Does open data open new horizons in urban planning?

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Abstract

This study deals with the issue of the availability of open data in the Czech Republic and their extent to which they are used in the framework of urban planning and development of urban space. In the context of rapid digitization and technological progress, open data is becoming increasingly important for the effective management and design of urban infrastructure. This work systematically analyses the current state of open data in Czech regional capitals, identifies key aspects of their availability and examines their potential applications in urban planning. In the practical part, the study focuses in more detail on Brno, which is the second largest city in the Czech Republic and provides freely available data on its website data.brno.cz. Finally, the achievements and challenges of the promoting and utilizing the OD are specified.

1. Open data

1.1 Open data – introduction, definition

The term "open data" has long been bandied about in society, with governments in various countries, especially in Europe, trying to make data access easier and to make data from public administrations and government institutions available to the general public. Open data means that it should be provided under an open license, without restrictions and that data should be in a format that is machine readable (Ayre & Craner, 2017). The definition used in the Czech Republic for open data is "*information published in a manner allowing remote access in an open and machine-readable format, whose manner and purpose of subsequent use is not restricted, and which is recorded in the national open data catalogue*" (Act No. 106/1999 Coll). This data can come from a variety of sources, including public administrations, and is available for analysis and the creation of applications, which brings several advantages for urban planning.

In a context of rapid digitisation and technological advances, open data is becoming increasingly important for the effective management and design of urban infrastructure. A strong role in opening data is played by the government in particular, which needs to make changes towards openness and public participation in decision-making processes (McDermott, 2010). Open data can figure in several different ways, it can help in improving transport systems, in promoting sustainable development, as a tool to increase transparency or to improve urban services (Barns, 2016). This data enables real-time analysis of urban life, new ways of urban governance and provides material for imagining and implementing more efficient, sustainable, competitive, productive, open and transparent cities (Kitchin, 2014).
Open data is becoming more and more abundant, the public and city leaders are responding, but there are still few studies that address the link between open data and urbanism. At the same time, many people are still unaware of the power and potential that open data undoubtedly has for urban development.

1.2 Open data and urbanism

Open data can be a very suitable complement to commercial data, but it can also be suitable as a stand-alone entity. Some cities have decided to start working with open data, providing it to the public and improving their city. Moreover, open data is considered an essential part of smart cities (Ojo et al., 2015). Ojo et al. (2015) in their study describes the connection between open data and smart cities, how this data influences the management and development of the city with the creation of an "innovation economy". Residents of a given city can engage with the city government and participate in designing changes in the city, open data can help people discuss, plan changes and provide analysis of the area (Barns, 2016).

Zurich uses open data for the development of the city, for several different reasons, especially as they are aware of the population growth, they stress the importance of opening not only 2D data but also 3D data, therefore they have released a digital twin of the city to the general public to help illustrate and simplify planning and decision making processes in the city (Schrotter & Hürzeler, 2020). Helsinki and their entire region support the sharing of open data, using it for mobile applications that improve public transport services of other areas in the city, they also try to use open data to help the public

in economic development and innovation in the region (Hielkema & Hongisto, 2013). Barcelona has chosen to use open data to make its citizens both decision makers and data providers, thus the citizens of Barcelona can contribute and use data for the common good, they can also strengthen their role as decision makers and contribute to the city's policies and strategies (Calzada, 2018). Chicago provides an open data portal with more than 800 datasets to assist in the transparency of the city government, while also serving as a support for citizen participation and collaboration with the city, for feedback, and also for the creation of applications using open data to serve the community (Kassen, 2013).

Applications can be built on the basis of open data, which can be used for support and decision-making in the management of the city, for its development, for better communication with the public, etc. Open data can also be used to calculate indicators that can help cities to plan and evaluate urban, transport or social projects, and in practice can serve as a basis for policy and decision-making processes; support for open data should also support open-source tools (Boeing et al., 2022). Applications such as My City forecast, which works with open data, can also be used for urban planning; this tool uses open data to simulate urban indicators and tries to compare them with plans for a compact city (Hasegawa et al., 2019).

2. The status of the open data in the Czech Republic

2.1 Regional level

To start describing the state of the open data problematic in the Czech Republic, we chose the bottom-up approach. Firstly, we are going to focus on the regional level which is here delimited by capitals of the Czech regions. These regions correspond to the 2nd level of the NUTS nomenclature. Please note, there are 14 regions in the Czech Republic but Prague, the capital of the whole country, is the capital for Central Bohemian Region and at the same time it is the region itself. Therefore, the analysis of the geoportals with open datasets and open data portals follows just for 13 regions' capitals. They are described in terms of the open data (OD) topicality, quantity, quality, and availability.

