OPEN DATA AS AN ASSET FOR SUSTAINABLE DEVELOPMENT OF DATA-DRIVEN SMART CITIES AND SMART SOCIETY

Innovation and Smart Government Conference 2022 (ISGOV2022)

Anastasija Nikiforova, PhD

TARTU ÜLIKOOL · UNIVERSITY OF TARTU · 1632

EUROPEAN OPEN SCIENCE CLOUD

BIO

PhD in Computer Science – Data Processing Systems and Data Networking

Research interests include but are not limited to data management with a focus on data quality, open government data, Smart City, Society 5.0, sustainable development, IoT, HCI, digitization.

Most recent experience:

- ✓ **Assistant professor at the University of Tartu, Institute of Computer Science**
- ✓ **European Open Science Cloud Task Force "*FAIR Metrics and Data Quality*"**
- ✓ **associate member of the Latvian Open Technology Association.**
- ✓ **expert of the Latvian Council of Sciences in (1) *Natural Sciences – Computer Science & Informatics*, (2) *Engineering and Technology-Electrical Engineering, Electronics, ICT*, (3) *Social Sciences – Economics and Business***
- ✓ **expert of the *COST – European Cooperation in Science & Technology***

- ✓ visiting researcher at the Delft University of Tehnology, Faculty Technology Policy and Management
- ✓ assistant professor at the Faculty of Computing, University of Latvia
- ✓ researcher in the Innovation Laboratory, Faculty of Computing, University of Latvia
- ✓ IT-expert at the Latvian Biomedical Research and Study Centre, BBMRI-ERIC LV National Node
- ✓ advisor for the Institute for Social and Political Studies, University of Latvia

TARTU ÜLIKOOL · UNIVERSITY OF TARTU · 1632

EUROPEAN OPEN SCIENCE CLOUD

LATA

TU Delft

Delft University of Technology

LATVIJAS UNIVERSITĀTE

Latvian Council of Science

BMC

BIO

- program committee for 20+ international conferences
- invited reviewer for 15+ high-quality (Q1-Q2) journals
- **Editorial Board Member** and an **Associate Editor**
  - ✓ ***BMC Research Notes (Springer Nature***
  - ✓ ***eJournal of eDemocracy and Open Government (JeDEM)***
  - ✓ ***Data & Policy*** (***Cambridge Press***)
  - ✓ ***International Journal on Semantic Web and Information Systems (IJSWIS) (IGI Global)***

Editorial Board Member for
BMC Research Notes
bmcresnotes.biomedcentral.com
BMC Part of Springer Nature

JeDEM eJOURNAL OF eDEMOCRACY & OPEN GOVERNMENT

INTERNATIONAL JOURNAL ON
Semantic Web and Information Systems

DATA & POLICY

CAMBRIDGE UNIVERSITY PRESS

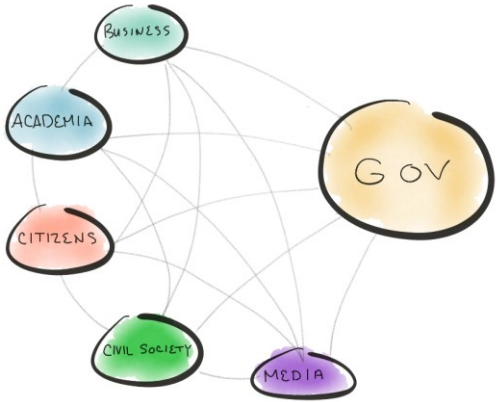
OPEN DATA AS AN ASSET FOR SUSTAINABLE DEVELOPMENT OF DATA-DRIVEN SMART CITIES AND SMART SOCIETY

OPEN DATA

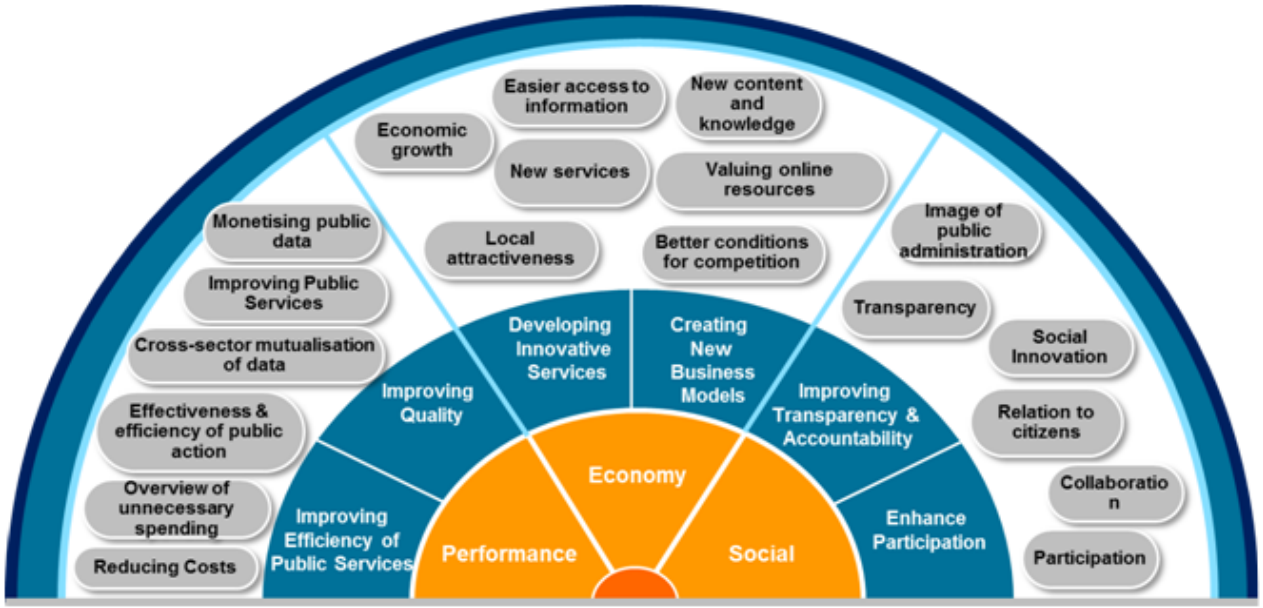
SMART CITIES

SMART SOCIETY

OPEN DATA AND OPEN GOVERNMENT DATA (OGD)



Open data are data that anyone can access, use and share ***



- Accessible
- Complete
- Primary
- Machine-processable
- Timely
- Non-discriminatory
- Non-proprietary
- Licence-free

Source: https://www.opengovguide.com/topics/open-government-data/

OPEN DATA USE. GOVERNMENT (source: data.europa.eu)

Supporting growing economies

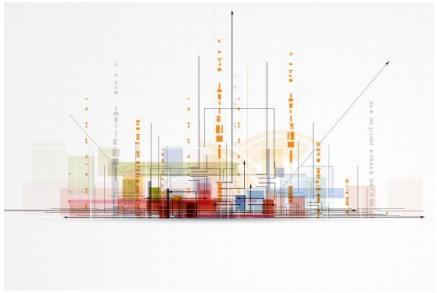
To support the emergence of new data-driven businesses and the growth of existing ones, governments need to publish key datasets.
Governments also need to support data infrastructure that connects data with those who use it.
In return, governments are reaping the benefits of a growing data economy, such as in Finland where SMEs with access to open data grew 15% faster than those without.
Take me to the Finnish case study

Improved service delivery

Governments need to balance the demands of growing populations with the need to tackle small-scale, local issues.
The availability of detailed open data is essential to improving delivery of services at the local level.
Some of these new services are available now:
Take me to mySociety
Take me to the Hungarian 'right to know' portal
Take me to Fix my Street Norway

Cost savings

Open data allows governments to make savings in key areas such as healthcare, education and utilities.
In the UK, open data helped reveal £200 million of savings in the health service.
In France, energy data is being used to drive more efficient energy generation practices.
Show me the France energy data.
Open data can also bring transparency and accountability to budgets.



Source: https://data.europa.eu/elearning/en/module2/#/id/co-01

OPEN DATA USE. COMMUNITY AND PUBLIC TRANSFORMATION, CULTURE AND ENVIRONMENT

Improving the way we move

Open data has the power to revolutionise the way we travel. Within the Dutch transport industry, open data is helping a growing number of small companies to develop new services. French app Tranquilien improves passenger comfort on transport and promotes efficient use of public transport by providing relevant information about empty seats, leaving times A new Dutch app, winner of the prestigious Apps4Europe competition, helps disabled people to book travel assistance for their journeys using open data.
Open transport data saves commuters time, makes journeys more accessible and helps tourists to travel in unfamiliar cities.

