



TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

ACTA TECHNICA NAPOCENSIS

Series: Applied Mathematics, Mechanics, and Engineering  
Vol. 67, Issue Special III, July, 2024

## IS THE DIGITAL ECONOMY AND SOCIETY INDEX RELEVANT FOR THE ACADEMIC RESEARCH?

**Timea CISMA, Larisa IVASCU, Aura DOMIL,  
Alin ARTENE, Oana BOGDAN, Valentin BURCA**

***Abstract:** The pandemic context demonstrated the fact that digital technologies had an essential role in overcoming the crisis generated by the novel coronavirus, activities being mostly transferred to the online environment in an accelerated manner, whether humanity was prepared or not for the new "normal" imposed by the measures aimed at limiting the spread of the virus. The ease or difficulty of implementing digital technologies in everyday activities was related to the existing digital infrastructure and skills in each country. In this sense, the concept of digitization has been given new meanings. The objective of the research is to illustrate to what extent the digital economy and society index (DESI) represents a relevant indicator in academic research, from the perspective of the most frequently approached themes regarding this concept. In the background allows the paper highlights an overview of the baggage of keywords proposed by the authors of the works indexed in the Web of Science Core Collection database that allow increasing the degree of understanding of the concept of digitization, from the perspective of the many fundamental aspects highlighted. Another objective of the study is to identify if the interest in academic research on the topic addressed, from a country, is correlated with the level of digitization of the country, i.e., if the country of origin of the authors with the most published works is in the top of the countries with the highest degree of digitization. The results of the undertaken study reflect the increased interest of the academic environment for research on the topic of sustainable development, but the countries of origin of the authors who wrote the most publications about the Digital Economy and Society Index are not at the top of the ranking published by the European Commission for the year 2022.*

***Key words:** DESI, performance, digital, technologies, academic research.*

### 1. INTRODUCTION

The pandemic generated by the novel coronavirus has accelerated the process of digitization (Deloitte, 2020), a process that has proven vital in trying to cope with the restrictions imposed by measures aimed at limiting the spread of COVID-19. In many sectors, the activity was transferred to the online environment, even if the human resources or the infrastructure were not prepared for such an event [1]. It is certain that some countries have been more prepared than others to quickly implement these technologies, whether we are talking about telework, online commerce or the automation of activities and processes because both at the country and sector level there are differences in terms of the degree of digitization.

The European Commission, since 2014, monitors the degree of digitization of the member states through the Digital Economy and Society Indicator (DESI) and annually allocates significant resources aimed at supporting the digital transformation on four levels, namely human capital, connectivity, the integration of digital technologies and public digital services. The final objective is to develop skills in this field among EU member countries and to digitize SMEs to the greatest extent possible [13].

The paper highlights to what extent the digital economy and society index (DESI) represents a relevant indicator in academic research, from the perspective of the most frequently approached themes regarding this concept. On the other hand, we want to provide a summary of the keywords put forth by the authors of the works that are

included in the Web of Science (WoS) Core Collection database. By doing this, we hope to improve understanding of the concept of digitalization from the standpoint of the many key elements that are highlighted. We also aim to analyse whether the interest in academic research in a country is correlated with the level of digitization of that country, in the sense that we aim to identify whether the country of origin of the authors with the most published papers is in the top of the countries with the highest degree of digitization.

The analysis undertaken in the study is carried out at the level of articles published in the Web of Science Core Collection database from the year 2014, the year from which the European Commission monitors the progress made by the member states in the digital field and until now. The structure of this paper is as follows: first chapter presents the literature review and hypothesis development; next chapter presents the research methodology, and chapter 4 highlights the results obtained. The last chapter shows the main findings, conclusions, and the future research directions.

## 2. LITERATURE REVIEW

The digitization process started gradually, since the 1960s, but over time it has experienced a formidable development, being used in most industries worldwide. Digitization thus left its mark on socio-economic development and represented a key point in the globalization and outsourcing of business, being associated with the performance recorded by companies.