The result of the analysis can be seen in very succinct form in the
Table **1**. Nine out of thirteen regional capitals provide their open data mainly through specifically devoted websites – the open data portals (ODP) as it is called. Three largest cities (Prague, Brno, Ostrava mentioned in descending order of their population) expose their open geodata on another website – the geoportal. There is no surprise that the rule "*the bigger the municipality, the larger the number of datasets they provide*" hold in OD area as well. When we look at the capitals except

Municipality	Type of portal	Number of open datasets	Number of topics	Website availability	NKOD linked	Source
Brno	ODP	160	7	HP → about Brno → Data About City	Yes	ODAE MMB, 2024
Brno	GP	79	12	HP → about Brno → *click on* Maps → Cataloque of data and applications	Yes	OMI MMB, 2024
České Budějovice	-	-	-	-	-	-
Hradec Králové	ODP	50	10	HP → *click on* About City → *click on* Data About City → Open Data	No	Statutární město Hradec Králové, 2024
Jihlava	ODP	17	4	HP → Open data	Yes	Jihlava, oddělení GIS, 2024
Karlovy Vary	-	-	-	-	-	-
Liberec	ODP	13	-	HP → Office Online → City Open Data	Yes	Statutární město Liberec, 2024
Olomouc	ODP	27	-	HP → Open Data	Partly	Burian, T., 2024
Ostrava	ODP	118	12	HP → Authority → *click on* Dataportal of Ostrava → Open Data	Yes	Statutární město Ostrava, 2024a
Ostrava	GP	68	2	HP → Authority → Map Portal	Yes	Statutární město Ostrava, 2024b
Pardubice	-	-	-	-	-	-
Pilsen	ODP	125	47	HP → About City → Open Data	Yes	TUTA Plzeň, 2024
Prague	ODP	350	12	HP → About City → Magistrat → Opendata	Yes	Operator ICT, 2024a.
Prague	GP	140	16	HP → About City → Maps → *click on* Geoportal Capital City Prague → Data And Services	Partly	IPR Prague, 2024b
Ústí and Labem	-	-	-	-	-	-
Zlín	ODP	14	-	HP → About Town → *click on* Maps → Open Data	No	Magistrát města Zlína, 2024

Table 1. Regional capitals and their OD portals (ODP) or geoportals (GP)

the most populated triad mentioned above, the population of these municipalities is about 100,000 inhabitants (almost all of them) with the smallest exceptions Jihlava and Karlovy Vary (50,000) to largest Pilsen (180,000). The only open dataset, which is published by all 13 regional capitals is official notice board. This was omitted from the analysis as it is not relevant for the article.

The number of topics does not follow the aforementioned rule but is quite of subjective nature. Some portals don't divide or tag the datasets at all (Liberec, Olomouc, Zlín), just use a few (Brno ODP, Ostrava GP, Prague GP) or plenty (Pilsen). The topics are not listed due to space constraints, but they serve as a springboard for discovering relevant datasets for urban planning. The most common are environment, population, transport, and urban planning. Website availability is determined by the simplicity of reaching the ODP or GP from the official website of the municipalities – their homepage (HP). Jihlava and Olomouc guide user to their ODP directly from their HP. Most other cities cover the link under "about section" directly (Brno ODP, Pilsen) or the user have to click further (Brno GP, Hradec Králové, Ostrava GP, Prague GP, Zlín). It can be more comfortable to search for open data through search engine if the user doesn't know the structure of the municipality website albeit they are structured quite logically.

ArcGIS Hub solution is used by other cities: Brno GP, Jihlava, Olomouc, Prague GP. The open sourced CKAN data portal is used by Hradec Králové and Liberec. Another open-sourced solution is LKOD by Golemio for Prague ODP – see two paragraphs later. The last solution is just specific website (Ostrava ODP & GP, Zlín).
It was observed during systematic review of OD portals at smaller municipalities that although they have the portal available, it seems, it was just one-time action without long-term ambitions without regular update. Liberec, Hradec Králové Olomouc and Zlín created they portals mainly in 2021 and since then do not update or even add new open datasets. With this information the group of active providers on regional level shrinks to 5 cities: Brno, Jihlava, Ostrava, Pilsen and Prague.