Improving the way we work

Open data is changing the way we work.
Open data reduces the time needed to find information and allows professionals to focus more of their time on productive activities. OpenCorporates offers an open database of companies around the world, showing their networks, financial stability and environmental impact. This helps organisations learn more about prospective clients, providers and partners.
Take me to OpenCorporates
The Finnish Kannattaako kauppa service provides insights on the price development of real estate in the future, making it easy to compare houses and neighborhoods by price and population.

Improving the way we govern

Open data is becoming a key source of evidence for governments in the policymaking process. Public administration will gain the most from opening up data, with a value of 22 bn EUR in 2020. For agriculture, the arts and entertainment sector, the benefits expected are smaller with 379 million EUR each. They still have a lot of potential in these sectors but will take more time to reach the full potential. They are also making the development of public policy more transparent and supporting dialogue between governments and citizens. Data on key issues such as immigration, trade and budget cuts can be used to inform important policy decisions.
CityScale is a Ukrainian platform that provides Ukrainian citizens with relevant open data, such as on crime rates, health care, and air pollution.
Take me to London fire station analysis

Environment

Open data helps farmers to improve yields and support a growing population without the need to destroy valuable habitats. Plantwise are collecting open data to produce valuable information packs for farmers about plant health and threats from diseases. Take me to Plantwise
CIARD has produced a central repository of more than 1,500 open agricultural research collections worldwide, highlighting new research opportunities. Take me to CIARD

Saving lives

Open data is helping to save lives. Open geographic data and aid statistics are being used by humanitarian groups to deliver targeted supplies in disaster zones.

Open mapping data helped disaster response teams target aid delivery during the 2010 Haiti earthquake. Haiti Open Street Map.
Open data was also used for responses to the Philippines typhoon in 2014.

Culture

Open data is connecting people with important cultural issues and helping to shape a more informed debate around them.
OpenGLAM is helping to capture the heritage and cultural memories of groups in Germany, Switzerland and Finland. Take me to OpenGLAM.

The Open Data Institute is leading a global Data as Culture programme, with artists in residence re-examining the fundamental ways in which data is perceived. Take me to ODI Data as Culture

OPEN DATA IN THE MOTION

real-time (!!!) open data → a participatory urban-sensing framework for fine particulate matters PM2.5 - Taiwan +29 countries → one of the largest deployment projects for PM2.5 monitoring in the world → collected data are released in real time and in an open data manner, which has contributed to the development of other products and services using data which has been made open, thereby creating a chain of valuable open data-based solutions and services

Stieb, D.M.; Evans, G.J.; To, T.M.; Brook, J.R.; Burnett, R.T. An ecological analysis of long-term exposure to PM2.5 and incidence of COVID-19 in Canadian health regions. Environ. Res. 2020, 191, 110052

a sensor-generated air pollution open data catalog → system focusing on the detecting and treatment of one of the most important sleep disorders, Obtrusive sleep apnea (OSA) (open data processing, along with other factors such as sleep environment, sleep status, physical activities, and physiological parameters)

Yacchirema, D.C.; Sarabia, D.; Palau, C.E.; Esteve, M. A Smart System for Sleep Monitoring by Integrating IoT With Big Data Analytics. IEEE Access **2018**, 6, 35988–36001

relationship between **COVID-19 open data and PM2.5 → a positive relationship between long-term PM2.5 exposure and the incidence of COVID-19**

Chen, L.J.; Ho, Y.H.; Lee, H.C.; Wu, H.C.; Liu, H.M.; Hsieh, H.H.; Lung, S.C.C. An open framework for participatory PM2.5 monitoring in smart cities. IEEE Access **2017**, 5, 14441–14454.

smart home connected to the Internet through a home gateway. Encrypted data traffic available in the form of open data to everyone (200,000 samples of encrypted data obtained from 15 applications in this particular case) → a software-defined network home gateway (SDN-HGW) framework to manage distributed smart home networks and support the SDN controller of the core network, where the SDN controller enables efficient network quality-of-service management based on real-time traffic monitoring and resource allocation of the core network for both types of data flows, encrypted or unencrypted.

Wang, P.; Ye, F.; Chen, X.; Qian, Y. Datanet: Deep Learning Based Encrypted Network Traffic Classification in SDN Home Gateway. IEEE Access 2018, 6, 55380–55391
Wang, P.; Chen, X.; Ye, F.; Sun, Z. A survey of techniques for mobile service encrypted traffic classification using deep learning. IEEE Access 2019, 7, 54024–54033

COVID-19 OGD → a SARS-CoV-2 virus transmission model based on human flow networks → new perspectives + modeling of different scenarios + illustrating the evolution of and trends in the pandemic

López, V.; Čukić, M. A dynamical model of SARS-CoV-2 based on people flow networks. Saf. Sci. **2021**, 134, 105034

ROLE OF THE OPENNESS. O(G)D

- **The majority of use-cases actively utilizing or promoting open data can be classified in at least two general categories, where open data are used as:**
  - **an input for new services, such as (bio)medicine or healthcare, transport, environment, Smart City, crisis management etc.,**
  - **a tool to improve the algorithms already developed, optimize solutions in use, or introduce new ones where the open data can be used as training data without the need for resources (both, time, money and human) to be spent on data collection.**
- **The way in which open data are reused points to:**
  - **their potential by themselves as a resource and a tool, i.e. data opening can be considered to be the key to various benefits, both commercial and non-commercial,**
  - **their potential in regard to Society 5.0,**
  - **the more data become available, the more new application areas will be explored.**
- **This, in turn, contributes significantly to the development of new cooperation and combating challenges with common forces**

TOOL OR RESOURCE?

INPUT DATA (RESOURCE)
New services, solutions etc.
Example: medicine, transport, environment, Smart City etc.

TOOL
Improvement of existing algorithms
Optimization of the existing algorithms, development of new algorithms (using as training data or supplementing data etc.).

SUSTAINABLE SMART CITIES
=
SMART CITIES + SUSTAINABLE CITITES

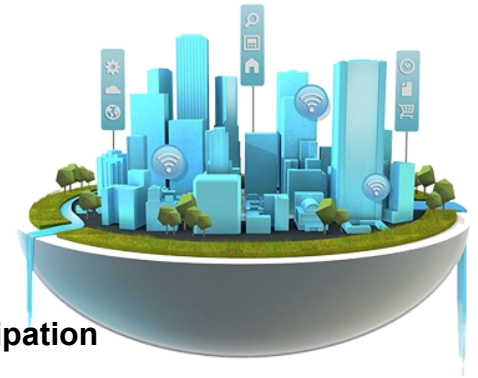
- ✓ Institutional infrastructure
- ✓ Physical infrastructure
- ✓ Social infrastructure
- ✓ Economic infrastructure

+

- ✓ Economic progress
- ✓ Environmental stewardship
- ✓ Social development

Source: https://social-innovation.hitachi/en-in/knowledge-hub/collaborate/smart-sustainable-cities/

SMART CITY



- ✓ **Smart city is a city that uses ICT to promote citizen engagement, and active participation allows continuous interactions. the strategy is collaboratively created with citizens and relevant stakeholders**

Van der Van der Graaf et al., 2014; Albino et al., 2015; Trivellato, 2017; Correia et al., 2022

- ✓ **the focus is on the inclusion of citizens in the co-creation and co-design of cities' processes and strategies to improve the policies' chances of success (Correia et al., 2022; Mainka et al., 2016; Al-Nasrawi et al., 2017).**

- ✓ **smart cities should overcome inequality and social polarization (Correia et al., 2022; Hollands, 2008)**

- ✓ **the decision-making process must promote inclusion and reduce social barriers (Correia et al., 2022; Silva et al., 2018).**

- ✓ **the bottom-up participatory approaches play an essential role in assessing and developing Smart Cities**

SMART CITIES

- ✓ **Various performance measurement and maturity models are used to overview the smart cities - their current state, strengths and weaknesses, and provide city leaders recommendations and guidelines towards its development.**

- ✓ **Each model consists of different domains (dimensions), phases, and corresponding indicator(s) used to assess the city's performance and maturity.**
  The main difference - their theoretical orientation and focus on the selected domain(s) and a sample of cities.

