Mapping and Visualization of Artificial Intelligence for Digital Economy Research: A Bibliometric Approach

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***Abstract*— Artificial Intelligence (AI) seems to be a disruptive technology that defines and reshapes the economy, more efficient industrial processes, new business models, and the service sector, becoming the development of different practices than before. The literature shows that it will be included in all fields and people's lives, as is the case in the digital economy. Artificial Intelligence for Digital Economy has not been studied significantly. This study uses bibliometric analysis to graphically map scientific publications and research trends in the Artificial Intelligence for Digital Economy sector around the world in the last ten years. The Scopus database was used to collect metadata information for this study, and VOSViewer was used to demonstrate bibliometric network mapping. We use an article selection procedure starting with the searched keywords and year constraints and then exporting the database to a RIS file format. Over the last ten years, we retrieved 540 scientific publications published between 2012 and 2021 from the Scopus database. From the data obtained, researchers at the Russian Federation have the most published papers indexed by Scopus among the most productive countries (N=131), the most productive authors are Petrenko, S.A. (N=4), and the most subject area is Computer Science (N=246). We also use VOSViewer to map the Network Theme. This study recommends incorporating research subjects Artificial Intelligence for Digital Economy: Thing, Education, Platform, Global Economy, abbreviated as TEPGE research theme.**

Keywords— artificial intelligence, digital economy, mapping, bibliometric, visualization

I. INTRODUCTION

Due to the proliferation of both the Internet and personal computers, an increasing number of people now have regular access to both, with the latter serving as the primary means by which they may learn about and make use of a vast array of topics and information [1]. In China, 48.8 percent of the population is online at any one time. The advent of the Internet has ushered modern society into the "network economy", with e-commerce as a central component [2]. Buyers supply diverse information and sales operations to customers directly through internet platforms. Manufacturers, retailers, service, and wholesalers' providers have all witnessed significant benefits, resulting in a significant rise in the effect of company operations, which considerably improves marketing and transaction efficiency. In this environment, practically every firm and customer recognize the need of shifting from physical to online sales.

Future expansion of China's digital economy will be mostly driven by artificial intelligence [2], and online transactions will be an essential component of the digital economy [3]. China's internet retail sector has prospered after more than a decade of expansion [4]. Business life cycles show that the e-commerce industry, which is built on an e-commerce platform, is now climbing. As one of the most significant successes in today's digital economy, internet shopping requires constant monitoring of consumer behavior data and the accurate forecasting of market developments.

It has been noted several times in worldwide literature that digital transformation of company is a move from traditional to digital business practices [5]. We don't think this is just a transition from the traditional "bricks and mortar" storefront to the more modern "clicks and bricks" one. Through the use of cutting-edge and often convergent technologies, digital transformation has permeated every sector of the economy and every type of business. So, the point of digital transformation is to use the web to make a regular company into a frontrunner in the digital economy. The majority of technologically sophisticated businesses, like Netflix, Google, Airbnb, and Uber, have built and executed digitized, collaborative business models, and open business models that are integrated into a coherent ecosystem of producers and consumers. Digital business transformation, according to one viewpoint, is an ecosystem of inventive platforms in which "Uber, the world's largest taxi firm, does not own cars and Facebook, the world's most popular media owner, does not generate content". "At the same time, Alibaba, the world's most expensive retailer, has no inventory, and Airbnb, the world's largest housing provider, does not own real estate" [6]. Due to the digital revolution, subscription services have become more popular than owning assets or selling things that need low inventory levels and subsequent amortization.

By analyzing consumer activity on social shopping platforms, fashion brand managers may gain a deeper understanding of how customers build collective perceptions of brands [7]. There is a notion known as "international online

shopping". People's initial e-commerce intentions are positively influenced by trust in China and the United Kingdom according to an investigation of a two-stage theoretical model of US consumer behavior in both countries [8]. It was the goal of the research to figure out what aspects of online shopping convenience impact customers' online buying preferences. As a result of this study, we now have more information on what makes people happy while shopping online and how to enhance our shopping habits as a result of it [9]. Perceived usefulness, usage intention, topic norms, subjective norms, and perceived pleasantness were shown to be associated to online shopping's acceptability, which was researched utilizing mostly minimal solution structural formula modeling [10].