Digitization and innovation change organizations, institutions, and society in general [4], however, the process was implemented naturally and gradually, most adapting to digital conditions according to needs, being a necessity for today's society, centered on sustainability, sustainable development, and economic growth. Thus, over time, the transition from the timid automation of some processes to cyber-physical systems, blockchain and Artificial Intelligence integrated into the daily activity of companies was achieved. This process, however, was accelerated in the context of the pandemic which forced the use of digital technologies on a wider scale [1].

The business environment was disrupted [7-9, 11-13] because it was necessary to rapidly implement new digital ways of collaboration through the Zoom or Google Meet platforms, the provision of delivery services that limit face-to-face contact by adopting Artificial Intelligence (AI) and robotic process automation (RPA), and paying increased attention to customer relationship management, by capitalizing on digital channels, using the Internet of Things, cloud-stored databases, or analytical forecasting [12-14]. Nowadays, the most innovative companies integrate digital technologies to create new products and processes, aimed at increasing performance, increasing profit, reducing much of production costs, and increasing competitive advantages [5].

According to statistical data, in 2018, digitally transformed companies accounted for 13.5 billion US dollars of global GDP, and by the end of 2023, they are expected to generate 53.3 billion US dollars, more than half of the overall nominal GDP. Studies attest to the magnitude of the phenomenon and demonstrate that research and managerial interest in digital technologies are booming because there are still considerable uncertainties regarding what digitization is and includes and the degree of its implementation in different sectors of activity [2]. However, just the willingness to use digital technologies alone is not enough; to benefit from digitization, companies must resort to business model innovation, i.e., implement advanced business models that are not without costs [6].

The European Union allocates substantial funds to support member states in the process of digital transformation and creates systems to monitor recorded performance, but is there interest from companies to implement digital technologies in their activities? Is there reluctance to use Artificial Intelligence? Are some sectors more open to digitization than others? Research shows that this topic is of great interest both among academic research and among practitioners [2-6], an aspect that allows deepening of debates and highlights the need for an effective mechanism for monitoring the level of implementation among states, in different sectors of activity.

### 3. METHODOLOGY AND DATA

The bibliometric analysis indexed in databases like Web of Science Core Collection or Scopus can be statistically evaluated using the bibliometric analysis of scientific publications. With the help of the computer program Vos Viewer, software designed for bibliometric networks, the mapping of science was carried out in this research.

All the scientific articles published in the Web of Science database dealing with the subject of digitization were thus selected, having as search criteria the DESI index, respectively the Digital Economy and Society Index. Starting from 2004 and until now, 317 published articles were identified for which the keywords proposed by the authors were extracted, with a minimum threshold of 5 simultaneous occurrences and a minimum of one citation, to observe the most used trends and topics in the field of digitization.

Also, the country of origin of the authors was highlighted to identify if the countries with the highest DESI level are among those from which the authors who publish the most on this topic come from. Then, with the help of the information published in the Eurostat database for the year 2022, we highlighted the degree of digitization by activity sector for the countries of the European Union.

### 4. RESULTS AND DISCUSSIONS

The European Commission, starting from 2014, monitors the progress that the member states of the European Union register in the digital field through the digital economy and society index (DESI). Each year, DESI reports highlight, by country profiles, the areas that require priority action and thematic chapters that provide an analysis of the essential digital areas that need to be prioritized [11-14].

The pandemic context highlighted the fact that compliance with the measures to limit the spread of the new coronavirus and carrying out activities in the "new normal" could be achieved largely with the help of digitization that allowed activities to be transferred to the online environment [1].

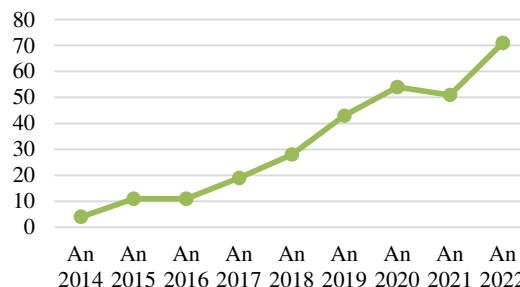


Fig. 1. The trend of scientific publications dealing with the Digital Economy and Society Index.