Overview of smart cities' positions in selected rankings.

City	IESE 2020	TOP 50 SCG 2021	IMD SCI 2020	GCI 2019	SCI 2018
Amsterdam	8	10	9	20	12
Athens	96	n/a	99	n/a	75
Berlin	7	23	38	14	18
Bratislava	62	n/a	76	n/a	n/a
Brussels	41	n/a	60	12	47
Bucharest	103	n/a	87	n/a	n/a
Budapest	74	n/a	77	62	57
Copenhagen	6	35	6	45	11
Dublin	33	26	34	46	20
Helsinki	22	5	2	n/a	n/a
Lisbon	32	48	73	n/a	82
Ljubljana	99	n/a	n/a	n/a	n/a
Luxembourg	n/a	n/a	n/a	n/a	n/a
Madrid	25	n/a	45	15	21
Nicosia	n/a	n/a	n/a	n/a	n/a
Paris	3	n/a	61	3	15
Prague	39	n/a	44	48	23
Riga	85	n/a	n/a	n/a	n/a
Rome	67	n/a	101	36	40
Sofia	116	n/a	89	n/a	n/a
Stockholm	14	50	16	39	2
Tallinn	55	12	59	n/a	n/a
Valletta	n/a	n/a	n/a	n/a	n/a
Vienna	18	9	25	25	5
Vilnius	65	n/a	n/a	n/a	n/a
Warsaw	54	n/a	55	55	54
Zagreb	98	n/a	n/a	n/a	n/a
London	1	3	15	2	1
Oslo	12	27	5	n/a	8
Reykjavik	5	n/a	n/a	n/a	n/a
Zurich	11	45	3	30	6

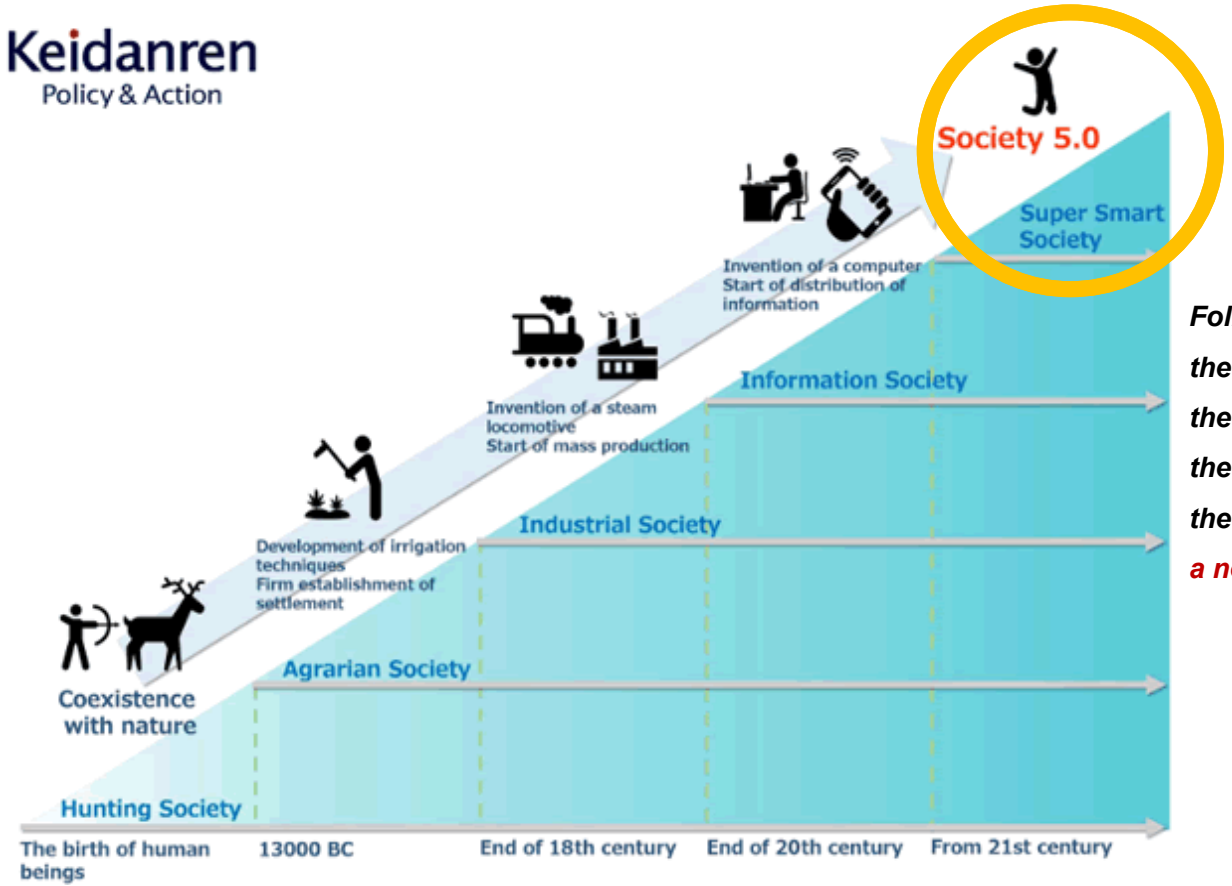
IESE Cities in Motion Index
Top 50 SCG - Top 50 Smart City Governments, 2021
IMD SCI - IMD smart city index
GCI - global cities index
SCI - sustainable cities index

Source: https://social-innovation.hitachi/en-in/knowledge-hub/collaborate/smart-sustainable-cities/

Image source: https://commons.wikimedia.org/wiki/File:Sustainable_Development_Goals.svg


16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
1 NO POVERTY
15 LIFE ON LAND
2 ZERO HUNGER
14 LIFE BELOW WATER
3 GOOD HEALTH AND WELL-BEING
13 CLIMATE ACTION
4 QUALITY EDUCATION
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
5 GENDER EQUALITY
11 SUSTAINABLE CITIES AND COMMUNITIES
6 CLEAN WATER AND SANITATION
10 REDUCED INEQUALITIES
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
8 DECENT WORK AND ECONOMIC GROWTH
7 AFFORDABLE AND CLEAN ENERGY
GovTech
FinTech
InsurTech
InsTech
CivicTech
RETech
JobTech
TourTech
LegalTech
AutoTech
FrontierTech
TransTech
FoodTech
DPTech
BioTech
UrbanTech
EnviTech
InfraTech
AgriTech
ConTech
CareTech
EdTech
HealthTech
SportsTech
HomeTech
MediaTech
AdTech
RetailTech
EneTech
FashionTech
MR
BigData
IoT
AR
AI
VR
Robot
5G
Drone
Cloud
Sensor
Edge
3DPrint
Mobile
Blockchain
OnDemand
Sharing
PKI
Citizen
Government
Large enterprise
Community
SME
Medical institution
Startup
Educational institution
Organization
Academic institution
Investor
Society5.0
for
SUSTAINABLE DEVELOPMENT GOALS

SOCIETY 5.0



Following the hunting society (Society 1.0),
the agricultural society (Society 2.0),
the industrial society (Society 3.0), and
the information society (Society 4.0),
the far-reaching policies of Society 5.0 propose
a new transformation of contemporary ways of life.

