


Editorial: NFDI4City – Research Data Management for Applied Urban Research

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Abstract: Within the agreement on the establishment and promotion of a National Research Data Infrastructure (NFDI), the Federal German Government and the Länder are striving for a discipline-specific service structure for research data, which aims for their long-term storage, safeguarding and accessibility. In the field of the applied urban research, data from different sectors such as administration, buildings, environment, mobility, social affairs must be considered and linked. In this workshop the NFDI4City-initiative met and discussed its overall vision, conceptual solutions as well as data domains inside and across these sectors. The goal of NFDI4City is to create new data-based overarching understandings of urban development through standardization and data analysis in the „Urban System“.

Keywords: Urban research, Research Data, Data Management, Data Governance.

1 Introduction

Research Data Management including (meta) data standards, common data spaces, data governance, infrastructure and services is a topic of increasing relevance in the international research landscape. In addition to the scientific community, the public sector is therefore also in the spotlight when it comes to openness, availability and reuse of data. In order to be able to place urban phenomena, trends and developments in their overall context and to develop effective measures and solutions, the city – as well as applied urban research – must be understood as a holistic system whose sub-

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areas influence each other. The discipline of applied urban research in context of the digital transformation of urban habitats towards smart cities unites different sectors, which are characterized by a homogeneous communication context (Scientific Community), a traditional body of knowledge, a common, well-founded research topic, a wide range of methods and scientific publication organs. The criteria of a scientific discipline are thus fulfilled. In contrast to many other NFDI consortia, however, existing basic research from other disciplines is used according to the principle of applied research. The following sections describe the data challenges, the vision as well as envisioned data management services of NFDI4City, before the data domains describe the researchers' point of view on their data challenges and structures.

2 Urban Development Questions and Data Challenges

In view of urbanization as a megatrend that will have a strong impact on the design of cities in the coming years, city data are of particular relevance to a wide range of stakeholders, such as politics, insurance companies and construction companies. The research data generated in applied urban research is made up of data from various sub-disciplines with their own standards. Looking at the individual sectors of administration, buildings, environment, mobility and social affairs (see Fig. 2), a picture of essential challenges emerges: (1) interdisciplinarity and therefore heterogeneity of research data, (2) lack of data availability due to separate data silos, (3) no comprehensive analyses of different data sets, (4) lack of methodological knowledge in data preparation and analysis, (5) outdated data, and (6) lack of data and process standards.

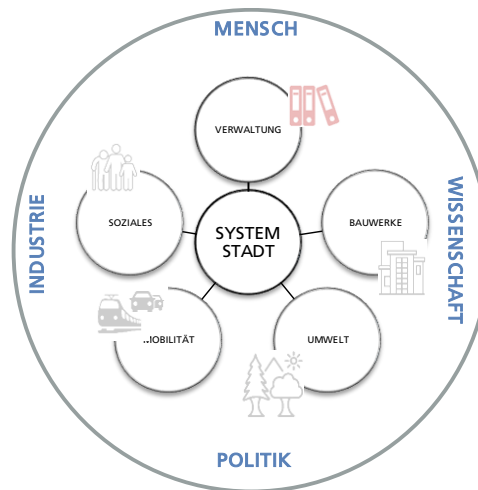


Figure 1: Applied Urban research as a discipline based on other disciplines

In urban research, heterogeneous and very individual data is created, where the difficulty lies in a limited possibility to standardize processes. At the same time, data protection concerns and economic exploitation interests in the data are also important factors in

shaping the necessary organizational regulations. In addition, cooperation is currently being established between the players – companies, politics, research and civil society – to ensure that data can generate added value.

Due to the character of an applied discipline, there are at least interfaces to the following other NFDI consortia⁹:

- *KonsortSWD (Sector Social Aspects)*
- *NFDI4MobilTech (Sector Mobility)*
- *NFDI4Earth (several sectors)*
- *NFDI4Ing (Sector Buildings)*

Analysis answering future interdisciplinary urban questions could be based on high-quality research data. Furthermore, the connectivity of city data to other disciplines for interdisciplinary research, such as climate research, could be guaranteed. For data producers, standardization will result in improved possibilities for exploitation, such as data portals that make different data available to end users. Quality standards and curation criteria also play a role in the long-term archiving and provision of data over many years. This task is performed by libraries and data centers. Defined quality standards and curation criteria can be used by them to assess and curate research data, thus supporting the long-term preservation and access to research data. Furthermore, specialists such as library staff and data stewards are enabled by generally accepted quality criteria to support scientists in achieving high data quality. In addition, the establishment of committees may create a cross-organizational framework in which the various actors in applied urban research and infrastructure operators can meet to develop quality standards. Table 1 shows some exemplary thematic areas that illustrate the interaction of the sectors in different urban research topics.

