Urban Data Platforms – An Overview

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ABSTRACT

Along the increasing digitization and interconnection in almost every domain in society or business, data is growing exponentially. It is expected that the worldwide Internet traffic will triple until 2020 in comparison to 2015. In the same time, the transmitted data volume will move from 53,2 Exabytes per months to 161 Exabytes per months [Cisco, 2016]. Cities and communities can support the provisioning and usage of urban data and benefit from resulting new services for the monitoring, understanding, decision making, steering, and control. Providing urban data is also supported by the ongoing movement of opening governmental data, but goes beyond. Urban data can include data from public, industrial, scientific or private sources. Yet, the design of urban data is still ongoing and numerous initiatives and standardization efforts on smart cities and communities put the grounds for the uptake and interoperability of urban data.

1. MOTIVATION

Urban data is a resource that is the basis for informed decisions in daily administrative business on optimizing urban processes and/or the usage of urban resources, in strategic decisions on urban development, etc. [BSI, 2016] defines four types of insights that can be drawn from urban data:

- Operational insight to understand properties and characteristics of urban things and processes, for example of buildings or government to citizen services and to derive improvement options
- Critical insight to monitor and derive recommendations of reactions in incidents and current cases
- Analytical insight to identify patterns and correlations and derive predictions for urban innovation, impact assessment or the evidencing of challenges and opportunities in urban development
- Strategic insight to enable an overarching approach along the strategic objectives, plans, and decisions in urban environments.

Since politicians, administrators, and citizens are typically not data experts and leak the expertise in data analytic, they are likely to use data specialists for data curation and management, data access and discovery as well as data analysis, reproducibility and collaboration as it was done along the opening of governmental data along the PSI directives [EC, 2003, EC, 2013, EC, 2014]. Numerous data and metadata portals have been established and surrounded by supporting services and processes like the German open governmental data portal [Klessmann et al., 2012, FOKUS et al., 2014] or the European open data portal [CapGemini and FOKUS, 2015] to name a few.

In May 2015 in Berlin, the Memorandum of Understanding [EC, 2015] "Towards Open Urban Platforms for Smart Cities and Communities" was signed by many representatives of industry as well as by Fraunhofer FOKUS. Cities and communities joined shortly later. Since "the market for current Urban Platform(s) is fragmented and uncertain on the demand-side and lacking interoperability and common standards in the supply-side", the signatories of this MoU have agreed to:

- Accelerate adoption of urban platforms in EU cities by drive interoperability and common standards to develop an urban platform market from the industry supply side according to city-lead requirements.
- Develop a set of principles and a joint reference architecture framework to enable interoperability, scalability and open interfaces to integrate different solutions.
- Develop a joint data and service ontology to be used by individual Smart cities commercial products and solutions."

City data plays a central role in the considerations of the MoU. It is being discussed, what they are, which role they can play, and how to leverage their potentials in European

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cities and communities. The draft definition says "City data is that which is held by any organization – government, public sector, private sector or not-for-profit – which is providing a service or utility, or is occupying part of the city in a way that can be said to have a bearing on local populations and the functioning of that place. It can be static, near-real time or in the future, real time, descriptive or operational. Further, in the future, data will be to a greater extent generated by individual citizens and this too (with due consideration to privacy and a strong trust framework) can be considered city data."

Furthermore, metadata is vital for the discovery of data. If metadata structure and meaning are sufficiently specified, portals can be realized to consolidate various data offers. This offers a "one-stop-shop" experience to data consumers, saving the trouble of collecting data from various portals, authorities or offices with different controls and settings. Consistent metadata is addressed in various domains through different approaches and priorities, such as environmental or bibliographic data. Within open data initiatives/communities Comprehensive Knowledge Archive Network (CKAN) is the de-facto standard for metadata catalog software and it is highly aligned to the Data Catalog Vocabulary (DCAT), the most prominent metadata catalog vocabulary [Maali et al., 2010]. CKAN exchanges metadata in JavaScript Object Notation (JSON) format. The metadata field name is the only required field, all others are optional. When opening governmental data on [FOKUS et al., 2014], a desire for more structure became apparent, as many data providers and developers were looking for precise instructions on what information must be persisted and in which format. In order to preserve the minimal, flexible character of CKAN and JSON, and to fulfill GovData requirements we developed a CKAN-based JSON schema for German public sector information. The structure is maintained on GitHub [Geschäfts- und Koordinierungsstelle GovData, 2016]. It is used as a tool to validate metadata, but also as a communication tool for those interested, like public decision-makers, data providers, developers and other open data initiatives in the German speaking area. For this reason the schema was published in early beta stage and now developed in public. The metadata structure supports the description of data sets (including data services), as well as documents and applications. The most important properties are stored at the top level. These include title, identifier, description, responsible and terms of use. Furthermore, the list of resources is essential, which contains pointers to the actual data, documents or applications. The most important property of a resource is its Uniform Resource Locator (URL). In addition, a description and format can be provided for a resource. This configuration allows capturing related files as one record, possibly for different periods, in different languages or formats. Within the "extras" all other data are stored. These mainly include the temporal and spatial arrangement, and details about the origin of imported items. We currently extend this metadata schema for the more general purpose of urban data, which also include open governmental data and many more.