The crisis generated by COVID-19 has thus accelerated digitization, and the increasing trend can be observed even in the academic environment, the interest of researchers increasing from year to year, as can be seen in Figure 1. As can be seen in this figure, in 2014, the first year dealing with the subject of DESI, 4 specialized papers were published, in 2022, 71 articles, and during the current year (2023), until May, 25 papers were indexed in the Web of Science Core Collection. Over time, Member States have made significant progress in the field of digitization, but significant financial resources are still needed to increase digital skills, the digital transformation of SMEs and the introduction of advanced 5G networks, aspects that highlight the increased interest in this topic.

Using selection criteria like the minimum threshold of 5 simultaneous occurrences and only the keywords suggested by the authors, the analysis of keywords enables the identification of the distribution and intensity of linkages between the most used terms in the specialized literature. The Vos Viewer program thus reflects, in a graphical way, the groups of keywords between which there is a link. Each word is represented by a node whose size is directly proportional to the relevance of the word. The links between the nodes are represented graphically by lines of different lengths and thicknesses. The shorter a line, the stronger the connection between the terms. Also, the thicker a line is, the more frequently the terms appear. Between 2014 and 2023, 317 articles were published in which keywords were identified, of which 198 meet the selected criterion of at least 5 occurrences. The first 1,000 words of these are plotted in Figure 2.



*Table 1*  
**Keywords considered in the research regarding the Digital Economy and Society Index (DESI)**

No.	Keyword	Occur.	Link strength
1	Digital economy	31	126
2	Digital economy and society index	9	37
3	digital transformation	5	36
4	European union	6	25
5	DESI	5	23
6	Digitalization	2	21
7	Asian digital economy	1	18
8	Covid-19 pandemic	1	18
9	Digital trade	1	18
10	Economic growth	1	18
11	Emerging technologies	1	18
12	Firm-level technological sophistication	1	18
13	Global value chains	1	18
14	Industrial infrastructure	1	18
15	Information and communication technologies (ICTS)	1	18
16	Information technology (IT)	1	18
17	Informatization	1	18
18	IT innovation	1	18
19	Smiling curve	1	18
20	Technological change	1	18
21	Technology impacts	1	18
22	Transaction costs	1	18
23	Value chain participation	1	18
24	Digital divide	3	16
25	DESI index	3	13
26	Digital competitiveness	3	13
27	NRI	2	12
28	Sustainable development	3	12
29	Digital skills	3	11
30	Digitization	3	11
31	Economy	3	11
32	Poland	2	11
33	Comparison methods	1	10
34	Composite assessment	1	10
35	Development	2	10
36	European countries	1	10
37	Functional network	1	10
38	Information and communications infrastructure	1	10

39	Information society	2	10
40	Information society model	1	10
41	Regional development	1	10
42	Russian regions	1	10
43	System analysis	1	10
44	Territorial differentiation	1	10
45	China	2	9
46	Agriculture	1	8
47	Australia	1	8
48	Comparative analysis	1	8
49	Connectivity	1	8
50	Digital inclusion	1	8

All 198 identified keywords are grouped into 23 clusters between which 702 links are established. Among the 23 groups of words, the red group contains the most used keywords from the specialized literature on the subject addressed. The first 50 of the 198 keywords were selected to show which ones are the most representative, and they are shown in Table 1 in descending order based on the strength of the relationships between them.

As can be seen, the researchers addressed topics related to digital transformation, emerging technologies, infrastructure, the information society and digital inclusion, topics that are also of interest to the European Commission through the measures taken with the aim of accelerating digitization, increasing the resilience of the EU and reducing external dependencies, both through reforms and through investments directed at these levels [13]. Analyzing the situation of the state network of origin of the author of scientific works in the field of digital technology with at least 5 documents and citations at the country level, we identified 26 countries that meet the criteria and are graphically represented in Figure 3. All 26 identified countries are grouped into 17 clusters between which 17 links are established. Among these groups of countries, the one formed by Denmark, the USA, Singapore, and Italy contains the most authors from the specialized literature in the field of digital technology center on the digital economy and society index. To be able to see which are the most representative countries, ordered in descending order according to the number of published documents, the first 20 that can be found in Table 2 were selected.