Topic	Administration	Buildings	Environment	Mobility	Social Aspects	Resilience
Urban land use planning (traffic and settlement areas, commercial areas, green spaces etc.)	x	x	x	x	x	
Social-spatial distribution of traffic-related air and noise pollution for the population	x	x	x	x	x	
Network planning and charging infrastructure in public and private buildings for electric mobility	x	x	x	x		x
Social inclusion and satisfaction of mobility needs of all population	x			x	x	

⁹ www.nfdi.de , oblique means funding started in 2020

Topic	Administration	Buildings	Environment	Mobility	Social Aspects	Resilience
groups						
Social and climate-friendly living and building	x	x	x		x	x
City of short distances	x	x	x	x		
Public and private parking areas; parking space management		x	x	x		
Tourism: day guests/overnight stays, tourist flows	x			x	x	
Safety (traffic accidents, civil protection, crime...)	x	x		x	x	x

Table 1: Cross-sectoral topics of applied urban research

3 Vision

The initiative's aim is to create a new understanding for urban transformation and development via the intersectoral approach of the „Urban System“. Addressing the ongoing acceleration of innovation cycles, technological progress, digital transformation and cultural change in public sector, valid, standardized and open research data can play a crucial role towards carbon-neutral, liveable and future-proof cities in the next decades.

In addition, access for partners in practice such as cities is just as much a goal as the interaction between science and society. The focus here is on creating homogeneous and interoperable data sets within the sectors and linking them through cross-sectoral standards. The required standards on both metadata and file level have to be developed and maintained within different sectors of applied urban research in coordination with the respective discipline-specific expert communities and NFDI consortia. With the help of organizational cross-sectoral data governance and technical support, research projects should realize a control and standardization of the comprehensive data management, which leads to an efficiency gain through research excellence as well as parallel and subsequent use. The interaction between science and society is also to be increased through citizen science, transparency of methodology and re-use vis-à-vis citizens and other data providers.

4 Envisioned Data Management Services

The initiative aims to achieve the mentioned goal of creating homogeneous data sets within the sectors of applied urban research by grouping files from researchers to data sets and link these to metadata. A major concept therefore are data domains, understood as logical grouping of research data collected with a certain method (e.g. questionnaires) or stored in a certain data format (e.g. sensor geodata with time reference). For metadata and file structures as well as for data handover and assessment processes cross-sectoral standards could be established and enhanced by sector and domain specific extensions.

Beside static data that is accessible in repositories, also dynamic data may play a role. Typical dynamic data are live-data from air-quality sensors that are available to researchers and practitioners by means of a public or restricted application programming interface (API). With the help of such technical solutions current research projects in urban research are to achieve efficiency gains through comprehensive data management, which in turn will lead to better data availability for practical use.

Organizational solutions including several roles for data stewardship as well as a workflow system complying to high standards in usability, e.g. based on the Data Governance Framework developed in the HEFE-project (Sautter, Wuchner 2020) are further envisioned services for researchers. The following services are envisioned along this vision:

- A data excellence organization, consisting of strategy, data governance, data management and a system architecture
- Data domains and responsible data owners within and across applied urban research sectors
- Common glossary and rules for metadata and files
- Transformation process for files along sensitivity levels from highly sensitive to open
- Phase oriented “Research process of the future”: Early categorization and curation of data records by service teams based on a set of rules, domain-specific document templates and metadata standards
- Overview for (planned) research data (depending on data value category) for scientific leaders and project managers

A central overall goal is to create a planning and results-based data counterpart of the scientific landscape that can be used for complex search queries as well as for analyses across different data sets including full text search and semantic integration.

5 Data Domains

In preparation of the workshop a “Call for domains” was tendered. With urban researchers as a target group, it asked for the data-challenge they face and their state-of-the-art in their

internal data management. The assessment or handing-over process was further an issue of interest as well as data types, meta data and file structures. Within and across sectors of urban research, highly relevant contributions on data domains were accepted as contributions to this workshop:

- **Construction Data:** Günter Wenzel from Fraunhofer IAO and Andrea Wuchner from Fraunhofer IRB describe the domain of building related data on the base of 3D geometry.
- **Urban Logistics Data:** Bert Leerkamp from the University of Wuppertal describes data related to transport demand and traffic flow with the aim to measure impacts on environment, urban structures and economy.
- **Trajectories:** As a important data type in the mobility sector, Daniel Krajewicz, Alexander Sohr and Jan Weschke from DLR describe trajectories for modeling as well as monitoring traffic.
- **Urban Production Data:** Michael Hertwig, Adrian Barwasser, et al. from Fraunhofer IAO and others describe urban production data as information about input and output of production companies with the aim of urban symbiosis.
- **Crisis Management Field Exercise Data:** Johannes Sautter, Patrick Drews et al from Fraunhofer IAO describe quantitative and qualitative data assessed in field exercises wherein practitioners of civil protection move vehicles and equipment.
- **Geographic Information Systems and Data Challenges:** Christoph Sebald from Fraunhofer IAO describes solutions to geospatial data challenges.

Some of the described domains can directly be assigned to a particular urban research sector, such as trajectories to the mobility sector. Others, such as urban production or geodata at least relate to two or more sectors. Furthermore, not all sectors are represented in the described domains. In particular, social sciences are missing although they are very relevant.

6 Conclusion

A first small step towards the vision of creating a new data-based overarching understanding of urban development has been achieved by this description of the NFDI4City concept enhanced by data domains from a researcher's point of view. This will facilitate identifying commonalities across domains in the direction of a more precise and elaborated mission and roadmap of NFDI4City.

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