



WOA 2025

PESCARA

29-30 MAGGIO

WOA XXVI - WORKSHOP DEI DOCENTI E RICERCATORI DI
ORGANIZZAZIONE AZIENDALE

Università degli Studi d'Annunzio Chieti-Pescara Viale Pindaro Pescara

29 - 30 MAGGIO 2025

NAVIGATING ORGANIZATIONAL CHANGE
IN TIMES OF UNCERTAINTY

ISBN: 979-12-210-9700-9

Pescara

29 – 30 maggio 2025

Connecting the dots: A bibliometric analysis on SMEs in the era of Data Ecosystems

Short Paper

Simona Leonelli, University of Modena and Reggio Emilia, Modena, Italy,
simona.leonelli@unimore.it

Filippo Ferrarini, University of Modena and Reggio Emilia, Modena, Italy,
filippo.ferrarini@unimore.it

Abstract

Research on data ecosystems is becoming an emerging field of study. Defined as socio-technical networks where actors collaborate to share and use data to foster value creation, these kinds of ecosystems are particularly important for small and medium enterprises (SMEs) as they can benefit from data, technology and resources, while becoming important actors which support the ecosystem itself. However, research connecting SMEs and data ecosystems has been largely overlooked so far. Therefore, the aim of this study is to a bibliometric analysis to examine the current trends regarding data ecosystems and SMEs. The analysis is performed by using Biblioshiny package on articles coming from Scopus database. Results reveal how the importance of this topic has increased over time. At the same time, the findings outline how this topic is tightly connected to innovation, competition, information and knowledge management, supply chains and decision-making processes.

Keywords: data ecosystems, SMEs, bibliometric analysis, data.

1 Introduction

In the current economic and technological landscape, data has been acquiring a central role for private and public organization as a strategic resource for creating value (Rozkrut, 2023). In this extent, the capability to collect, elaborate and share data by organizations is a key dimension to foster innovation, competitiveness and efficiency (Ramalli & Pernici, 2023). As organizations normally do not have all the necessary capabilities to manage and retain the value of data, data ecosystems emerge as a new concept of collaborative models that can support co-creation activities for value generation by means of data creation, data use and data sharing (Heinbach et al., 2024). In this extent, data ecosystems are defined as socio-technical networks that enable collaboration between actors such as enterprises, institutions, and individuals and facilitate knowledge discovery to create value (Oliveira. et al., 2019; Ramalli & Pernici, 2023). Along this vein, the main foundations of data ecosystems are: (I) the network of actors involved in the production, sharing and use of data; (II) the collaboration among actors to provide access to data and resources to partners; (III) the creation of value, as data ecosystems are value driven (IV); the self-organization, as in data ecosystems value is not generated through a linear sequence of steps, but it is the output of multiple interconnected actors; (V) interoperability as data come from different sources, the technical ability to exchange data effectively is paramount (Heinz et al., 2022; Möller et al., 2024; Oliveira & Lóscio, 2018).

In this extent, the concept of data ecosystems is also recognized by public institutions. For instance, the European Union (EU) underlines the importance of data generation, sharing and use, highlighting the substantial societal and individual benefits that data can yield (European Commission, 2020). Therefore, public legislation strongly recommends the creation of data ecosystems through public actions (i.e. constitution of data spaces), involving businesses, civil society and the public sector (European Union, 2022).

In this extent, data ecosystems are particularly beneficial for small and medium enterprises (SMEs). In fact, the literature highlights how SMEs are considered important actors in the context of data ecosystems. In fact, SMEs are equipped with important resources (i.e., skills, competences, technology, flexible structures) which can make them key actors for the development of data ecosystems in order to deliver innovative value (European Commission, 2020). At the same time, SMEs can have relevant benefits in participating into data ecosystems as they can have access to important resources such as data, technology, competences, and relationships which can foster their digitalization process, innovative capabilities and market competitiveness (Gašpar et al., 2025; Hafeez et al., 2025; Huber et al., 2020).

Nevertheless, so far, the literature has posed little attention on understanding the relationship between SMEs and data ecosystems. This is surprising given the fact that SMEs are the backbone of the economy (Sati, 2024). In addition, the role and the importance of SMEs in data ecosystems has been emphasized by public institutions. In fact, data economy should make possible to give access to data and knowledge for those SMEs that have limited financial, technological and administrative resources (European Union, 2022).

