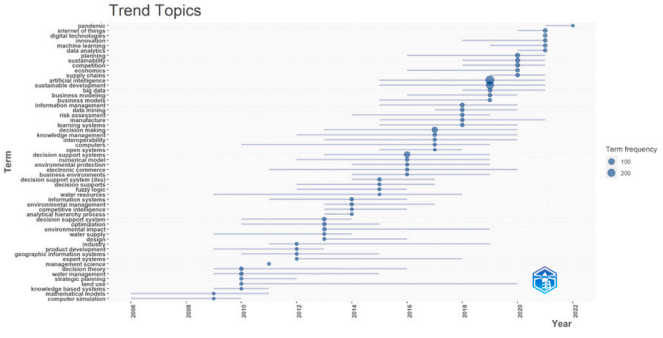
(a) Keyword Distribution



(b) Keyword Growth



(c) Keyword Evolution

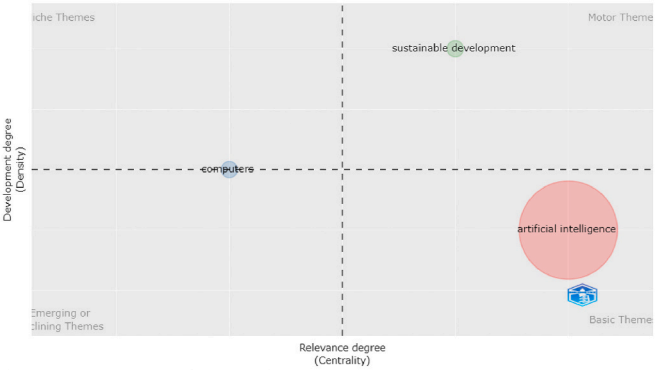


(d) Trending Keywords

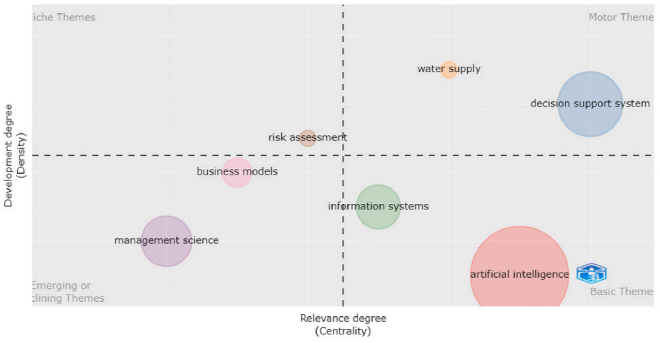
Fig. 4. Keyword dynamics.

apart from the geographical and intellectual variety. According to a growing number of articles and citations, sustainable development appears to be an increasing trend. Finally, from all the results and discussion, we conclude that AI has a positive impact on sustainable entrepreneurship. In the future, we include papers from other databases, such as the web of science, in our research.

(a) Thematic Map



(b) Keyword Analysis for time slice 1



(c) Keyword Analysis for time slice 2

(d) Keyword Analysis for time slice 3

Fig. 5. Trending topics.

Credit authorship contribution statement

B. B. G., Conceptualization, Formal analysis, writing, Supervision.
A. G., Conceptualization, Formal analysis, Writing.
P. K. P., Conceptualization, writing, Supervision.
V. A., Conceptualization, writing.

Data availability

Data will be made available on request.

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