Using the Scopus database, we analyzed research on AI for the digital economy throughout the past decade, from 2012 to 2021. Scopus has indexed 540 scholarly articles on the topic of AI for the digital economy. VOSviewer and the Scopus graphically map let us analyze and visualize our research findings.

II. Research Methods

A methodical and transparent bibliometric evaluation process that emphasizes the limits of knowledge [11]. Figure 1 depicts the search and selection criteria for bibliometric analysis purposes. Scopus, one of the most-cited archives, was utilized to get the data. This study used the search phrases "Artificial Intelligence for Digital Economy" to avoid selecting publications that were inappropriate to its aim.

Only those terms are considered to maximize relevant search results. We used various specialty publications in the last ten years, from 2012 to 2021. A search was performed on May 20, 2022. There were 975 documents retrieved initially, however this number dropped to 822 after excluding older articles (from before 2012) from the study. We restrict the source type to Journal, dan Conference Proceeding, then the result of the document reduces to 585. Then, we choose the language English only, and the documents reduce to 540. The bibliometric information of 540 articles was analyzed. Figure 1 depicts the steps involved in making a purchase decision.

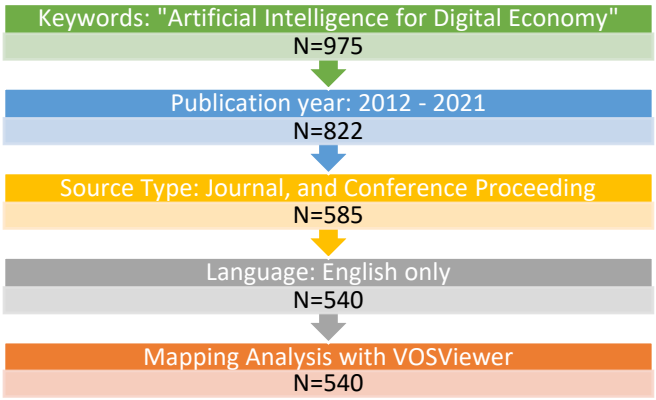


Fig. 1. Article selection process

A statistical approach for examining the content of scientific publications is known as bibliometrics. To gauge the impact of scientific publications, survey papers use the citation count. These variables were measured using the following criteria: annual publication, most cited document, productive author and organization, SJR, and subject area.

III. Result and Discussion

From the search results using the keyword "Artificial Intelligence for Digital Economy" on the Scopus website, it was found that 540 articles had been published during the last 10 years from 2012 to 2021. The data obtained was then processed based on several information needs such as Annual Publication, the highest citation based on journal sources, the most productive organization and author, Scientific Source with SJR, to map using VOSviewer software to map the theme network and author network.

A. Artificial Intelligence for Digital Economy Research Sector's Annual Publications

Figure 2 shows a graph of the annual trend of increasing publications in the last ten years, from 2012 to 2021. From the Artificial Intelligence for Digital Economy publication database published in 2016, starting with five documents, there was a significant increase in the number of publications in 2017 (N=16), 2018 (N=47), 2019 (N=122), 2020 (N=138), until 2021 experienced an increase of up to 36.67% (N=198).

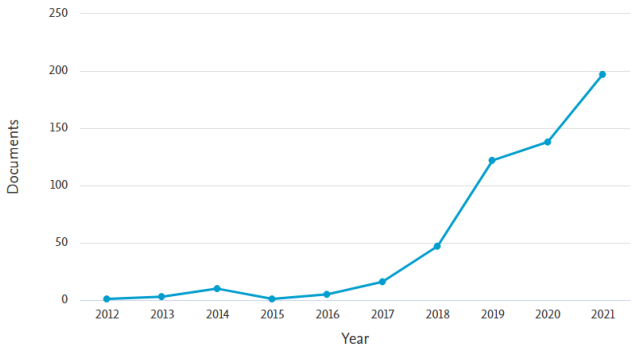


Fig. 2. Chart documents per year on Artificial Intelligence for Digital Economy literature

B. The Most Document Cited of Artificial Intelligence for Digital Economy Research

In 2013, the article on Decision Support Systems source about artificial intelligence and the digital economy that received the most citations worldwide were the one that was written by those associated with that company. Table I displays the annual distribution of citations to the most-cited publications.