2.2 Three main regional providers of OD

The capital city Prague hosts the highest number of the open datasets. The open geodata is published somewhat duplicated on both OD sites. The ODP is operated by city company for information communication technologies Operator ICT through their open sourced Golemio data platform (Operator ICT, 2024b). This platform serves as the solution for the Local Catalogue of the Open Data (LKOD) to directly published them in the National catalogue of open data. It is open source and can be used by other municipalities. The GP is operated by The Prague Institute of Planning and Development (IPR Prague) which is city contributory organization for conceptual urban planning (IPR Prague, 2024a). The geoportal is interlinked with ArcGIS Hub proprietary solution where larger variety of formats are at disposal than at the geoportal itself (IPR Prague, 2024b), which might be confusing for the user.

The second most populated Czech city Brno operates two portals with open data as well. data.brno.cz (ODP) is fully devoted to opening data and run on ArcGIS Hub. Originally it ran as CKAN catalogue system, nonetheless it turned out that ArcGIS Hub is more versatile solution not only due to better connection to NKOD, but possibility to extend output formats of already published data or streaming of sensor data (Spál, 2020). The latter access point to OD of Brno is its Mapping portal operated by T-Mapy company. In the section Catalogue of applications, data and services OD can be easily found by tag OD. Both portals largely overlap in the area of open geodata but on data.brno.cz are also published non-geographical open data and on Mapping portal other non-open geodata and mapping applications are also provided. This duplicity observed in Prague and Ostrava is still justifiable.

Ostrava don't use any specific catalogue solution for both portals. Its ODP lacks filters (format, date etc.), which could be applied, and any tags. The OD are just structured according to topic. More user-friendly is its Mapping portal where data can be filtered by their keywords, geometry type or topic. This is common feature for portals in Brno and Prague.

2.3 National level

When we move to national level, the main project for OD in the Czech Republic is National Catalogue of Open Data (NKOD). It was established in 2017 as fulfilment of the international initiative Open Government Partnership followed by Action plan for Open Government (OGP, 2024). In April 2024, it has 317 contributors with almost 8000 datasets. It stores also links to other local OD catalogues. In
Table **1**, it can be seen that almost all OD portals of regional capitals are linked with NKOD.

All open geodata at the state level, which conforms to the INSPIRE directive, should be discoverable on the Czech National Geoportal (CENIA, 2023). Today it contains 177 open datasets out of 1,330. It can be also used for creation of metadata record in accordance with INSPIRE directive.

We cannot forget to remark one of the greatest events of the past year 2023 in open geodata branch. Since 1st July 2023 the Czech Office for Surveying, Mapping and Cadastre (ČÚZK) opened ZABAGED, the orthophoto of the Czech Republic, the state map work, the database file of geographic nomenclature and point fields and put them under CC BY 4.0 license (ČÚZK, 2023a). Cadastre and Registry of Territorial Identification, Addresses and Real Estates (RÚIAN) had been opened even some time before. ZABAGED is a digital vector geographic model of the territory of the Czech Republic and is main source for the state map work ranging from the scale 1:5,000 to 1:1,000,000. RÚIAN is one of for registers of the public administration with territorial information, so address points, cadastre and administrative boundaries or building objects in the country can be downloaded.

In 2023, most of the results of the 2021 census was published as well by Czech statistical office (CZSO, 2023). They were also released as open data explicitly. Furthermore, data are implicitly opened through Public Database where plenty of other statistics including previous census might be discovered.

2.4 Hackathons are opening power of the open data

Regular hackathons are already organized to spread awareness about open data on these portals, which illustrate well the breadth of possible use of data and the hidden potential of making data available to a wide professional and lay public.

Public administration has organised hackathon at the state level for five years (NKÚ, 2024). They use the power of the OD and enable broad public to take part in developing and improving of the public sector. Some regional capitals also organise hackathons with OD. data.brno.cz team together with Czechitas (nonprofit organization supporting women in IT), for example, has already organized two hackathons (2022 and 2024). One of the most creative examples of the first year was the creation of a Minecraft world derived from an OD 3D model of the city of Brno, which is unconventional, but mainly the lay public can start to think more actively about their surroundings and how to contribute to its improvement. This year a solution of joining notice board of all Brno districts won; mainly due to its ability to retrieve the information by AI. This shows that AI technology might bring another information concealed in OD.