Table 2

**Origin countries of the author within the framework of blockchain technology research**

No.	Country	Docs	No. of citations	Link strength
1	China	10	187	5
2	Russia	8	35	1
3	Ukraine	5	42	1
4	Croatia	4	21	2
5	Poland	4	64	3
6	Italy	3	74	4
7	Romania	3	43	1
8	Slovakia	3	4	0
9	Hungary	2	29	0
10	Latvia	2	11	1
11	Australia	1	24	0
12	Bosnia & Herceg	1	0	0
13	Czech Republic	1	0	0
14	Denmark	1	64	4
15	Greece	1	21	0
16	Japan	1	40	1
17	Kazakhstan	1	0	1
18	Portugal	1	1	0
19	Serbia	1	3	0
20	Singapore	1	64	4

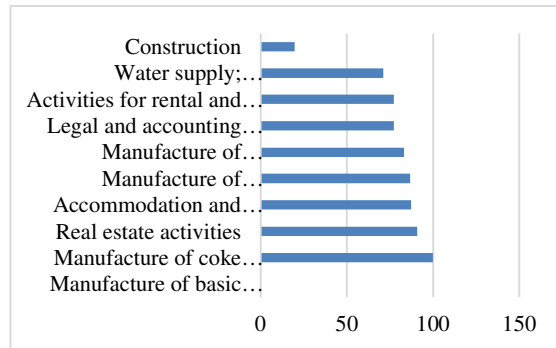


Fig. 6. TOP 10 weakly digitized sectors in 2022 (Authors own projection after EUROSTAT, 2022)

Researchers from China contributed 10 publications out of a total of 317 items, the biggest number of scientific articles found in the Web of Science database. We can see that Italian authors have only published 3 scientific papers, yet they have received 74 citations, which is the second-highest number behind China.

Considering the latest report published by the European Commission on the degree of digitization of the European Union countries in 2022 [13] presented in Figure 4, we note that there is no correlation between the leading states in terms of the publication of academic articles and the leaders of the European Union in terms of global performance in the digital field, on the 4 levels of interest, namely human capital, connectivity, the integration of digital technologies and public digital services.

If we are to analyze the list of the least digitized sectors in 2022, presented in Figure 6, we find that among them are sectors that were strongly affected by the new coronavirus pandemic, such as construction and real estate.

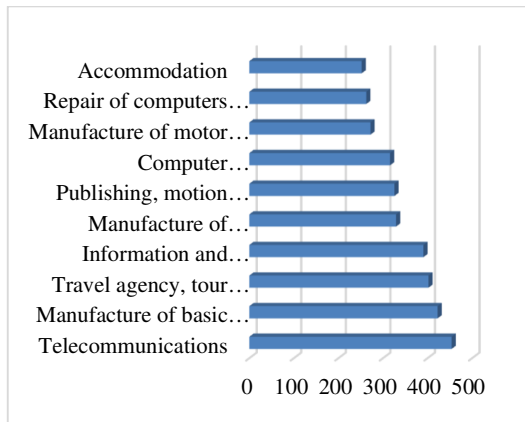


Fig. 5. TOP 10 digitized sectors in 2022 (Authors own projection after EUROSTAT, 2022)

If we analyze the degree of digitization in the main sectors of activity in the member states of the European Union, the top 10 being presented in Figure 5, we find that digitization is increased in strategic sectors that are based on innovative technologies, process automation, cost reduction, productivity improvement, to gain competitive advantages and for better data management.

### 5. CONCLUSIONS

The use of digital technologies is a widely debated topic and of interest both among practitioners and in academic research because innovative business models incorporate more and more digital elements aimed at contributing to the sustainable and sustainable development of companies and constituting multiple competitive advantages, in a business world in which there is fierce competition.

In this paper we have highlighted the extent to which the DESI index represents a relevant

indicator in academic research, from the perspective of the most frequently approached themes regarding this concept. In the second plan, the study undertaken reflects an overview of the baggage of keywords proposed by the authors of the works indexed in the WoS - Core Collection database, with the aim of increasing the degree of understanding of the concept of digitalization, from the perspective of the many fundamental aspects highlighted. Also, the research analyzed the extent to which the interest in academic research in a country is correlated with the level of digitization of that country, in the sense that the country of origin of the authors with the most published works is in the top of the countries with the highest degree of digitization.

