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Towards sustainable public and open data ecosystems: An introduction to a special section

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I Introduction

Data ecosystems are networks of autonomous actors who consume, produce, or provide data along with related resources such as software, services, and infrastructure (Oliveira and Lóscio, 2018, p.4). Public Data Ecosystems (PDE)¹ and Open Data Ecosystems (ODE) are specific subtypes of data ecosystems (Degen & Teubner, 2024; Lnenicka et al., 2024). They have the potential to transform how governments use data, stimulate public sector innovation (Janssen et al., 2017; Kankanhalli et al., 2017; Ruijter & Meijer, 2020), and foster collaborative efforts to co-create smarter cities and societies (Lnenicka et al., 2024; Van Loenen et al., 2021; Nikiforova et al., 2023; Roblek et al., 2021; Sołtysik-Piorunkiewicz & Zdonek, 2021).

Public and open data ecosystems play a crucial role in supporting democratic societies by increasing government transparency, promoting citizen participation, and encouraging multi-stakeholder cooperation (Ruijter et al., 2017). Moreover, they significantly contribute to the achievement of the Sustainable Development Goals (SDGs) and alignment with principles of smart living (Corbett & Mellouli, 2017; Germann, 2022; Nikiforova et al., 2023; Sharma et al., 2020; Van Loenen et al., 2021). Public and open data ecosystems also support the vision of Society 5.0² (Nikiforova et al., 2023; Roblek et al., 2021; Sołtysik-Piorunkiewicz & Zdonek, 2021). To fulfill this potential, it is essential that public and open data ecosystems are not only established but also designed to be sustainable, resilient, equitable, and fair (Calzati & van Loenen, 2023; Lnenicka et al., 2024; Van Loenen et al., 2021). However, achieving these goals is challenging, as public and open data ecosystems are complex phenomena that go beyond traditional definitions of data ecosystems.

Public and open data ecosystems can bring public value across economic, social and environmental dimensions, making it central for public data ecosystems and other types of data infrastructures and data spaces (Lnenicka et al., 2024). These public data and open (government) data ecosystems are viewed as political and socio-economic phenomena expected to contribute to the development of transparent, efficient, and high-quality public services, thus fostering innovation and civic engagement, benefiting the economy (Kassen, 2020; Matheus et al., 2023; Reggi & Dawes, 2016; Santos-Hermosa et al., 2023).

Having collaborative governance models is one of the prerequisites for a resilient and value-adding data ecosystem, of which stakeholders is an inevitable element, making it necessary to ensure those ecosystems are stakeholder-oriented. These governance models are expected to support all actors - public sector, private sector, business, civil society and citizens - who may have different levels of digital and open data literacy (Calzati & van Loenen, 2023; Santos-Hermosa et al., 2023; Vargas et al., 2023), needs and demands, and expectations for public value creation and co-creation. Understanding, designing, and maintaining these ecosystems is further complicated by the fact that both data, service and process quality must be ensured and kept maintained with a limited understanding of how the above are expected to be ensured even alone.

Recent research has identified key components shaping the public data ecosystem that are: (a) components and relationships, (b) stakeholders, (c) actors and their roles, (d) data types, (e) processes and activities, and (f) data lifecycle phases (Lnenicka et al., 2024). Moreover, these ecosystems, just like their components, are continuously (co-)evolving due to

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both internal and external factors, including rapid technological advancements. Emerging technologies such as big data, artificial intelligence (AI), generative AI, machine learning (ML), federated learning (FL), the Internet of Things (IoT), and the metaverse are redefining the landscape of public and open data development. These changes, together with growing stakeholder expectations to address existing data asymmetries through the implementation of business-to-government (B2G) and citizens-to-government (C2G) models, are influencing and shaping the design and development of these data environments (Kassen, 2021; Lnenicka et al., 2024; Verhulst & Young, 2022). These environments are also expected to change. For example, in relation to B2G, the European Commission is taking regulatory action and has created the Data Act to set the rules and conditions, thereby changing the current voluntary model to a more mandatory data sharing (Susha et al., 2022).

New research is needed to assist public managers and politicians in (1) integrating emerging technologies and technological innovations, (2) meeting the public data ecosystems' stakeholders' expectations, needs, regulations and demands, incl. assessing the impact public and open data ecosystems have in individuals, organizations, and society, and (3) transforming public data ecosystem into more sustainable ecosystems that will "fuel" or "smartify" society (support the transition from the Information Society (Society 4.0) to a Super Smart Society (Society 5.0)), cities and various areas of life, including, facilitating achievement of SDGs. Moreover, efforts of every individual helix should complement others in order to enable effective data reuse and value co-creation.

