Open Data for Smart Cities: An Exploratory Study

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The UNESCO Recommendation on Open Science defines Open Science as an inclusive construct that aims to make multilingual scientific knowledge openly available, accessible, and reusable for everyone. Its goal is to increase scientific collaborations and sharing of information for the benefit of science and society, at large. Open Science opens up the processes of scientific knowledge creation, evaluation and communication to actors beyond the traditional scientific community. It comprises all scientific disciplines, including basic and applied sciences, natural and social sciences and the humanities. The key pillars of Open Science are open scientific knowledge, open science infrastructures, science communication, open engagement of societal actors and open dialogue with other knowledge systems.

Open Data is considered to be a crucial aspect of Open Science, playing a significant role in supporting UNESCO's Recommendations on Open Science. Open data enable data sharing, enhances reproducibility and transparency, promotes data interoperability and standards, and supports data preservation and long-term access. This has profound implications for various fields, including education, research, cultural heritage and health.

Evaluating the impact of open data initiatives on Smart Cities (SC) is currently limited despite existing policies and studies (Neves, F., et al, 2020). Open data's multifaceted impact includes improved city governance, transparency, citizen engagement and innovative solutions to socio-economic and environmental problems (Neto et al., 2017; Ubaldi, 2013; Yadav et al., 2017; Young & Verhulst, 2016). Angelidou defined smart cities as urban settlements utilizing Information and Communications Technology (ICT) strategically for prosperity, effectiveness and competitiveness (Angelidou, 2014). Open data's accessibility stimulates innovation, entrepreneurial and positive social change by empowering citizens (Abella et al., 2017; Berrone et al., 2016; Davies & Perini, 2016; Smith et al., 2015; Verhulst & Young, 2017).

As per the Open Data Barometer and the data for the year 2022 reported by Neves et al. (2020), the production of open data is rapidly increasing daily (Neves, de Castro Neto, and Aparicio 2020). The European Commission Strategic Foresight Report for 2022, prioritizes making societies greener and more digital equitably. Open data, freely usable, re-usable and redistributable is expected to face opportunities and challenges in rapidly adapting to societal changes.

Open data comprises two dimensions. The first involves data produced and held by public sector bodies, including ministries, state agencies, municipalities, and organizations funded or controlled by public authorities. The second dimension refers to research data, collected or produced in scientific research activities and are used as evidence or validation following FAIR Principles (findable, accessible, interoperable, and reusable). European Commission and national authorities establish policies to ensure open access to research data.

The Open Data Directive, replacing the Public Sector Information Directive, was implemented differently by EU Member States. Cyprus demonstrated a rapid response by approving and harmonizing Cypriot legislation with the European Directive 2019/1024/EU on open data and the public sector information. This law replaced the previous Law on the Further Use of Information of the Public Sector of 2015 (Law 205 (I) / 2015). Various actions have been taken at different levels to support the policies in recent years.

The European strategy for data focuses on adopting legislative measures for data governance, access, and reuse to maintain leadership in the global data economy. Examples include promoting business-to-government data sharing, providing high-value datasets for free reuse across the EU, investing in data processing infrastructures, and facilitating access to secure, fair, and competitive cloud services. These measures aim to enhance data availability for business innovation.

Since 2017, the EU Commission has mandated that research data from EU-funded projects must be openly accessible and adhere to FAIR principles. Following this example, many member states, including Cyprus, have implemented re developed their own national policies in this regard.

Policy development takes place at both EU and member state levels. The proliferation of smart devices and digitization generates a vast amount of heterogeneous data, known as Big Data, presenting challenges and opportunities for cities and citizens. E-government processes in smart cities need to be tailored to address citizens' needs and digital skills.

Digitized essential services may exclude certain segments of the population due to language, culture, and age factors. Lister (2020) proposes inclusive and accessible digitally mediated learning activities to address this issue. Trained professionals are crucial for planning, creating and educating citizens to enhance resilience in Smart Cities.

Professional skills development is crucial as highlighted by (Fitsilis and Kokkinaki 2021), who emphasize the implications of a limited number of employees in with DevOps knowledge for the sustainable smart city services. Enhancing skills, knowledge, and the adoption of tools is essential to maximize the potential of the workforce in shaping and supporting smart cities.

References

Abella, A., Ortiz-de-Urbina-Criado, M. & De-Pablos-Heredero, C. 2017, "A model for the analysis of data-driven innovation and value generation in smart cities' ecosystems", *Cities,* vol. 64, pp. 47-53.

Angelidou, M. 2014, "Smart city policies: A spatial approach", *Cities,* vol. 41, pp. S3-S11.

Berrone, P., Ricart, J.E. & Carrasco, C. 2016, "The open kimono: Toward a general framework for open data initiatives in cities", *California management review,* vol. 59, no. 1, pp. 39-70.