The scientific publications published in the Web of Science Core Collection database between 2014 and 2023 were taken into consideration for the analysis that was conducted for the study. We also used the Eurostat database regarding the degree of digitization at the EU level by activity sector in 2022 and the level of digitization of the EU member states according to the value of the Digital Economy and Society index.

The results of our study reflect the increased interest of the academic environment for research on the topic of sustainable development; The basic concepts of DESI can be found among the keywords proposed by the authors in the works published and indexed in the Web of Science Core Collection, and the countries of origin of the authors who wrote the most publications on the subject of the digital economy and society index are not found at the top of the DESI 2022 ranking. Our study also highlighted the fact that there are differences between sectors of activity in terms of the level of digitization recorded. In this context, we consider it fundamental to continue the digitization process and to find some levers to eliminate the gap between the member states of the European Union.

## 6. REFERENCES

- [1] Farcane, N., Bunget, O., Blidisel, R., Dumitrescu, A., Deliu, D., Bogdan, O., Burca, V., *Auditors' perceptions on work adaptability in remote audit: a COVID-19 perspective*, *Economic Research - Ekonomska Istraživanja*, 36(1), 422-459, 2023. Doi: 10.1080/1331677X.2022.2077789
- [2] Hanelt, A., Bohnsack, R., David, M., Marante, C., *A Systematic Review of the Literature on Digital Transformation: Insights and Implications for Strategy and Organizational Change*, *Journal of Management Studies*, 2021. Doi: 10.1111/joms.12639.
- [3] Herghiligiu, I.V., Pislaru, M., Vilcu, A., *e-Learning Structural Framework on Organizational Environmental Practices*, *Proceedings of the 14th International Scientific Conference eLearning and Software for Education: Elearning Challenges and New Horizons*, vol. 3, pp. 162-167, 2018. Doi: 10.12753/2066-026X-18-165
- [4] Kraus, S., Jones, P., Kailer, N., Weinmann, A., Chaparro-Benegas, N., Roig-Tierno, N., *Digital Transformation: An Overview of the Current State of the Art of Research*, 2021, <https://doi.org/10.1177/21582440211047576>.
- [5] Paunov, C., Planes-Satorra, S., Guellec, D., *Digital Innovation: Seizing Policy Opportunities*, 2019. Doi: 10.1787/a298dc87-en.
- [6] Parida, V., Sjödin, D., Reim, W., *Reviewing Literature on Digitalization, Business Model Innovation, and Sustainable Industry: Past Achievements and Future Promises*, *Sustainability Journal*, 11, pp. 391, 2019. Doi: 10.3390/su11020391.
- [7] Pislaru, M., Trandabat, A., Avasilcai, S., *Neuro-Fuzzy Model for Environmental Impact Assessment*, *Environmental Engineering and Management Journal*, 10(3), 381-386, 2011.
- [8] I. Sarfraz, M., Hafeez, H., Abdullah, M.I., Ivascu, L., Ozturk, I., *The effects of the COVID-19 pandemic on healthcare workers' psychological and mental health: The moderating role of felt obligation*, *Work – A Journal of Prevention Assessment & Rehabilitation*, 71(3), 539-550, 2022.
- [9] I. Sarfraz, M., Ivascu, L., Belu, R., Artene, A., *Accentuating the interconnection between business sustainability and organizational performance in the context of the circular economy: The moderating role of*

- organizational competitiveness*, Business Strategy and the Environment, 30(4), 2108-2118, 2021.
- [10] Trandabat, A.F., Pislaru, M., Brinzila, M., SiadEnv - *Environmental Friendly E-Building Energy Management System*, Environmental Engineering and Management Journal, 11(3), 687-694, 2012.
- [11] Wirtz, B.W., Weyerer, J.C., Heckerroth, J.K., *Digital disruption and digital transformation: A strategic integrative framework*, International Journal on Innovation and Management, 26(3), 2240008, 2022.
- [12] Website KPMG (2020), Who or What is Driving Digital Transformation at Your Organization?, available at <https://home.kpmg/xx/en/blogs/home/posts/2020/08/accelerating-digital-transformation.html>, accessed on May, 20, 2023.
- [13] Website European Commission -DESI (2023) available at <https://digital-strategy.ec.europa.eu/ro/policies/desi>, accessed on May, 10, 2023.
- [14] Website Statista, Nominal GDP driven by digitally transformed and other enterprises worldwide 2018–2023, available at <https://www.statista.com/statistics/1134766/nominal-gdp-driven-by-digitally-transformed-enterprises/>, (2022), accessed on April, 23, 2023.