Therefore, following the current reasoning, the aim of this paper is to collect contributions from a quite dispersed and fragmented literature by conducting a bibliometric analysis in order to explore the intersections between SMEs and data ecosystems. Hence, the following research question is formulated: *Which are the current trends linking SMEs and data ecosystems?*

Addressing this research question is important as it can contribute to provide an up-to-date understanding of the relationships between SMEs and data ecosystems. At the same time, synthetizing the findings from a quite fragmented and dispersed literature is important in order to deliver a comprehensive understanding of a such recent phenomenon. Thus, it will help to guide future studies on a promising field of research which has been largely financed by public policy programs. Moreover, responding to such question is important to collect information in order to guide policymakers to make tailored policy interventions.

2 Data and methods

Articles were retrieved in November 2024 from Scopus database by using sets of different keywords. The first keyword was “Data ecosystem*”, which retrieved 185,975 documents. Then synonyms were added as additional keywords such as “software ecosystem*” or “open data ecosystem*” following prior studies on the topic (Cui et al., 2020; Möller et al., 2024; Oliveira et al., 2019). Then, by using AND - OR Boolean terms, other keywords referred to the themes of interests were added such as “SME*”, “Participat*”, “Influenc*” and their relative synonyms. These terms were included as prior research highlights that SMEs are not passive actors, but active participants whose engagement can influence the development, structure, and outcomes of the entire data ecosystem (e.g. Jackson et al., 2024).

The initial search process retrieved 4.877 articles across multiple subject categories. To enhance the relevance and quality of results, several filters were applied. Specifically, the temporal range was limited to publications from 2011 to 2024, in alignment with the literature review by Oliveira et al. (2019). The search was further refined by restricting the subject areas to business and management, econometrics, social science, computer science, and environmental science. Only document classified as article, book chapter, conference paper, book, review and written in English, were included. Conference papers were retained due to their relevance in computer science. The filtering process reduced the dataset to 2.820 articles. Further refinement was conducted by excluding all journals not indexed in the ABS (academic journal guide) database, resulting in a final sample of 2.294 articles.

To further refine the dataset, four-member research team undertook a manual screening process, selecting only those articles deemed relevant to the research themes. As a result, 1,716 articles were excluded for falling outside the scope of interest (see Table 1). The final dataset consisted of 148 articles, which were analyzed through the Biblioshiny package of the R programming language.

Related topic	N. of articles deleted
Finance	665
Marketing	394
Enterprise culture and development	198
Leadership and HRM	173
Not related to data management	51
Others not pertinent articles	235

Table 1. Number of articles excluded during the screening phase (n=1,716).

3 Results and discussion

Table 2 presents the main characteristics of the dataset. A total of 425 authors contributed to writing the documents, with an average of 2.87 authors per document. The annual growth rate of publications on the topic is 11.60%.

Description	Results
Documents	148
Sources	133
Timespan	2011:2024
Annual growth rate	11.60%
Author's keywords	575
Average citations per document	21.95
Authors	425
Documents per author	0.35
Authors per document	2.87
Co-authors per documents	2.92
Document average age (years)	5.61

Table 2. Number of articles excluded during the screening phase (n=1,716).

As illustrated in Figure 1, scholarly interest has steadily increased since 2011, with a significant surge observed from 2021 onwards.

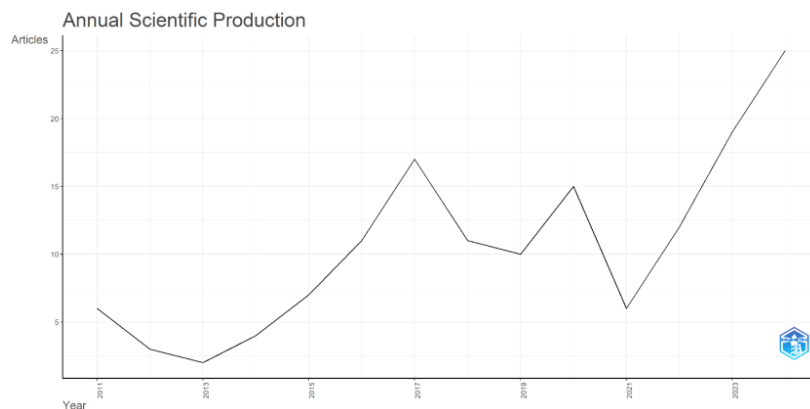


Figure 1. Trends of publication.

Figure 2 instead displays countries' scientific production. It is possible to notice the scientific production is somehow global, nevertheless, the leading countries are the UK (40 articles), followed by Italy (37), China (34), the USA (27), Germany (23) and India (20).