Davies, T., Walker, S.B., Rubinstein, M. & Perini, F. 2019, *The state of open data: Histories and horizons,* African Minds.

de Castro Neto, M., Rego, J.S., Neves, F.T. & Cartaxo, T.M. 2017, "Smart & open cities: Portuguese municipalities open data policies evaluation", *2017 12th Iberian Conference on Information Systems and Technologies (CISTI)*IEEE, , pp. 1.

European Commission 2022a, *The European Commission's 2022 Strategic Foresight Report is out!*.

European Commission 2022b, *European legislation on open data*. Available: https://digital-strategy.ec.europa.eu/en/policies/legislation-open-data.

European Commission 2022c, *Smart cities*. Available: https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en.

European Commission 2022d, *Strategic Foresight Report 2022*.

European Commission 2022e, *Where is Open Science in Horizon Europe?*. Available: https://openscience.eu/Open-Science-in-Horizon-Europe?fbclid=IwAR18qn2KAnz0_6SIozTtlhB95TKR_9cN2mDvWMZCsoHGP7hPHPwksgGyo9w.

European Commission 2021a, *Europe Sustainable Development Report 2021*.

European Commission 2021b, *Open Data Maturity Report 2021*. Available: https://data.europa.eu/sites/default/files/landscaping_insight_report_n7_2021.pdf.

European Commission 2021c, *Open Science. Research and innovation*. Available: https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science_en.

European Commission 2020, *Proposal for a Regulation of the European Parliament and of the Council on European data governance (Data Governance Act)* . Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020PC0767.

European Commission 2019a, *Directive (EU) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector*

information. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1561563110433&uri=CELEX:32019L1024 [2023, .

European Commission 2019b, *The Future of the Cities. Opportunities Challenges and the Way Forward*.
Available: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC116711/the-future-of-cities_online.pdf.

Fitsilis, P. & Kokkinaki, A. 2021, *Smart Cities Body of Knowledge,* 1st edn, ERASMUS+ Project Smart DevOps Competences for Smart Cities.

Lister, P. 2020, "Smart learning in the community: Supporting citizen digital skills and literacies", *Distributed, Ambient and Pervasive Interactions: 8th International Conference, DAPI 2020, Held as Part of the 22nd HCI International Conference, HCII 2020, Copenhagen, Denmark, July 19–24, 2020, Proceedings 22*Springer, , pp. 533.

Neves, F.T., de Castro Neto, M. & Aparicio, M. 2020, "The impacts of open data initiatives on smart cities: A framework for evaluation and monitoring", *Cities,* vol. 106, pp. 102860.

Open Knowledge Foundation 2023a, *Open Definition. Defining Open in Open Data, Open Content and Open Knowledge*. Available: https://opendefinition.org/ [2023.

Open Knowledge Foundation 2023b, *What is Open Data?*.
Available: https://opendatahandbook.org/guide/en/what-is-open-data/ [2023.

Republic of Cyprus. Ministry of Finance 2023, , *Open Data Cyprus*.
Available: https://www.data.gov.cy.

Ubaldi, B. 2013, "Open government data: Towards empirical analysis of open government data initiatives".

United Nations Educational, Scientific and Cultural Organization (UNESCO) 2023, *Open data for AI. What now?*.
Available: https://unesdoc.unesco.org/ark:/48223/pf0000385841?posInSet=1&queryId=a7bf30be-b2e9-413d-97b0-beea17dbe7a0 [2023, .

United Nations Educational, Scientific and Cultural Organization (UNESCO) 2021, *Recommendation on Open Science*.
Available: https://unesdoc.unesco.org/ark:/48223/pf0000379949?posInSet=10&queryId=63eafee3-babf-42d7-9654-1560daa1ca25 [2023, .

United Nations Educational, Scientific and Cultural Organization (UNESCO) 2019, *Smart cities: shaping the society of 2030,*

United Nations Educational, Scientific and Cultural Organization (UNESCO) 2018, *Digital skills critical for jobs and social inclusion*.
Available: https://en.unesco.org/news/digital-skills-critical-jobs-and-social-inclusion.

Verhulst, S.G. & Young, A. 2017, *Open Data in Developing Economies Toward Building an Evidence Base on What Works and How,* African Minds.

World Wide web foundation 2022, *The Open Data Barometer*. Available: https://opendatabarometer.org/?_year=2017&indicator=ODB.

Yadav, P., Hasan, S., Ojo, A. & Curry, E. 2017, "The role of open data in driving sustainable mobility in nine smart cities", .

Young, A. & Verhulst, S. 2016, *The global impact of open data,* O'Reilly Media, Incorporated.