2 Overview of the special section

This Special Section emerged as a follow-up from the track "Sustainable Public and Open Data Ecosystems" at the 25th Annual International Conference on Digital Government Research (dg.o 2024) and the track "Open Data" at the IFIP EGOV-CeDEM-EPART 2024. The interesting papers on public and open data ecosystems presented in the tracks of both conferences revealed a common interest in open platforms, where data providers and data users find each other and collaborate to co-create services and products that benefit society, where this collaboration is enabled by digital technologies. The presentations confirmed earlier claims, according to which the adoption and development of these ecosystems have been fragmented, lacking balance between data supply and demand, and often excluding specific user groups being linear and lacking skill-training, which reduces their value-generation and sustainability. It is where the idea of the Special Section emerged from, and three papers were selected for publication.

The papers in this Special Section consider both holistic and specific perspectives on public data ecosystems. Ali et al. propose a framework for the multi-dimensional assessment of ODE development within the context of the Greek national ODE, whereas Tseng and Nikiforova explore the High-Value Datasets opening lifecycle in Taiwan. Complementing these studies, Vargas et al. focus on the development of open data literacy as early as from the elementary school, exemplifying it with Danish schools to demonstrate how open data education can be integrated into the curriculum.

"A Framework for the Multi-dimensional Assessment of Interoperability for Open Data Ecosystems Development" by Mohsan Ali, Georgios Papageorgiou, Abdul Aziz, Euripidis Loukis, Yannis Charalabidis, Charalampos Alexopoulos, and Francisco Javier López Pellicer focuses on the interoperability capabilities of Open Government Data (OGD) infrastructures. From a research design reviewing existing European interoperability frameworks and literature frameworks, the paper presents a conceptual contribution in the form of the Technical, Semantic, Legal, and Organizational (TSLO) Interoperability Framework. The framework is then applied and validated for the assessment of the interoperability of the OGD infrastructures of the Greek local governments, as well as with municipalities that do not provide OGD. The value of this conceptual contribution is twofold: first, it offers a diagnostic tool to analyze interoperability of OGD infrastructures. Second, it can be used as a governance to increase interoperability of OGD infrastructures, and increase the social and economic value of OGD.

"Navigating the High-Value Dataset Landscape from Determination to Impact: Lessons from Taiwan's OGD Ecosystem" by Hsien-Lee Tseng and Anastasija Nikiforova examines Taiwan's High-Value Datasets (HVD) lifecycle, a critical subset of OGD. Through qualitative interviews with government officials, scholars, and NGO, the study examines Taiwan's approach to defining and opening HVDs, emphasizing local priorities such as disaster resilience and social welfare, while also aligning with global frameworks such as the G8 Open Data Charter and the EU's Open Data Directive. The study identifies key gaps in data interoperability and limited engagement with end-users, which hinder the maximization of HVDs' impact. To overcome these challenges, the authors propose an HVD opening lifecycle roadmap, structured around the PDCA (Plan-Do-Check-Act) cycle that informs the proposed HVD opening lifecycle, guiding policy makers through strategic, technical, and impact assessment phases. This roadmap not only helps to refine Taiwan's HVD strategy but also offers insights for other nations aiming to optimize their HVD and as such open data ecosystems for public value creation. The study underscores the importance of continuous improvement, high data quality standards and the

need for AI-ready data, and sustained stakeholder engagement to unlock the full potential of high-value datasets, driving innovation, transparency, and social benefits.

Finally, “*Open Data learning designs in elementary school: Defining the essential elements for developing open data competencies*” by Alejandra Celis Vargas, Rikke Magnussen, Birger Larsen, and Ingrid Mulder, explore how to integrate open data literacy acquisition –that the authors refer to as *open data education*– into elementary school settings using a design-based research approach. Conducted over three cycles and involving multiple interventions in Danish schools, the study iteratively developed and tested “*the Open Data Newsroom*” – a role-playing game that helps students build open data competencies. The game immerses students in a data journalism process to solve real-world problems, promoting skills such as data analysis, critical thinking, and problem-solving. The results emphasize that authentic learning experiences, engagement with real-world data, and a structured, yet flexible, approach support students in developing practical open data skills. This innovative educational model highlights the potential of open data in fostering civic engagement and digital literacy from a young age, contributing to a growing body of research focused on preparing students – or citizens – to participate meaningfully in open data ecosystems. The study also offers insights into the key design elements—authentic practices, local data, and game-based learning—that are crucial for successful open data learning experiences in elementary education.