Country Scientific Production

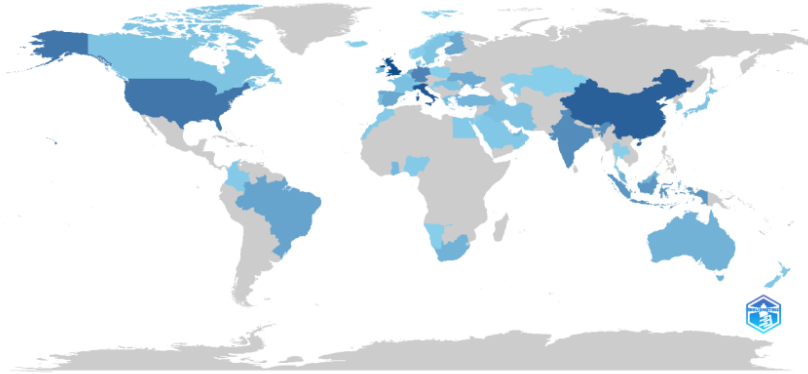


Figure 2. Trends of publication.

Moreover, looking at the most relevant articles in terms of citations in the field it is possible to highlight that the first top three articles are (1) Ceccagnoli et al. (2012) – 677 citations; (2) Razmerita et al. (2016) – 281 citations; (3) Micheli et al. (2020) – 145 citations. Then for position number 4 to 6 we have (4) Martínez-Román et al. (2011) – 145 citations; (5) Cunningham & Link (2014) – 110 citations (6) Elmagrhi et al. (2017) – 95 citations. Finally, the list is concluded by (7) Maroufkhani et al. (2020) – 86 citations; (8) Song et al. (2016) – 76 citations; (9) Jin & Hurd (2018) – 65 citations; (10) Kude et al. (2011) – 57 citations.

If we look at those articles, we can find that the leading article is Ceccagnoli et al (2011). This is an important article which outlines that the participation of a platform ecosystems by small enterprises improve their business performance in terms of sales, thereby highlighting the importance of inter-firm collaborations. Their findings are in line with the work of Jin & Hurd (2018), where they outline how digital platforms ecosystems, help to internationalize SMEs, by reducing their entry barriers into new markets. On this way, it is worth to mention the work of Micheli et al. (2020), which highlight the most important roles for the actors involved into data ecosystems, which depends on inter-organizational relationships, values and governance principles. In this extent, the articles touch some of the foundations of data ecosystems, such as the importance and value of data, data generation and data and knowledge sharing, as well as the importance of industry 4.0 technologies for bringing new values to organizations, thereby the governance and organizational mechanisms and dimensions that encourage (or discourage) organizations to collaborate.



Figure 3. Words cloud.

Interesting is also the Word cloud in Figure 3 which highlights the most used keywords. Those keywords which indicated the same word such as “big data” or “open data” or “data analytics”, as well as, “small and medium-sized enterprise” or “sme” or “smes” or the “innovation” and “innovative output” or “innovation activity”, were aggregated into main umbrella keywords. The the most frequent keyword is “Small and medium enterprises”, followed by “ecosystems”, then by the word “innovation” which has 28 occurrences, and information management. Interesting is the fact that the keywords can be grouped in different clusters that can be tightly related to data ecosystems dimensions, such as ‘SMEs’, which is the main actor investigated in this article, which is important for the development of the ecosystems, industry 4.0 technology which are the levers for data ecosystems in order to use and exploit data (Blaiszik et al., 2019; Cui et al., 2020). Value generation (i.e. innovation, decision and making), as data ecosystem aim to create value by fostering innovation among actors involved while improving the decision-making process (Oliveira et al., 2019). Knowledge management, ecosystems and supply chain, which are referred to the inter-organizational collaboration which are the foundations of data ecosystems (Heinz et al., 2022), as well as information, data and knowledge management, which can be related to absorptive capacity of the actors involved.

The current analysis brings interesting insights to SMEs and data ecosystems. Firstly, the results show that the topic of data ecosystems and SMEs is gaining attraction since the scientific production is expanding rapidly. Therefore, this underline that the topic is currently a fertile ground to be explored. At the same time, data show how data ecosystems is global phenomenon, encompassing different countries. While some countries are leaders such as China, USA, Italy and UK, others are following rapidly. In addition, the World Cloud highlights how SMEs and data ecosystems can be linked to relevant topics with are at the core of data ecosystems literature such as value creation (i.e. innovation and decision making), absorptive capacity (i.e. information, data and knowledge management), digital technologies (i.e. business and data analytics, digital platforms data warehouses and data spaces).