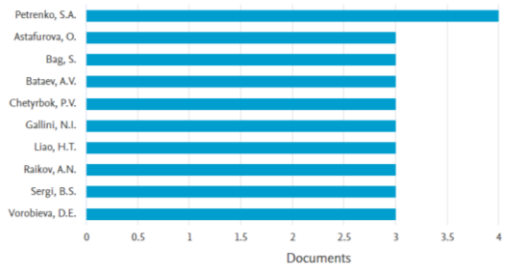
TABLE I. Top five most Document Cited

No	Cites	Title	Source	Year
1	388	"Leveraging the capabilities of service-oriented decision support systems: Putting analytics and big data in cloud" [12]	Decision Support Systems	2013
2	191	"The fourth industrial revolution: Opportunities and challenges" [13]	International Journal of Financial Research	2018

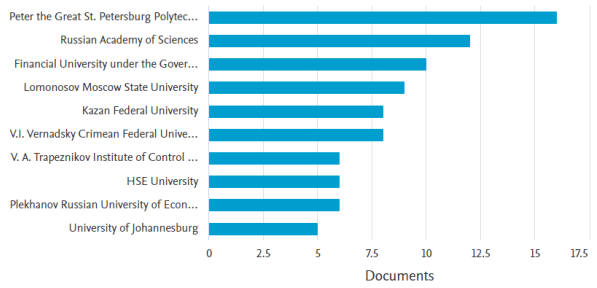
No	Cites	Title	Source	Year
3	137	"Industry 5.0-a human-centric solution" [14]	Sustainability (Switzerland)	2019
4	102	"Role of institutional pressures and resources in the adoption of big data analytics powered artificial intelligence, sustainable manufacturing practices and circular economy capabilities" [15]	Technological Forecasting and Social Change	2021
5	101	"Digitalisation and intelligent robotics in value chain of circular economy oriented waste" [16]	Waste Management	2019

C. *The Most Productive Author and Organizational Affiliations of Artificial Intelligence for Digital Economy Research*

1421 individual researchers have researched Artificial Intelligence for Digital Economy. In Figure 3 (a), it can be explained that the author with the most publications in the field of Artificial Intelligence for Digital Economy is Petrenko, S.A. from "Innopolis University, Kazan, Russian Federation" (N = 4). Followed by Astafurova, O. from "Russian Presidential Academy of National Economy and Public Administration, Moscow, Russian Federation" (N = 3); Bag, S. from "University of Johannesburg, Johannesburg, South Africa" (N = 3); Bataev, A.V. from "Peter the Great St. Petersburg Polytechnic University, Saint Petersburg, Russian Federation" (N = 3); Chetyrbok, P.V. from "V.I. Vernadsky Crimean Federal University, Simferopol, Ukraine" (N = 3); Gallini, N.I. from "V.I. Vernadsky Crimean Federal University, Simferopol, Ukraine" (N = 3); Liao, H.T. from "Nanfang College of Sun Yet-sen University, Guangzhou, China" (N = 3); Raikov, A.N. from "V. A. Trapeznikov Institute of Control Sciences, Russian Academy of Sciences, Moscow, Russian Federation" (N = 3); Sergi, B.S. from "Harvard University, Cambridge, United States" (N = 3); Vorobieva, D.E. from "Sankt-Peterburgskij Gosudarstvennyj Elektrotehniceskij Universitet, Saint Petersburg, Russian Federation" (N = 3); The most prolific individual researcher in Artificial Intelligence for Digital Economy research is dominated by Russia (n = 4). Petrenko, S.A. is the most significant contributing author in Artificial Intelligence for the Digital Economy. Petrenko, S.A. has 42 publications with an h-index of 8.