3 Final remarks and future research agenda

In line with the overarching theme of this special section, the contributing papers highlight several future research directions. One prominent area of focus is *data interoperability*, which emerges as a critical research priority, serving as the central research object in one study, and a takeaway in another. Enhancing interoperability is essential to breaking down existing data silos and enabling cross-sectoral collaboration, ultimately leading to more integrated and impactful public and open data ecosystems and public services. Future research should delve into *systematic approaches for improving interoperability* across multiple dimensions –technical, semantic, legal, and organizational– while examining how these dimensions interact in diverse national and local contexts and influence the generation of social and economic value from open data. Developing *impact assessment frameworks* with standardized metrics and tools to measure the economic, social, and environmental benefits of open data, including for high-value datasets, is identified as another research priority.

Another critical direction involves advancing *user-centric approaches* in public sector data management. This entails exploring ways to engage diverse stakeholders, including citizens, developers, and businesses, in the identification and definition of high-value datasets, the use of the OGD, and (co-)creation of public value from them. Such engagement ensures that data assets and the ecosystems surrounding them better reflect real needs and priorities of end-users, making them more likely to be utilized, and therefore, more sustainable and resilient.

Moreover, there is a growing emphasis on researching *educational strategies for building open data competencies from an early age*. This includes investigating how *game-based and experiential learning* can be effectively used to teach data literacy and real-world problem-solving skills. Future studies should explore how these educational interventions can be scaled to various age groups and learning environments, as well as the role of *teacher training and curriculum development* in supporting these initiatives. This calls for a broader exploration of *innovative pedagogical models* that equip younger generations to engage actively and meaningfully in public and open data ecosystems.

Collectively, these future research directions highlight the need for a *multi-dimensional approach* that considers *global, local, and user-specific contexts* in shaping emerging public sector data strategies and digital governance frameworks. Such an approach is essential to fostering resilience and sustainability in public and open data ecosystems. Together, these efforts are expected to pave the way for a new era of digital governance that is transparent, participatory, and aligned with the goals of a smart and sustainable society.

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Notes

1. Public Data Ecosystem is a dynamic and adaptable network of elements and interrelations between them, driven by occurring internal and external data flows and requirements arising within it, where elements are components that can be used to describe the context of an ecosystem and/or to affect the dynamics of data ecosystem management and development, where interrelation between these

elements or relationships is a connection between elements, the nature of which depends on the nature of the elements with which it is connected, with most relationships being represented by data activities through which data are disclosed and reused (McLeod & McNaughton, 2016). Dynamism and adaptability of the network of these elements and interrelations between them, in turn, refers to changes in the state of a data ecosystem that occur through a series of successive / sequential steps over time, which is called *evolution* (Lnenicka et al., 2024).

2. Society 5.0 (also known as “super smart society” and “society of imagination”) is the concept introduced by the Japanese government (5th Science and Technology Basic Plan), with the overarching goal “to create a human-centric society in which both economic development and the resolution of societal challenges are achieved, and people can enjoy a high quality of life that is fully active and comfortable. It is a society that will attend in detail to the various needs of people, regardless of region, age, sex, language, etc. by providing necessary items and services. The key to its realization is the fusion of cyber space and the real world (physical space) to generate quality data, and from there create new values and solutions to resolve challenges” (Fukuyama, 2018).