Image source: https://arcticanthropology.org/

Image source: https://globalbusinesscoalition.org/global-governance-news/b20-tokyo-summit-joint-recommendations-society-5-0-for-sdgs/attachment/figure-2-society-5-0-for-sdgs/

SOCIETY 5.0

«a way by which to guide and mobilize action in science, technology and innovation (STI) to achieve a prosperous, sustainable, and inclusive future»

-- Japan, 5th Science and Technology Basic Plan

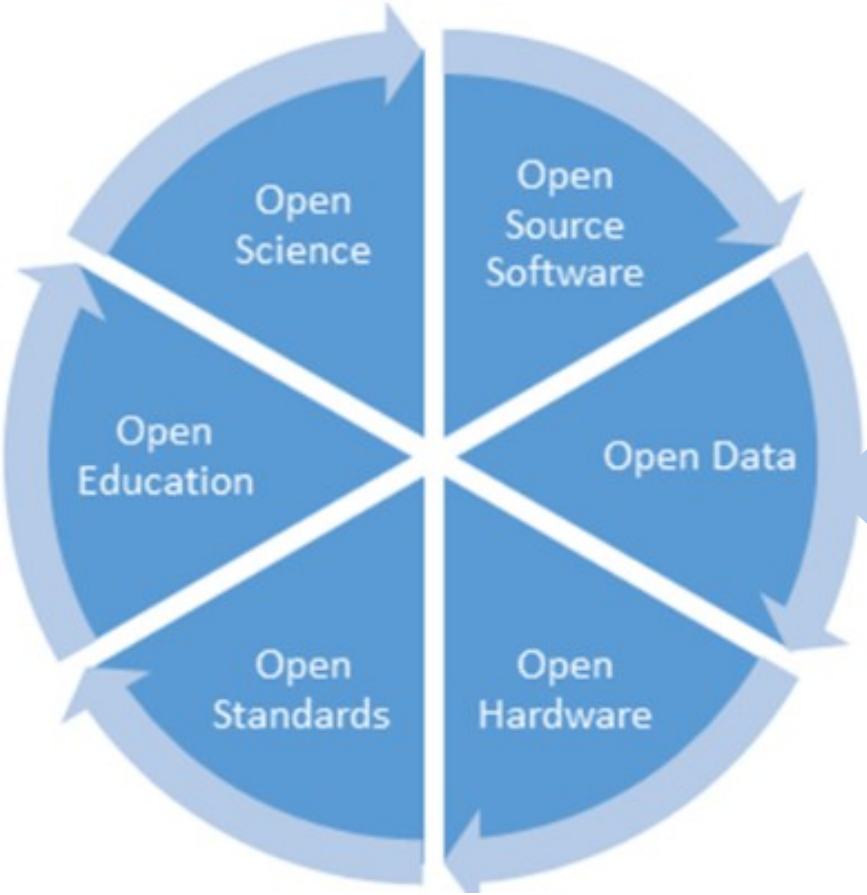
✓**Society 5.0 aims to resolve various modern social challenges by incorporating game-changing innovations such as the *Internet of things (IoT), robotics*, *AI* and *big data* into all industries and social activities.**

✓**Rather than a future controlled and monitored by AI and robots, technology is harnessed to achieve a *human-centred society* in which every person can lead an active and enjoyable life.**

Source: https://www.japanhouselondon.uk/whats-on/2020/society-5-0-a-new-model-for-an-ageing-society-a-talk-by-professor-harayama-yuko/

Source: https://digital.thecatcompanyinc.com/b20magazine/tokyo-2019/society-5-0-updates-on-japanese-business-and-economy/

OPENNESS



✓**Open data**, i.e., freely accessible, shareable, and usable data;
✓**Open science**, i.e., making scientific research and its dissemination accessible to all levels of the society;
✓**Open standards**, i.e., technology neutral specifications for hardware, software, or data developed through an open process;
✓**Open source software**, i.e., free and open collaborative software development;
✓**Open hardware**, i.e., physical products, machines and systems designed and offered by means of publicly shared information;
✓**Open education**, i.e., learning and teaching without barriers

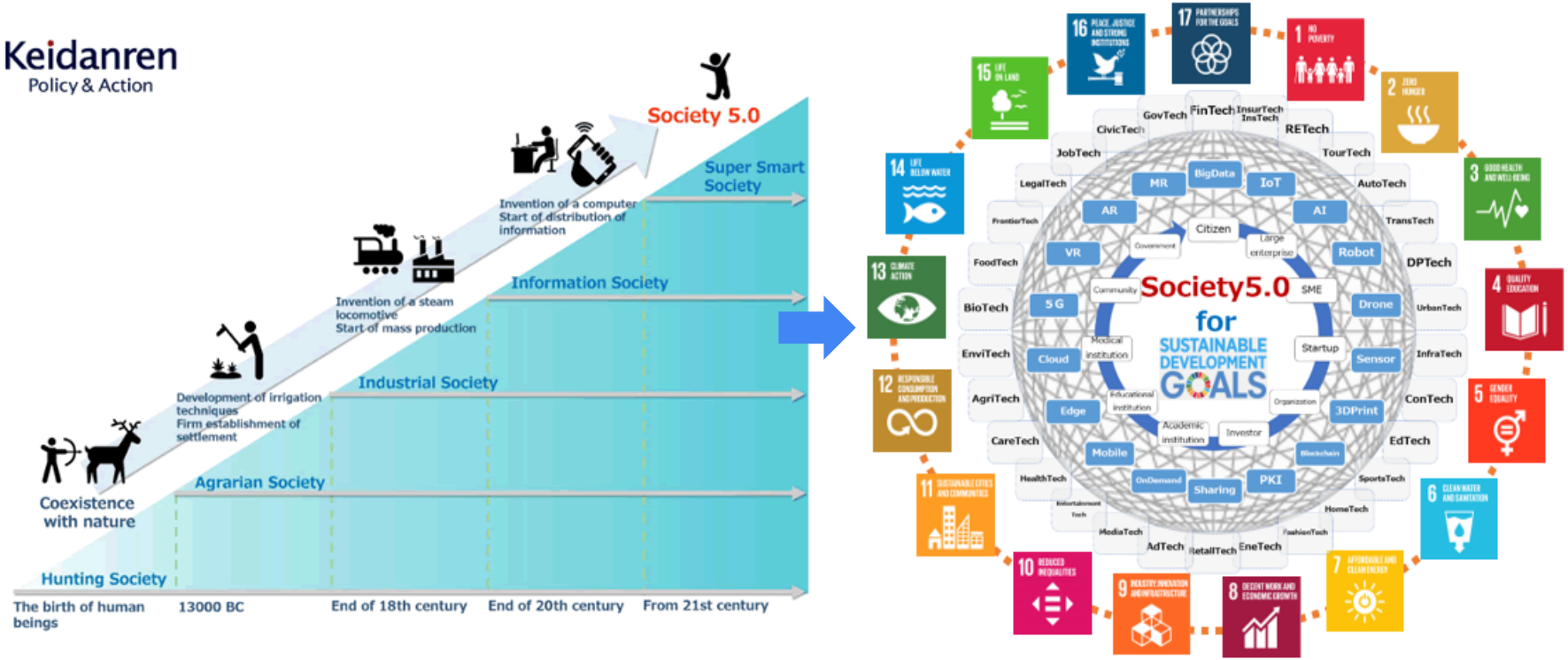


Image source: https://arcticanthropology.org/

Image source: https://globalbusinesscoalition.org/global-governance-news/b20-tokyo-summit-joint-recommendations-society-5-0-for-sdgs/attachment/figure-2-society-5-0-for-sdgs/

DIGITAL TRANSFORMATION

X

IMAGINATION AND CREATIVITY OF INDIVIDUALS

PROBLEM SOLVING

VALUE CREATION

https://digital.thecatcompanyinc.com/b20magazine/tokyo-2019/society-5-0-updates-on-japanese-business-and-economy/

SUSTAINABLE OPEN DATA ECOSYSTEM: WHAT DOES IT MEAN? AND HOW TO ACHIEVE IT?

✓**van Loenen (2022) and Aziz et al. (2022) refer to it as a combination of three pillars: (1) "user driven", (2) "circular", (3) "inclusive".**

✓**Wiener et al. (2016) suggest that a "sustainable data ecosystem" requires a design that can flexibly leverage and link existing platforms, specifying rules of engagement, sharing, discovery, and communication, which becomes a challenging task, since new data types will inevitably result from new technologies developed from the current worldwide initiatives.**

✓**Heimstädt et al. (2014) do not explicitly define sustainability in the context of open data ecosystems, but state that data providers must be convinced of the value of publishing data for the open data ecosystem to be sustainable or they may stop providing data.**

✓**Van Schalkwyk et al. (2016) believe that boosting of open data flows will help to enhance access to these data and ensure the sustainability of open data supply in the ecosystem.**

SUSTAINABLE OPEN DATA ECOSYSTEM: WHAT DOES IT MEAN? AND HOW TO ACHIEVE IT?