(a)



(b)

Fig. 3. The top ten number of Productive Author (a) and Organizational Affiliations (b) of Artificial Intelligence for Digital Economy Research

439 affiliated organizations have researched Artificial Intelligence for the Digital Economy. The ten most prolific research affiliates in Artificial Intelligence for Digital Economy research are "Peter the Great St. Petersburg Polytechnic University" (N = 16); "Russian Academy of Sciences" (N = 12); "Financial University under the Government of the Russian Federation" (N = 10); "Lomonosov Moscow State University" (N = 9); "Kazan Federal University" (N = 8); "V.I. Vernadsky Crimean Federal University" (N = 8); "V. A. Trapeznikov Institute of Control Sciences, Russian Academy of Sciences" (N = 6); "HSE University" (N=6); "Plekhanov Russian University of Economics" (N = 6); "University of Johannesburg" (N = 6) as shown in Figure 1. All of the top affiliates who have made significant contributions to publications in the digital economy are Russian.

D. *Artificial Intelligence for Digital Economy Research from Scientific Source with SJR*

Over the past few years, 375 different publications have included articles about AI study's application to the digital economy. The "ACM International Conference Proceeding Series", with an SJR of 0.182 (N = 20) is the most cited annual source for works on AI for the digital economy. Figure 2 displays the data.

TABLE II. ARTIFICIAL INTELLIGENCE FOR DIGITAL ECONOMY RESEARCH FROM SCIENTIFIC SOURCE WITH SJR

Scientific Source	SJR	Article
"ACM International Conference Proceeding Series"	0.182	20
"CEUR Workshop Proceedings"	0.177	20
"IOP Conference Series: Materials Science and Engineering"	0.198	13
"Journal of Physics: Conference Series"	0.210	12
"Sustainability"	0.612	11

The average number of publications in each journal over the three years previously to the reporting year is the basis for the SCImago Journal Ratings (SJR) [17]. SJR indices range from 0.177 to 0.612 for the most prolific journals publishing Artificial Intelligence for the Digital Economy research.

E. *The Subject Area of Artificial Intelligence for Digital Economy Research*

Found 540 documents published by Artificial Intelligence for Digital Economy in the last ten years, from

2012 to 2021. The most knowledge is in the field of Computer Science, with 22.6% academic documents (N=246). Then the second is Engineering with 13.1% academic documents (N=143), and the third is Business, Management, and Accounting with 13% academic documents (N=142). Social Sciences with 11.4% academic documents (N=124), Decision Sciences with 7.4% academic documents (N=81), Economics, Econometrics and Finance with 5.5% academic documents (N=60), Energy with 4.1% academic documents (N=45), Environmental Science with 4.0% academic documents (N=44), Mathematics with 3.9% academic documents (N=42), Physics and Astronomy with 3.4% academic documents (N=37), and others with 11.5% academic documents such as images of Artificial Intelligence for Digital Economy publication documents (Figure 4).

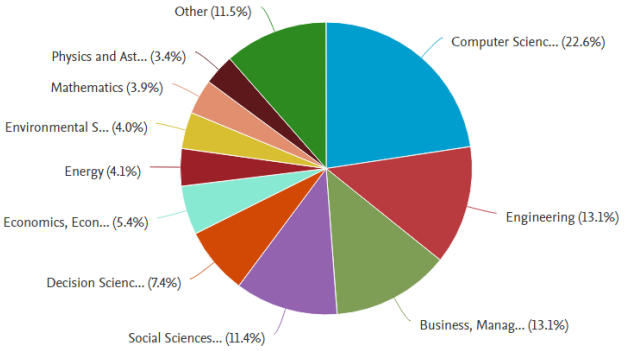


Fig. 4. Graph Documents by the Subject Area of Artificial Intelligence for Digital Economy Research

F. Theme Map of Artificial Intelligence for Digital Economy Research

Using the VOSViewer application, Artificial Intelligence for Digital Economy on keyword mapping networks, the following subject map investigation was conducted. In this inquiry, we'll be looking at the titles and abstracts of articles. A binary representation of the result is used in the calculation.