All these topics should be further investigated while considering data ecosystems context. For instance, potential future enquiries of research could be: *How do SMEs belonging to data ecosystems improve their absorptive capacity? How do SMEs improve their value creation when collaborating within data ecosystems? How much are digital technologies relevant for SMEs which are part of data ecosystems?*

These future lines of investigation would help to deepen the scholarly understanding regarding the dynamics between SMEs and data ecosystems. For example, the development of both quantitative and qualitative research in order to answer to such research questions would be particularly beneficial in order to bring sound results on this emerging topic. At the same time, it would be crucial to develop questionnaires or interviews to understand the dynamics among the SMEs involved, such as how and why they use data, how they can benefit from data for their internal capabilities, and how threats and opportunities affect the value creation of SMEs when they participate in data ecosystems. This would broaden the scholarship understanding of this topic.

The main limitation of the current work is certainly the fragmentation of the literature across multiple fields, as well as the use of only one main source for data retrieval (i.e., Scopus database). Therefore, future research could consider incorporating other alternative databases, such as the Web of Science database in order to add further value to this research.

Acknowledgements

We acknowledge financial support under the National Recovery and Resilience Plan (NRRP), Mission 4, Component 2, Investment 1.1, Call for tender No. 1409 published on 14.9.2022 by the Italian Ministry of University and Research (MUR), funded by the European Union – NextGenerationEU– Project Title Data4Innovation- Data ecosystem governance toward enhancing data sharing for innovation: implications for organizations – CUP C53D2300807001 - Grant Assignment Decree No. 1409 adopted on 14/09/2022 by the Italian Ministry of Ministry of University and Research (MUR).

References

- Blaiszik, B., Ward, L., Schwarting, M., Gaff, J., Chard, R., Pike, D., Chard, K., & Foster, I. (2019). A data ecosystem to support machine learning in materials science. *MRS Communications*, 9(4), 1125–1133. <https://doi.org/10.1557/mrc.2019.118>
- Ceccagnoli, M., Forman, C., Huang, P., & Wu, D. J. (2012). Cocreation of value in a plat-form ecosystem! The case of enterprise software. *MIS quarterly*, 263-290.
- Cui, Y., Kara, S., & Chan, K. C. (2020). Manufacturing big data ecosystem: A systematic literature review. *Robotics and Computer-Integrated Manufacturing*, 62, 101861. <https://doi.org/10.1016/j.rcim.2019.101861>
- Cunningham, J. A., & Link, A. N. (2015). Fostering university-industry R&D collaborations in European Union countries. *International Entrepreneurship and Management Journal*, 11, 849-860.
- Elmagrhi, M. H., Ntim, C. G., Crossley, R. M., Malagila, J. K., Fosu, S., & Vu, T. V. (2017). Corporate governance and dividend pay-out policy in UK listed SMEs: The effects of corporate board characteristics. *International Journal of Accounting & Information Management*, 25(4), 459-483.
- European Commission. (2020). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions an Sme strategy for a sustainable and digital Europe*, retrieved 15 January, 2025 from <https://eur-lex.europa.eu/legal-content/IT/TXT/?uri=CELEX%3A52020DC0103>
- European Union. (2022). *Regulation (EU) 2022/868 of the European Parliament and of the Council of 30 May 2022 on European data governance and amending regulation (EU) 2018/1724 (Data Governance Act)*, retrieved 15 January, 2025 from <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022R0868>
- Gašpar, G., Budjač, R., Valášek, M., Bartoň, M., Meravý, T., & Strémy, M. (2025). Digitizing SMEs in the EU: A scalable model for retrofitting machinery to Industry 4.0. *Applications in Engineering Science*, 23, 100230. <https://doi.org/10.1016/j.apples.2025.100230>
- Hafeez, S., Shahzad, K., Helo, P., & Mubarak, M. F. (2025). Knowledge management and SMEs' digital transformation: A systematic literature review and future research agenda. *Journal of Innovation & Knowledge*, 10(3), 100728. <https://doi.org/10.1016/j.jik.2025.100728>
- Heinbach, C., Gessler, J., Rychlik, H., Stecenko, C., Wieker, H. and Schulz, W. H. (2024). Sharing Business Data Securely: Insights from the European Gaia-X Project on Technical and Economic Roles Enabling Federated Data Spaces. *Journal of Telecommunications and the Digital Economy*, 12, 66–84.
- Heinz, D., Benz, C., Fassnacht, M., & Satzger, G. (2022). Past, Present and Future of Data Ecosystems Research: A Systematic Literature Review. *PACIS 2022 Proceedings*, 46. <https://aisel.aisnet.org/pacis2022/46>
- Huber, F., Wainwright, T., & Rentocchini, F. (2020). Open data for open innovation: Managing absorptive capacity in SMEs. *R&D Management*, 50(1), 31–46. <https://doi.org/10.1111/radm.12347>
- Jackson, E. B., Weck, M. and Pappel, I. (2024). The Role of Data Intermediaries for Small- and Medium-Sized Enterprises in the Innovation Ecosystems of the Nordic-Baltic Silver Economy. *In Proceedings of the 15th International Conference on Applied Human Factors and Ergonomics (AHFE 2024)*, Nice, France.
- Jin, H., & Hurd, F. (2018). Exploring the Impact of Digital Platforms on SME International-ization: New Zealand SMEs Use of the Alibaba Platform for Chinese Market Entry. *Journal of Asia-Pacific Business*, 19(2), 72–95. <https://doi.org/10.1080/10599231.2018.1453743>
- Kude, T., Dibbern, J., & Heinzl, A. (2011). Why do complementors participate? An analysis of partnership networks in the enterprise software industry. *IEEE Transactions on Engineering Management*, 59(2), 250-265.
- Maroufkhani, P., Wan Ismail, W. K., & Ghobakhloo, M. (2020). Big data analytics adoption model for small and medium enterprises. *Journal of Science and Technology Policy Management*, 11(4), 483–513. <https://doi.org/10.1108/JSTPM-02-2020-0018>