✓**Kitsios et al. (2021) state that "it is necessary to create a model that fosters value and entrepreneurship for the open data ecosystem, aiming to develop an economically self-sustained ecosystem", thus defining a sustainable open data ecosystem as an economically viable one.**

✓ ***An open data ecosystem can be considered sustainable if the by-products it creates have a positive impact on sustainability.***

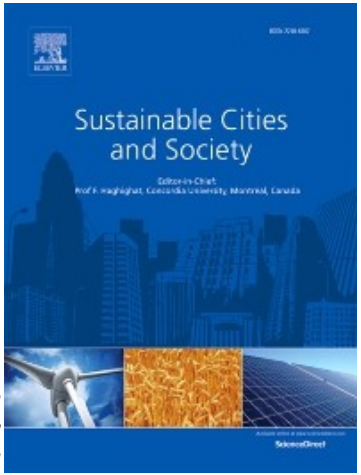
Yadav, 2017; Corrales-Garay, 2020; Feyzbakhsh et al., 2022

While there is a lack of clear definition of sustainability, the research body shares the vision that:

a sustainable open data ecosystem is an ecosystem that is sustained in time, and they put forward conditions for achieving this such as continuous diffusion of information about the ecosystem, financial resources, and providers convinced of the value of publishing open data.

TRANSPARENCY OF OPEN DATA ECOSYSTEMS IN SMART CITIES:

DEFINITION AND ASSESSMENT OF THE MATURITY OF TRANSPARENCY IN 22 SMART CITIES



Lnenicka, M., Nikiforova, A., Luterek, M., Azeroual, O., Ukpabi, D., Valtenbergs, V., & Machova, R. (2022). Transparency of open data ecosystems in smart cities: definition and assessment of the maturity of transparency in 22 smart cities. Sustainable Cities and Society, 103906.

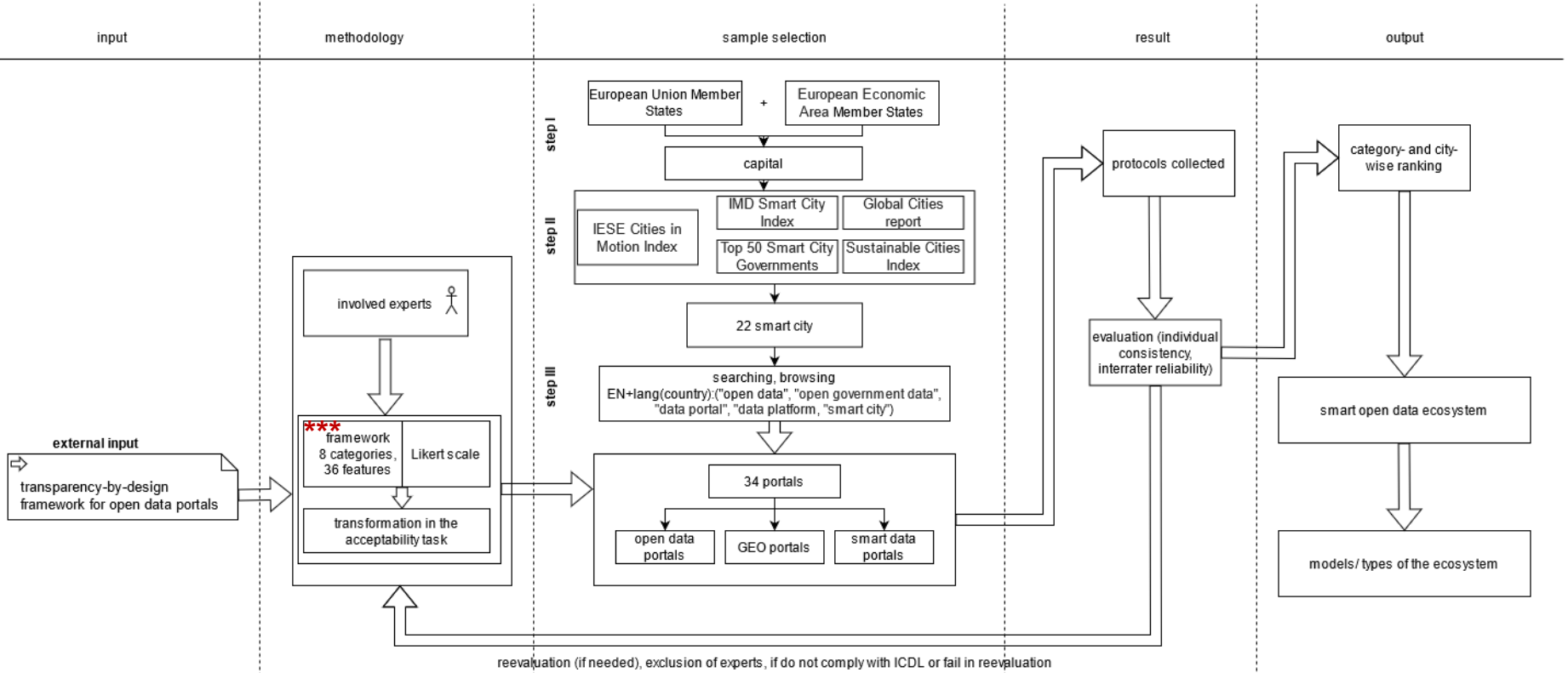
TRANSPARENCY OF OPEN DATA ECOSYSTEMS IN SMART CITIES

- ✓ **Definition and assessment of the maturity of transparency in 22 smart cities**
- ✓ **Focus on the issue of the transparency maturity of open data ecosystems seen as the key for the development and maintenance of sustainable, citizen-centered, and socially resilient smart cities.**

  - ✓ ***Investigation of smart city data portals' compliance with the transparency requirements***
  - ✓ ***Four levels of maturity are defined to assess transparency of smart city data portals***
  - ✓ ***Expert assessment is used to assess the transparency of 22 smart city data portals – 34 in total.***
  - ✓ ***Smart city portals are ranked determining their level of transparency maturity.***
  - ✓ ***Open data ecosystem is conceptualized and 5 types of current ecosystems are identified.***

Read more -> Lnenicka, M., Nikiforova, A., Luterek, M., Azeroual, O., Ukpabi, D., Valtenbergs, V., & Machova, R. (2022). Transparency of open data ecosystems in smart cities: definition and assessment of the maturity of transparency in 22 smart cities. *Sustainable Cities and Society*, 103906.