There are just two repetitions required for a keyword-related document. 358 of the 13337 words are inside the acceptable range. A word must have a minimum of ten occurrences. Each of the 358words will be assigned a relevance score. The most relevant 60 percent of the terms are picked by default, and the maximum number of terms that may be selected is 215 terms. We can see from Figure 5.

The data obtained on the topic "Artificial Intelligence for Digital Economy" was processed using VOSviewer software and obtained 13337 terms, with 358 meet the threshold. By default, 60% of the relevant terms will be selected, bringing it to 215 selected terms. Of the 215 terms will be mapped network as in figure 5 and divided into four clusters, namely:

1. Cluster 1 has 74 items, which are red. In this network we choose terms Things. This cluster with the word network like access. Adoption, advance, age, benefit, big data analytic, blockchain, citizen, city, collaboration, combination, community, competitive advantage, concern, contribution, convergence, culture, customer, cyber physical system, decision making, design methodology ap, digital revolution, disruptive technology, driver, evidence, extent, firm, gap, governance, health, history, human, implication, individual, insight, interest, iot, large number, life, light, literature, medium, nature, necessity, new form, new opportunity, new technology, originality value, overview, pattern, performance, practical implication, privacy, promotion, question, recent year, regard, relationship, researcher, review, rise, robot, robotic, skill, smart city, social medium, success, sustainability, technological innovation, threat, understanding, virtual reality, worker.
2. Cluster 2 has 60 items, which are red. In this network we choose terms Education. This cluster with the word network like account, artificial intelligence technology, author, basis, blockchain technology, business process, cloud technology, comparison, competitiveness, complexity, component, consequence, consumer, content, course, current state, degree, direction, economic development, education, element, employee, end, essence, expert, fintech, formation, good, group, hand, higher education, identification, kind, law, methodology, national economy, object, parameter, place, priority, processing, prospect, rapid development, regulation, relevance, rule, Russia, Russian economy, Russian federation, specialist, sphere, student, subject, task, turn, university, usage, user, whole, world economy.
3. Cluster 3 has 51 items, which are blue color. In this network we choose terms Platform. This cluster with the word network like action, advantage, algorithm, architecture, artificial neural network, assessment, characteristic, china, circular economy, cloud, cloud computing, computer, computing, construction, control, cost, data analysis, ecosystem, empirical study, energy, enterprise, evaluation, finance, focus, function, globalization, information technology, investment, job, manufacturing, marketing, mechanism, netwok, neural network, optimization, platform, policy, power, prediction, proceeding, safety, software, speed, storage, sustainable developer, technique, theory, topic, trade, training, uncertainty.
4. Cluster 4 has 30 items, which are yellow color. In this network we choose terms Global Economy. This cluster with the word network like agriculture, availability, bank, big data technology, communication technology, competition, corporation, covid, device, digital innovation, digitalization, economic growth, farmer, gdp, help, ict, important role, india, labor, limitation, iot, nation, pandemic, period, population, productivity, scale, sensor, technological development.