- Martínez-Román, J. A., Gamero, J., & Tamayo, J. A. (2011). Analysis of innovation in SMEs using an innovative capability-based non-linear model: A study in the province of Seville (Spain). *Technovation*, 31(9), 459-475.
- Micheli, M., Ponti, M., Craglia, M., & Berti Suman, A. (2020). Emerging models of data governance in the age of datafication. *Big Data & Society*, 7(2), doi 10.1177/2053951720948087
- Möller, F., Jussen, I., Springer, V., Gieß, A., Schweihoff, J. C., Gelhaar, J., Guggenberger, T., & Otto, B. (2024). Industrial data ecosystems and data spaces. *Electronic Markets*, 34(1), 41. <https://doi.org/10.1007/s12525-024-00724-0>
- Oliveira, M. I. S., Barros Lima, G. D. F., & Farias Lóscio, B. (2019). Investigations into Data Ecosystems: A systematic mapping study. *Knowledge and Information Systems*, 61(2), 589–630. <https://doi.org/10.1007/s10115-018-1323-6>
- Oliveira, M. I. S., & Lóscio, B. F. (2018). What is a data ecosystem? Proceedings of the 19th Annual *International Conference on Digital Government Research: Governance in the Data Age*, 1–9. <https://doi.org/10.1145/3209281.3209335>
- Ramalli, E., & Pernici, B. (2023). Challenges of a Data Ecosystem for scientific data. *Data & Knowledge Engineering*, 148, 102236. <https://doi.org/10.1016/j.datak.2023.102236>.
- Razmerita, L., Kirchner, K., & Nielsen, P. (2016). What factors influence knowledge sharing in organizations? A social dilemma perspective of social media communication. *Journal of Knowledge Management*, 20(6), 1225–1246. <https://doi.org/10.1108/JKM-03-2016-0112>
- Rozkrut, M. (2023) Digital Transformation and Data Ecosystem: Implications for Policy Actions and Competency Frameworks. *Wiadomości Statystyczne. The Polish Statistician*, 2023, 65–82.
- Sati, Z. E. (2024). Comparison of the criteria affecting the digital innovation performance of the European Union (EU) member and candidate countries with the entropy weight-TOPSIS method and investigation of its importance for SMEs. *Technological Forecasting and Social Change*, 200, 123094. <https://doi.org/10.1016/j.techfore.2023.123094>
- Song, H., Yu, K., Ganguly, A., & Turson, R. (2016). Supply chain network, information sharing and SME credit quality. *Industrial Management & Data Systems*, 116(4), 740–758. <https://doi.org/10.1108/IMDS-09-2015-0375>