References

- Calzati, S., & van Loenen, B. (2023). A fourth way to the digital transformation: The data republic as a fair data ecosystem. *Data & Policy*, 5, e21. <https://doi.org/10.1017/dap.2023.18>
- Corbett, J., & Mellouli, S. (2017). Winning the SDG battle in cities: How an integrated information ecosystem can contribute to the achievement of the 2030 sustainable development goals. *Information Systems Journal*, 27(4), 427–461. <https://doi.org/10.1111/isj.12138>
- Degen, K., & Teubner, T. (2024). Wallet wars or digital public infrastructure? Orchestrating a digital identity data ecosystem from a government perspective. *Electronic Markets*, 34(50), 1–25. <https://doi.org/10.1007/s12525-024-00731-1>
- Fukuyama, M. (2018). Society 5.0: Aiming for a new human-centered society. *Japan Spotlight*, 27(5), 47–50.
- Germann, S. (2022). Conceptual and normative approaches to AI governance for a global digital ecosystem supportive of the UN sustainable development goals (SDGs). *AI and Ethics*, 2(2), 293–301. <https://doi.org/10.1007/s43681-021-00058-z>
- Janssen, M., Konopnicki, D., Snowdon, J. L., & Ojo, A. (2017). Driving public sector innovation using big and open linked data (BOLD). *Information Systems Frontiers*, 19, 189–195. <https://doi.org/10.1007/s10796-017-9746-2>
- Kankanhalli, A., Zuiderwijk, A., & Tayi, G. K. (2017). Open innovation in the public sector: A research agenda. *Government Information Quarterly*, 34(1), 84–89. <https://doi.org/10.1016/j.giq.2016.12.002>
- Kassen, M. (2020). Open data and its peers: Understanding promising harbingers from Nordic Europe. *Aslib Journal of Information Management*, 72(5), 765–785. <https://doi.org/10.1108/AJIM-12-2019-0364>
- Kassen, M. (2021). Understanding motivations of citizens to reuse open data: Open government data as a philanthropic movement. *Innovation*, 23(1), 44–70. <https://doi.org/10.1080/14479338.2020.1738940>
- Lnenicka, M., Nikiforova, A., Luterek, M., Milic, P., Rudmark, D., Neumaier, S., Kević, K., & Zuiderwijk, A., & Bolívar, M. P. R. (2024). Understanding the development of public data ecosystems: from a conceptual model to a six-generation model of the evolution of public data ecosystems. *Telematics and Informatics*, 94, 1–23. <https://doi.org/10.1016/j.tele.2024.102190>
- Matheus, R., Faber, R., Ismagilova, E., & Janssen, M. (2023). Digital transparency and the usefulness for open government. *International Journal of Information Management*, 73, 102690. <https://doi.org/10.1016/j.ijinfomgt.2023.102690>
- McLeod, M., & McNaughton, M. (2016). Mapping an emergent open data eco-system. *The Journal of Community Informatics*, 12(2). <https://doi.org/10.15353/joci.v12i2.3220>
- Nikiforova, A., Flores, M. A. A., & Lytras, M. D. (2023). The role of open data in transforming the society to society 5.0: A resource or a tool for SDG-compliant smart living? In *Smart Cities and Digital Transformation: Empowering Communities, Limitless Innovation, Sustainable Development and the Next Generation* (pp. 219–252). Emerald Publishing Limited.
- Oliveira, M. I. S., & Lóscio, B. F. (2018). What is a Data Ecosystem? In *Proceedings of the 19th Annual International Conference on Digital Government Research Governance in the Data Age - dgo '18* (pp. 1–9). ACM.
- Reggi, L., & Dawes, S. (2016). Open government data ecosystems: Linking transparency for innovation with transparency for participation and accountability. In *Electronic Government: 15th IFIP WG 8.5 International Conference, EGOV 2016, Guimarães, Portugal, September 5–8, 2016, Proceedings 15* (pp. 74–86). Springer International Publishing.
- Roblek, V., Meško, M., & Podbregar, I. (2021). Mapping of the emergence of society 5.0: A bibliometric analysis. *Organizacija*, 54(4), 293–305. <https://doi.org/10.2478/orga-2021-0020>
- Ruijter, E., Grimmelikhuijsen, S., & Meijer, A. (2017). Open data for democracy: Developing a theoretical framework for open data use. *Government Information Quarterly*, 34(1), 45–52. <https://doi.org/10.1016/j.giq.2017.01.001>
- Ruijter, E., & Meijer, A. (2020). Open government data as an innovation process: Lessons from a living lab experiment. *Public Performance & Management Review*, 43(3), 613–635. <https://doi.org/10.1080/15309576.2019.1568884>
- Santos-Hermosa, G., Quarati, A., Loria-Soriano, E., & Raffaghelli, J. E. (2023). Why does open data get underused? A focus on the role of (open) data literacy. In *Data Cultures in Higher Education: Emergent Practices and the Challenge Ahead* (pp. 145–177). Springer International Publishing.

- Sharma, N., Ghosh, S., & Saha, M. (2020). *Open Data for Sustainable Community: Glocalised Sustainable Development Goals*. Springer Nature.
- Sołtysik-Piorunkiewicz, A., & Zdonek, I. (2021). How society 5.0 and industry 4.0 ideas shape the open data performance expectancy. *Sustainability*, 13(2), 917. <https://doi.org/10.3390/su13020917>
- Susha, I., Schiele, J., & Frenken, K. (2022, August). Business-to-government data sharing for public interests in the European union: results of a public consultation. In *International Conference on Electronic Government* (pp. 515–529). Springer International Publishing.
- van Loenen, B., Zuiderwijk, A., Vancauwenberghe, G., Lopez-Pellicer, F. J., Mulder, I., Alexopoulos, C., & Flores, C. C. (2021). Towards value-creating and sustainable open data ecosystems: A comparative case study and a research agenda. *JeDEM-eJournal of EDemocracy and Open Government*, 13(2), 1–27. <https://doi.org/10.29379/jedem.v13i2.644>
- Vargas, A. C., Magnussen, R., Mulder, I., & Larsen, B. (2023). Towards a framework for open data literacy in education: A systematic mapping review of open data skills and learning approaches. *Interaction Design and Architecture (s)*, (57), 133–151. <https://doi.org/10.55612/s-5002-057-008>
- Verhulst, S., & Young, A. (2022). Identifying and addressing data asymmetries so as to enable (better) science. *Frontiers in big Data*, 5, 888384. <https://doi.org/10.3389/fdata.2022.888384>