### Reprezintă DESI un indicator relevant în cercetarea academică?

Contextul pandemic a demonstrat faptul că tehnologiile digitale au avut un rol esențial în depășirea crizei generate de noul coronavirus, activitățile fiind în foarte mare măsură transpuse în mediul online în mod accelerat, fie că omenirea a fost pregătită sau nu pentru noul „normal” impus de măsurile menite să limiteze răspândirea virusului. Ușurința sau dificultățile întâmpinate de implementarea tehnologiilor digitale în activitățile cotidiene au fost legate de infrastructura și competențele digitale existente în fiecare țară. În acest sens, conceptului de digitalizare i s-au acordat noi valențe. Obiectivul cercetării este de a ilustra în ce măsură indicele economiei și societății digitale (DESI) reprezintă un indicator relevant în cercetarea academică, din perspectiva celor mai des abordate teme ce privesc acest concept. În plan secund, lucrarea evidențiază o imagine de ansamblu a bagajului de cuvinte cheie propuse de autorii lucrărilor indexate în baza de date Web of Science Core Collection care să permită creșterea gradului de înțelegere al conceptului de digitalizare, din perspectiva numeroaselor aspecte fundamentale evidențiate. Un alt obiectiv al studiului este de a identifica dacă interesul pentru cercetarea academică pe topicul abordat, dintr-o țară, este corelat cu nivelul de digitalizare al țării, respectiv dacă țara de proveniență a autorilor cu cele mai multe lucrări publicate se află în topul țărilor cu cel mai crescut grad de digitalizare. Rezultatele studiului întreprins reflectă interesul crescut al mediului academic pentru cercetare pe tematica dezvoltării durabile, însă țările de proveniență ale autorilor ce au scris cele mai multe publicații pe tema Digital Economy and Society Index nu se regăsesc în fruntea clasamentului publicat de Comisia Europeană pentru anul 2022.

**Timea CISMA**, Ph.D. Student, Politehnica University of Timișoara, Faculty of Management in Production and Transportation, [timea.cisma@student.upt.ro](mailto:timea.cisma@student.upt.ro), +40256404284, 14 Remus Street, Timisoara, Romania.

**Larisa IVASCU**, Prof. habil. Ph.D. Eng., Politehnica University of Timișoara, Faculty of Management in Production and Transportation, [larisa.ivascu@upt.ro](mailto:larisa.ivascu@upt.ro), +40256404284, 14 Remus Street, Timisoara, Romania.

**Aura DOMIL**, Assoc. Prof. Ph.D. Ec., West University of Timișoara, Faculty of Economics and Business Administration, [aura.domil@e-uvt.ro](mailto:aura.domil@e-uvt.ro), +40256592553, 16 Pestalozzi Street, 300115 Timișoara, Romania.

**Alin ARTENE**, Assoc. Prof. Ph.D. Ec., Politehnica University of Timișoara, Faculty of Management in Production and Transportation, [alin.artene@upt.ro](mailto:alin.artene@upt.ro), +40256404284, 14 Remus Street, Timisoara, Romania.

**Oana BOGDAN**, Lecturer Ph.D. Ec., West University of Timișoara, Faculty of Economics and Business Administration, [oana.bogdan@e-uvt.ro](mailto:oana.bogdan@e-uvt.ro), +40256592553, 16 Pestalozzi Street, 300115 Timișoara, Romania.

**Valentin BURCA**, Lecturer Ph.D. Ec., West University of Timișoara, Faculty of Economics and Business Administration, [valentin.burca@e-uvt.ro](mailto:valentin.burca@e-uvt.ro), +40256592553, 16 Pestalozzi Street, 300115 Timișoara, Romania.