2. RELATED STANDARDIZATION WORK

The approach on urban data by [EC, 2015] on understanding and steering urban infrastructures, services and processes is different to the one taken by by ISO on "Global city indicators for city services and quality of life" [ISO, 2014]. It defines a set of indicators to measure and steer the performance of city services and quality of life in urban areas. It aims at providing city indicators that help city managers, politicians, planners, researchers et al to analyze and value their prospective decisions. It defines city metrics that measure the social, economic, and environmental performance of a city in relation to other cities.

Also, the Smart City Concept Model (SCCM) by [BSI, 2016] is different as it addresses mainly interoperability of urban data by defining an overarching framework of concepts and relationships that can be used to describe data from any sector.

The Asociación Española de Normalización y Certificación (AENOR) considers in [AENOR, 2016] concrete metrics for urban infrastructures, in particular for utility networks of various kinds such as water, waste, energy (electricity, gas), telecommunications or transportation. The aim is to facilitate better services to citizens, while ensuring maximum efficiency and easy integration in the environment. In [AENOR, 2015], AENOR provides a methodology on how to assess the publication of Open Data in a city. It measures the degree of maturity of the opening of data and recommends datasets that are considered to have priority in open data initiatives.

Last but not least, the Infrastructure for Spatial Information in Europe (INSPIRE) [EC, 2007, EC, 2008] needs to be considered. Effectively, it regulates the registration and provisioning of most geo-related data. INSPIRE contributed substantially to the implementation of regional and national metadata registers. These in turn are great inspiration for urban data in terms of structure and semantics for re-usable data and metadata. However, from an open data perspective, INSPIRE activities have not succeeded in regulating the catalogization of machine processable online resources and the indication of re-use friendly, interoperable license terms, which we consider to be likewise important for urban data.

3. RELATED RESEARCH WORK

Research on urban data has always been part of urban planning and development research. However along the realm of digitization, also in this research urban data receives new momentum. For example, Townsend in [Townsend, 2015] defines urban science to be "an emerging domain of research at the intersection of science and design, drawing on new disciplines in the natural and information sciences, that seeks to exploit the growing abundance of computation and data".

In [Aguilera et al., 2016], Aguilera et al present the platform of the Internet-Enabled Services for the Cities across Europe (IES) project that supports the development of urban apps by combining heterogeneous datasets provided by diverse entities like government, citizens, sensor infrastructure or other information data sources. The platform uses a client/server architecture consisting of a data access, business, and client layer and supports the management of datasets and urban apps ecosystems. The query mapper (offering an SQL(Structured Query Language)-based interface and returning JSON results) is the main component pro-

viding query support for the consumption of open data and generation of new data for the development of urban apps.

A urban big data framework is presented by Pan et al in [Pan et al., 2016]. They characterize and define urban big data and provide a categorization. For example, infrastructural support, urban services, urban governance, and economic development are considered to be main data pillars in China's development model for city intelligence. The authors also argue about the challenges in urban big data like solving data integration and sharing issues, assuring information security, providing advanced technical innovations for big data, addressing sustainable urban big data solutions, or providing qualified personal for urban big data.

Kitchin et al review in [Kitchin et al., 2015] city indicators, urban benchmarking and urban dashboard initiatives. They highlight that these initiatives are not simple and straight data assemblages, but rather "complex, politically-infused, socio-technical systems that, rather than reflecting cities, actively frame and produce them".

Recently, a political economy framework for urban data has been presented by Edwards et al in [Edwards et al., 2016]. It addresses the need of city leaders to base their decisions and efforts "on good data and reliable evidence". They propose to "shift the focus of data-driven governance policies and practices from capacity and supply to incentivizing efficient service delivery, transparency, and accountability". The provisioning and usage of urban data should be about the solution to concrete problems in urban environments, not just about the pure quantities of urban data. At the end, urban data is just a means to do urban monitoring, steering and development more effectively, efficiently and reliably.

4. THE KEYNOTE

The keynote will present and review the different dimensions of urban data and providing them via urban data platforms. It will report about the status of the MoU on Open Urban Platforms and put it in relation to other initiatives.

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