TRANSPARENCY OF OPEN DATA ECOSYSTEMS IN SMART CITIES



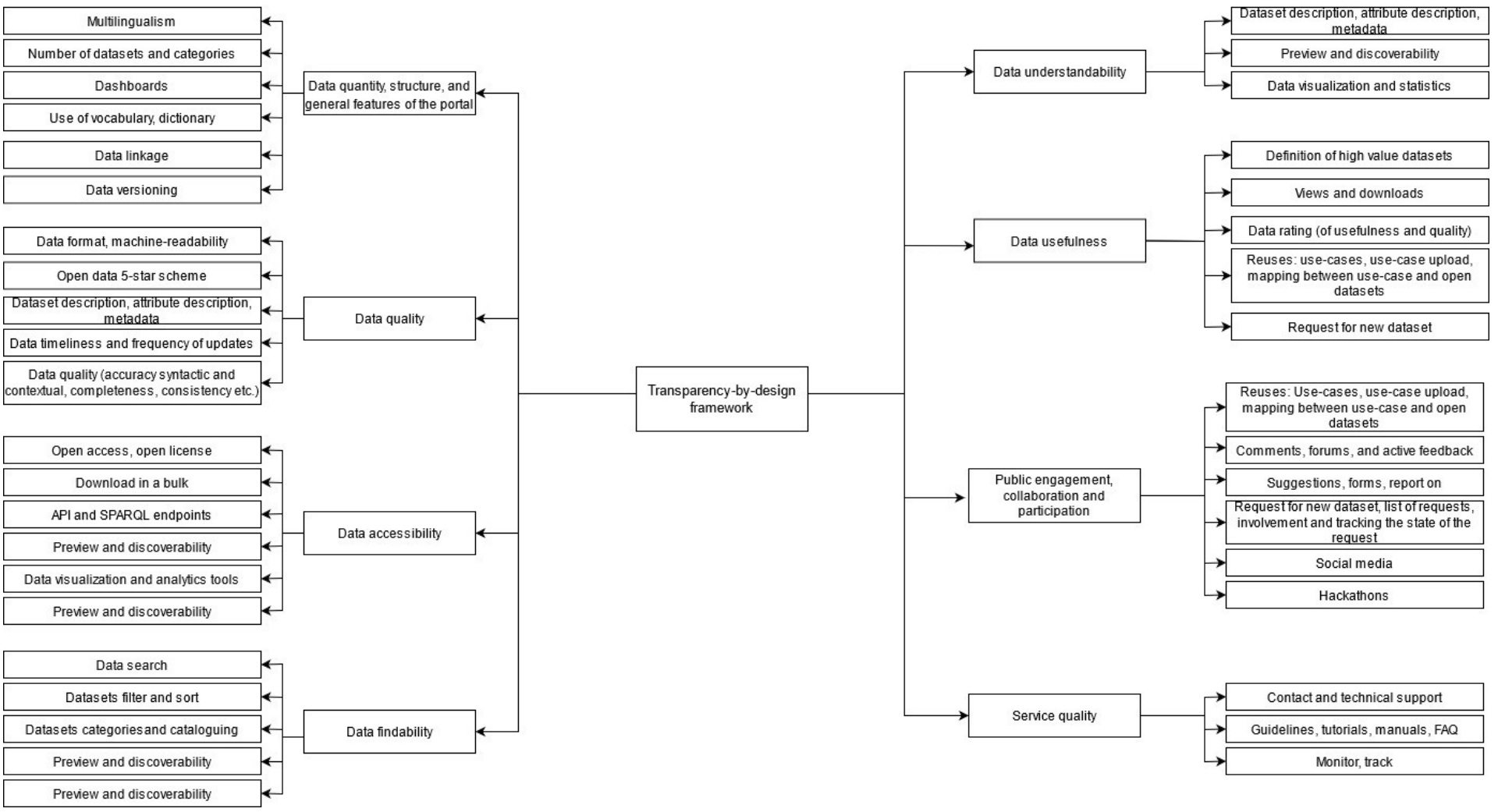
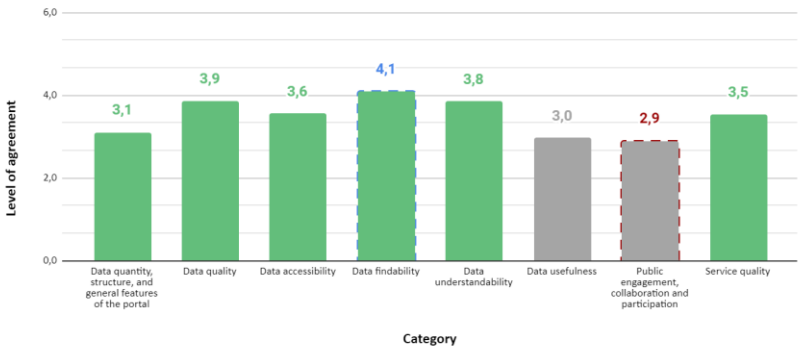
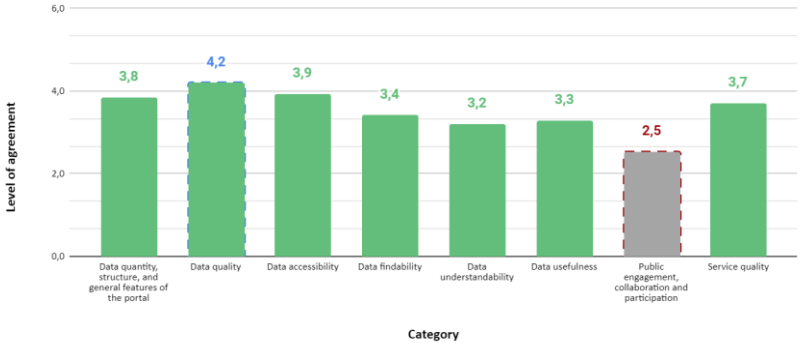


Fig. 2. Constructs of the transparency-by-design framework.

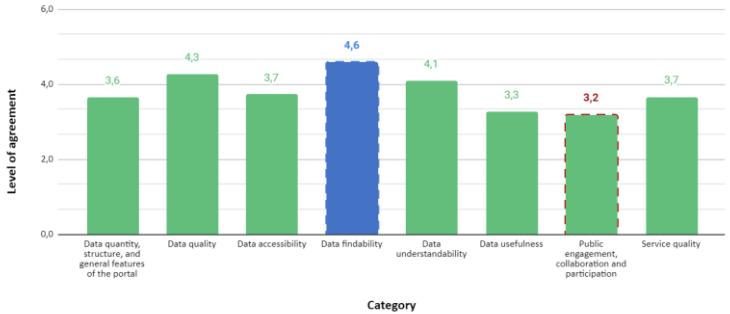
TRANSPARENCY OF OPEN DATA ECOSYSTEMS IN SMART CITIES: MEAN VALUES FOR OPEN DATA PORTALS (BY CATEGORY)



Mean values for geodata portals (by category)



Mean values for smart data portals (by category)



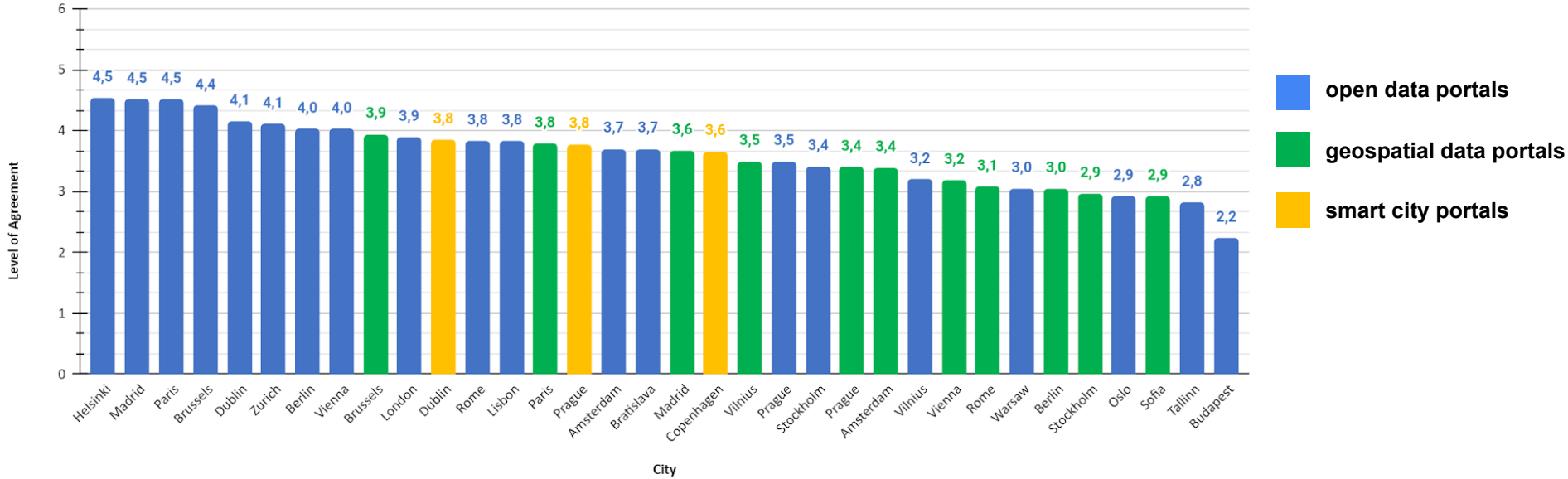
Mean values for open data portals (by category)

TRANSPARENCY OF OPEN DATA ECOSYSTEMS IN SMART CITIES: MEAN VALUES FOR ALL PORTALS (BY CATEGORY)

- ✓ *the best result is demonstrated by data quality*** dimension with 4.1 points, followed by data findability (4 points).*
- ✓ *The most negative result that can be seen as the most critical - public engagement, collaboration and participation.*
- ✓ *This is followed by data usefulness (3.2), data quantity, structure and general features of the portal (3.5), service quality (3.6), data understandability (3.7), and data accessibility (3.7), which although have been assessed as partly fulfilled, still have less than 4 points of 6.*

- ✓ **Changes and improvements should be subject to all dimensions and corresponding features**
- ✓ **!!! public engagement, collaboration and participation should become central.**
- ✓ **This is not only due to such low results but also due to the importance of this category, in the light of data portals of all types, i.e., open, geodata, and especially smart data portals. Otherwise, if there are no features supporting public engagement, collaboration and participation or the respective features are not well implemented, there are very minor chances for any changes, value creation and meeting the objectives of the initiatives concerned.**