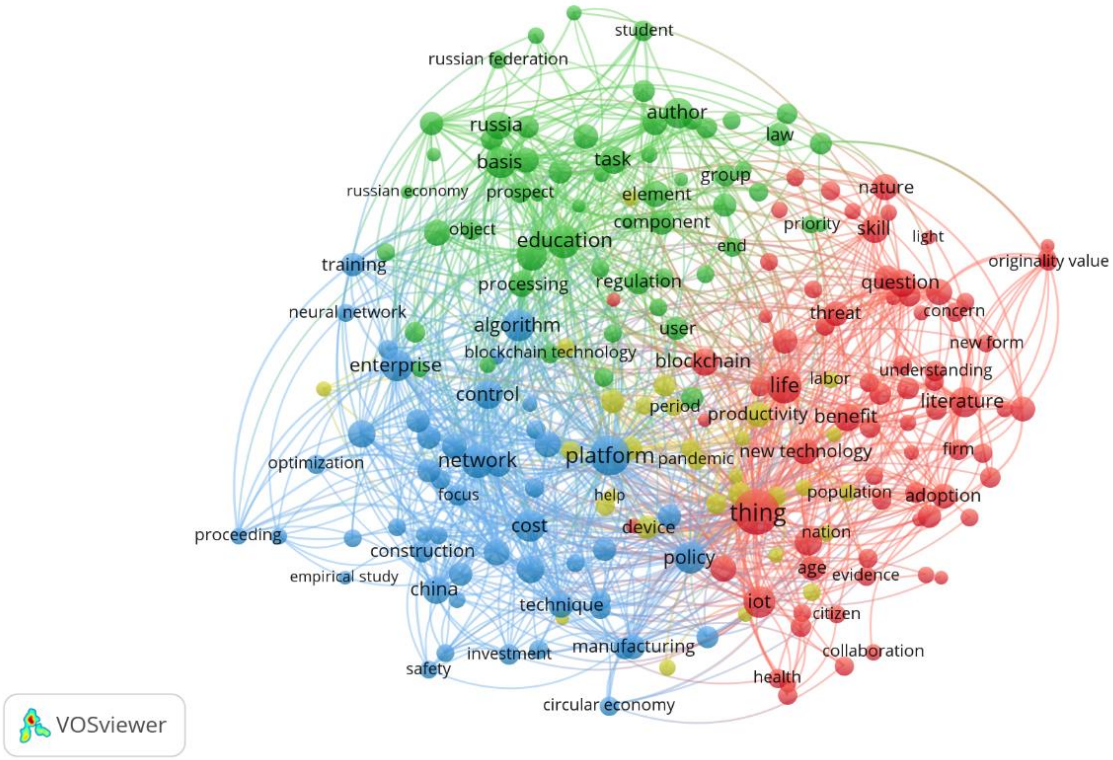


Fig. 5. Incongruity between 215 of the most frequently used phrases (with at least four occurrences). The strength of the connection between terms was calculated by looking at how often they occurred in articles together and is shown here by line thickness. Crafted using VOSViewer

G. *Authorship Network*

A trend of collaborative research may be seen in figure 6 of an Artificial Intelligence for Digital Economy article. There are 1421 authors in the Authorship Network; 14 of them fulfill the criterion, the authors with the greatest total link strength (TLS) will be selected. There are eleven different research teams in all, and all of them are connected to one another in some way.

Fig. 6. The network of 14 co-authors publishing in Artificial Intelligence for Digital Economy

From figure 6, in the red nodes, Chetyrbok, Petr V. and Gallini, Nadezhda I. are connected to each other. Both authors come from the same campus, namely V.I. Vernadsky Crimean Federal University, Simferopol, Ukraine.

IV. Conclusion

A rising body of worldwide literature on AI for the digital economy is uncovered by this article's analysis of Scopus citation data. The highest countries with Artificial Intelligence for Digital Economy publications are Russian Federation have 131 documents. Then, China has 59 documents, United States have 59 documents. With 232 academic publications, "Computer Science" subject area dominates Artificial Intelligence for Digital Economy sector (22.6%). Next comes "Engineering", with 143 scholarly articles (13.1% of total). The "Business, Management, and Accounting" field comes in third with 142 scholarly articles (13.1%).

This research provides a taxonomy of the Artificial Intelligence for the Digital Economy study, which may have to wait several years for the significant topics to emerge, based on the contribution to knowledge. As a result, new subjects may be investigated or researched to improve understanding in this field. In the future, the contribution and influence of Artificial Intelligence on the Digital Economy should be evaluated expeditiously by analyzing citations based on a mix data from Scopus website, Web of Science (WOS), and other indexations.

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