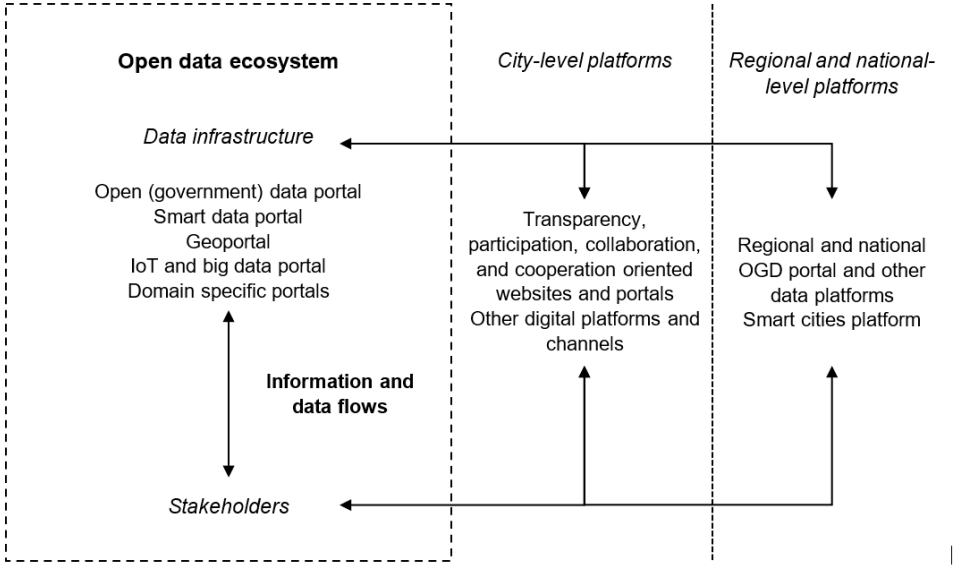
TRANSPARENCY OF OPEN DATA ECOSYSTEMS IN SMART CITIES: MEAN VALUES FOR ALL PORTALS (BY CITY)



- ✓ **Three smart cities - Helsinki, Madrid, and Paris, have demonstrated relatively high results with an average result. All portals belong to open data portals.**
- ✓ **Although the results for the open data portals of Madrid and Paris are expected because the corresponding countries are constant leaders in the context of the maturity of open data (portal) (Open Data Maturity Report), Helsinki is something that is not so self-evident, particularly given that the above-mentioned report states that Finland is among six countries, which were moved down from fast-trackers to followers.**

!!! cities and smart cities can develop more rapidly compared to the whole country, when resources, both human- and financial, are allocated wisely.

COMPONENTS AND RELATIONSHIPS OF THE OPEN DATA ECOSYSTEM IN THE SMART CITY CONTEXT



Concepts that should be considered since they affect/ shape the ecosystem:

- **stakeholders and their roles,**
- **phases of the data lifecycle, in which a stakeholder participates in the ecosystem,**
- **technical and technological infrastructure,**
- **generic services and platforms,**
- **human capacities and skills of both providers and consumers,**
- **smart city domains (thematic categories) as the targeted areas for data reuse,**
- **externalities having an effect on goals, policy and resources,**
- **level of (de)centralization of data sources – development, restrictions,**
- **perception of importance and support from public officials,**
- **user interface, user experience and usability.**

RECOMMENDATIONS FOR IMPROVING THE MATURITY LEVEL

Level	Description
Level 1 (Developing)	There are no formal procedures for publishing open (government) data, and the transparency efforts fall to each data provider (publisher). This results in missing relationships between the components of the ecosystem and no or low engagement of stakeholders.
Level 2 (Defined)	There are formal procedures for publishing open (government) data to be followed. These procedures are defined, documented, and communicated. Although the data infrastructure is implemented, the processes of involving stakeholders to reuse open data are lacking.
Level 3 (Managed)	There are standardized processes to be followed in the open government and transparency vision achievement. Open data ecosystem and its components are mainly automated. Stakeholders are active in the ecosystem and provide feedback to improve it.
Level 4 (Integrated)	Procedures are based on best practices. Components and relationships between them are optimized for the city's environment and the requirements and needs of involved stakeholders, which are constantly being identified and monitored.

Current and targeted levels	Recommendations
Level #1 to Level #2	✓ define formal procedures for publishing open (government) data, ✓ document and communicate these procedures with stakeholders, ✓ establish relationships between the components of the ecosystem, ✓ establish or improve engagement of stakeholders.
Level #2 to Level #3	✓ identify and implement actions and/or activities to involve stakeholders and encourage them to reuse data, ✓ ensure possibility to provide feedback, collect it and use for defining agenda, ✓ determine the current and improve the level of automation of the open data ecosystem and its components.
Level #3 to Level #4	✓ ensure that procedures are based on the best practices, ✓ constantly identify and monitor stakeholders and their needs, ✓ optimize components and relationships between them for the city's environment and the requirements and needs of involved stakeholders.

TRANSPARENCY OF OPEN DATA ECOSYSTEMS IN SMART CITIES: 5 TYPES OF ECOSYSTEMS

Type of data ecosystem	Description
Type 1	The city's OGD portal is the center of the data infrastructure and all OGD including those labeled as smart are published and centralized through it. For this type of open data ecosystem, other websites that had previously provided open data or other services to access public sector information have been replaced by the OGD portal. The focus is on datasets, providing features to work with them, reuse them, and making all data requests transparent at one place.
Type 2	This type of ecosystem also usually has the OGD portal as the central point but there are also other portals and platforms that publish open data. The smart data portal and online city dashboards focusing on different dimensions such as transport, health, air quality etc. are important components of this type of ecosystem.
Type 3	A decentralized type of the ecosystem that includes many components such as OGD portal, smart data portal, geodata portal etc. However, it increases the complexity of the ecosystem that is more difficult to manage and less usable for stakeholders.
Type 4	The smart city portal focused on projects and services is usually the center of this type of ecosystem but providing data and appropriate features to reuse them is not the priority. Most services are developed by public sector organizations, research institutions or businesses and then provided to citizens.
Type 5	In addition to the city's OGD portal there are other transparency-, participation-, collaboration-, and cooperation- oriented websites and portals to support the formation and improvement of relations between stakeholders. This type of ecosystem is focused on processes to improve open data reuse

The definition of the open data ecosystem and its description aims to be general and includes all components we found. However, there can be identified some variations of this ecosystem based on the predominant components of the data-centric and data-driven infrastructure.

TRANSPARENCY OF OPEN DATA ECOSYSTEMS IN SMART CITIES

The open data ecosystem in the smart city context can be defined as

«systematic efforts to integrate ICT and technologies into city life to deliver citizen-centric, better-quality services, solutions to city problems with open data published through the data-centric and data-driven infrastructure.»

- ✓ **It can also be viewed as a part of the transition to the knowledge economy.**
- ✓ **It is also a part of a local e-government system, and it is usually considered as one of the e-government services.**
- ✓ **Generally, all these approaches to smartness and smart open data services evolved from the concept of e-government and respective websites that have been upgraded to meet the needs of smart cities.**

****** The definition is established based on the knowledge and experience of the experts involved and observations made during the study.***

SOME KEY TAKEAWAYS…

- ✓ **Open data** became a daily phenomenon, i.e., making government data publicly available is not enough - there is time and need for the next steps towards sustainable and smart data ecosystems, requiring transformations at all levels.

- ✓ **Open data is not only about open government data!**

  open data, B2G, crowdsourced data, sensor generated data and not only

- ✓ **Open data is not about data availability and accessibility.**

  The data ~~should~~ must be qualitative* (?), well-documented, valuable** (high value data (?)), smart (?), while the entry point from which they are available should be sufficiently user-friendly and interactive (?)

  * Open data quality is not only about metadata, their completeness and accuracy, it is also about the quality of content of the dataset, where completeness of data is not the only criteria to be assessed! (reliability, internal and external consistency, timeliness, currency / up-to-date'ness and many more!)

  ** "quality over quantity" (?) requires identification of high value data not only on a high level (PSI Directive already did it), but also at country and even lower level

SOME KEY TAKEAWAYS

- ✓ **Data ecosystem ({open, geospatial, smart, …} data ecosystem) is not only about the platform (e.g., open government data portal), from which data can be downloaded, and not only about data governance or management. It is also not only about the data, which is, however, the key asset. It is many more…**
- ✓ **OD users – individuals, businesses (SME) etc., are not only end-users, they are (should be) an integral part of open data ecosystem. In other words, public data (eco)system is also about "public" → stakeholders and actors of OD ecosystems should be identified (their role, needs etc.), which should then imply in requirements for newer and sustainable data ecosystems, which will facilitate interaction of (multiple) stakeholders**
- ✓ **All in all, it's all about data, portal, service, policy… */ what else?***
- ✓ **At the same time users and the whole society should be educated and acquire knowledge and skills needed to interact with the OD artifacts → digital literacy, open data literacy (?)**

ICEGOV 2022 GUIMARÃES PORTUGAL

15th International Conference on Theory and Practice of Electronic Governance
"*Digital Governance for Social, Economic, and Environmental Prosperity*"

A community-based, participatory, interactive workshop

Identification of high-value dataset determinants: is there a silver bullet?

SESSION CHAIRS & SPEAKERS

Workshop #3 - Chair '22
ANASTASIJA NIKIFOROVA
University of Tartu

Workshop #3 - Speaker '22
CHARALAMPOS ALEXOPOULOS
University of the Aegean

Workshop #3 - Speaker '22
MAGDALENA CIESIELSKA
Gdańsk University of Technology

Workshop #3 - Speaker '22
NINA RIZUN
Gdańsk University of Technology

THANK YOU FOR YOUR ATTENTION!

Contact information:

Website: https://anastasijanikiforova.com/

Email: nikiforova.anastasija@gmail.com

LinkedIn: https://www.linkedin.com/in/anastasija-nikiforova-466b99b3/

EUROPEAN OPEN SCIENCE CLOUD

For further reading in case of interest…

Nikiforova, A., Alor, M. A., & Lytras, M. D. (2022). The role of open data in transforming the society to Society 5.0: a resource or a tool for SDG-compliant Smart Living?. *arXiv preprint arXiv:2206.11784*.

Lnenicka, M., Nikiforova, A., Luterek, M., Azeroual, O., Ukpabi, D., Valtenbergs, V., & Machova, R. (2022). Transparency of open data ecosystems in smart cities: Definition and assessment of the maturity of transparency in 22 smart cities. Sustainable Cities and Society, 82, 103906.

Nikiforova, A. (2021). Smarter open government data for society 5.0: are your open data smart enough?. Sensors, 21(15), 5204.

- ✓ **Nikiforova, A. (2020, October). Timeliness of open data in open government data portals through pandemic-related data: a long data way from the publisher to the user. In 2020 Fourth International Conference on Multimedia Computing, Networking and Applications (MCNA) (pp. 131-138). IEEE.**
- ✓ **Lnenicka, M., & Nikiforova, A. (2021). Transparency-by-design: What is the role of open data portals?. Telematics and Informatics, 61, 101605.**
- ✓ **Nikiforova, A., & Lnenicka, M. (2021). A multi-perspective knowledge-driven approach for analysis of the demand side of the Open Government Data portal. Government Information Quarterly, 38(4), 101622.**
- ✓ **Nikiforova, A., & McBride, K. (2021). Open government data portal usability: A user-centred usability analysis of 41 open government data portals. Telematics and Informatics, 58, 101539.**

REFERENCES

- ✓ *Nikiforova, A. (2021). Smarter Open Government Data for Society 5.0: are your open data smart enough?. Sensors, 21(15), 5204.*
- ✓ *Lnenicka, M., Nikiforova, A., Luterek, M., Azeroual, O., Ukpabi, D., Valtenbergs, V., & Machova, R. (2022). Transparency of open data ecosystems in smart cities: definition and assessment of the maturity of transparency in 22 smart cities. Sustainable Cities and Society, 103906.*
- ✓ *Lnenicka, M., & Nikiforova, A. (2021). Transparency-by-design: What is the role of open data portals?. Telematics and Informatics, 61, 101605.*
- ✓ *Correia, D., Marques, J. L., & Teixeira, L. (2022). City@ Path: A collaborative smart city planning and assessment tool. International Journal of Transport Development and Integration, 6(1), 66-80.*
- ✓ *de Souza, A. A. C., d'Angelo, M. J., & Lima Filho, R. N. (2022). Effects of Predictors of Citizens' Attitudes and Intention to Use Open Government Data and Government 2.0. Government Information Quarterly, 101663.*
- ✓ *Hall, R. E., Bowerman, B., Braverman, J., Taylor, J., Todosow, H., & Von Wimmersperg, U. (2000). The vision of a smart city (No. BNL-67902; 04042). Brookhaven National Lab.(BNL), Upton, NY (United States).*
- ✓ *Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J., & Williams, P. (2010). Foundations for smarter cities. IBM Journal of research and development, 54(4), 1-16.*
- ✓ *Angelidou, M. (2014). Smart city policies: A spatial approach. Cities, 41, S3-S11.*
- ✓ *Mohanty, S. P., Choppali, U., & Kougianos, E. (2016). Everything you wanted to know about smart cities: The internet of things is the backbone. IEEE Consumer Electronics Magazine, 5(3), 60-70.*
- ✓ *Hollands, R. G. (2008). Will the real smart city please stand up? Intelligent, progressive or entrepreneurial?. City, 12(3), 303-320.*
- ✓ *Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. Journal of urban technology, 18(2), 65-82.*
- ✓ *Barrionuevo, J. M., Berrone, P., & Ricart, J. E. (2012). Smart cities, sustainable progress. Iese Insight, 14(14), 50-57.*
- ✓ *Neirotti, P., De Marco, A., Cagliano, A. C., Mangano, G., & Scorrano, F. (2014). Current trends in Smart City initiatives: Some stylised facts. Cities, 38, 25-36.*
- ✓ *Ahvenniemi, H., Huovila, A., Pinto-Seppä, I., & Airaksinen, M. (2017). What are the differences between sustainable and smart cities?. Cities, 60, 234-245.*
- ✓ *Van der Graaf, S., & Veeckman, C. (2014). Designing for participatory governance: assessing capabilities and toolkits in public service delivery. info.*
- ✓ *Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart cities: Definitions, dimensions, performance, and initiatives. Journal of urban technology, 22(1), 3-21.*
- ✓ *Trivellato, B. (2017). How can 'smart'also be socially sustainable? Insights from the case of Milan. European Urban and Regional Studies, 24(4), 337-351.*
- ✓ *Mainka, A., Castelnovo, W., Miettinen, V., Bech-Petersen, S., Hartmann, S., & Stock, W. G. (2016). Open innovation in smart cities: Civic participation and co-creation of public services. Proceedings of the Association for Information Science and Technology, 53(1), 1-5.*
- ✓ *Al-Nasrawi, S., El-Zaart, A., & Adams, C. (2017, September). The anatomy of smartness of smart sustainable cities: An inclusive approach. In 2017 International Conference on Computer and Applications (ICCA) (pp. 348-353). IEEE.*
- ✓ *Silva, B. N., Khan, M., & Han, K. (2018). Towards sustainable smart cities: A review of trends, architectures, components, and open challenges in smart cities. Sustainable Cities and Society, 38, 697-713.*
- ✓ *López, V.; Čukić, M. A dynamical model of SARS-CoV-2 based on people flow networks. Saf. Sci. 2021, 134, 105034*
- ✓ *Stieb, D.M.; Evans, G.J.; To, T.M.; Brook, J.R.; Burnett, R.T. An ecological analysis of long-term exposure to PM2.5 and incidence of COVID-19 in Canadian health regions. Environ. Res. 2020, 191, 110052*
- ✓ *Yacchirema, D.C.; Sarabia, D.; Palau, C.E.; Esteve, M. A Smart System for Sleep Monitoring by Integrating IoT With Big Data Analytics. IEEE Access 2018, 6, 35988–36001*
- ✓ *Chen, L.J.; Ho, Y.H.; Lee, H.C.; Wu, H.C.; Liu, H.M.; Hsieh, H.H.; Lung, S.C.C. An open framework for participatory PM2.5 monitoring in smart cities. IEEE Access 2017, 5, 14441–14454.*