3. The open data in the Czech urban planning

We at the Brno City Chief Architect‘s Office (KAM) (non-profit organisation and the main conceptual workplace of Brno in the field of architecture, urban planning and city design) provide OD and also work with them. We publish data through the Brno city ODP data.brno.cz, where we did so with a 3D model of Brno (jointly with city government), data related to retail, transport survey and building survey data. Moreover, we come into contact with OD relevant for urban planning by organisations mentioned in section 2 and explain them now in greater detail. We use OD to supplement data for urban studies, spatial analysis documents, urban plans, modelling of flood protection measures.

3.1 3D data

As already stated in previous section (2.4), Brno is endowed with 3D model (see
Figure **1**), which was finished in March 2024 (MMB, 2024). Prague finished its 3D model (IPR Prague, 2024c.), the city of Ostrava is still working on it. All of them are released as OD in various format suitable for GIS, CAD and even other modelling software. 3D model of Brno is used in our office for viewshed analysis or assessment of the influence of new buildings on city skyline.

Figure 1. 3D building model of Brno

3.2 Base data

Mainly as basemap or basic situation for map production ZABAGED data or state map work (see 2.3) is very useful and conveniently accessible when turn into OD last year. Even though the city government prepare its own basemap it is not suitable for printing production, but for online webmaps instead. Having RÚIAN data as OD enable us having updated geometry of estates and administrative units and getting some technical information of the buildings attached to them (ČÚZK, 2023b).

Cadastre data is opened just to some extent – property rights of buildings or estates can be found out but by open access only through webpage nahlizeni.dokn.cz and only for one building or estate at one moment (ČÚZK, 2024a). On the other hand, the spatial part of cadastre – the map – is regularly updated by ČÚZK and can be downloaded as OD (ČÚZK, 2023c). The potential can be hidden in the emerging Digital Technical Map of the Regions (DTM) which will be to some extent opened to public. The extent is still questioned since the project will be launched in the beginning of July 2024. ČÚZK is going to be the operator of the Information System of the Digital Map of Public Administration, the main part of which will be the DTM (ČÚZK, 2024b).

3.3 Quality of Life

Data about crimes is regularly published by police office (Policie ČR, 2024a). Data are anonymized by aggregation of delicts to Voronoi polygons. This dataset help finding hotspots of criminality of given kind. Institute of Health Information and Statistics of the Czech Republic (ÚZIS) outputs every month register of healthcare providers (ÚZIS, 2016). Many other interesting data are available at their webpage, but they don’t meet definition of OD (especially regarding format). Non-traditional information of present population in the city can be obtained from mobile network. It is used for gaining the amount to which the city infrastructure is used and scale it appropriately. The dataset is published regularly and on the level of the basic settlement units (the smallest aerial statistical unit) for South Moravian region (data.brno.cz, 2021).

3.4 Transport

Police office published accidents as OD (Policie ČR, 2024b). It serves for identification of problematic places in traffic as was done in our office during creation of Spatial analytical data (OÚPR MMB, 2020). *Brněnské komunikace* (city organisation of Brno for road maintenance and planning) prepares traffic flow diagram once a year. The coordinator of public transport in South Moravian region exposes timetables in opened GTFS format and, moreover, real-time fleet positional data can be consumed via GTFS Realtime or JSON feed (data.brno.cz, 2024).

4. Discussion

During exploring and assessing the OD some non-OD were also found. The OD portal of Pilsen contains tens of links to its map services on geoportal (WMS, WMTS etc.). These are not real, machine-readable format conforming the OD. Nonetheless, governments might perceive them as the way of conveying openly an information to public and so attach them to OD portals.

Concerning the process of opening data to general public, their regular update is of critical issue and often not practiced – examples are the OD portals of Liberec, Hradec Králové Olomouc and Zlín. Without the update, the usage of this data is questionable. The OD should be therefore taken broadly like never ending process or ecosystem where not only data are important but human resources are needed to utilize fully its potential. The data.brno.cz OD portal had set robust system of administration where at each dataset the information about responsible person or department, update frequency and date of the last update is provided. This enables real utilization of the OD there.

Beside the update of the OD, the connection among ODP or GP with NKOD is sometimes not set (Hradec Králové, Olomouc, Prague GP) or the URL path from NKOD is set incorrectly. The issue connecting with previously ones is spreading the OD without proper metadata. We can find providers following no metadata profile to exemplary ones, which corresponds to findings by Quarati (2023). The keywords, which should facilitate finding the OD, are also often misleading or missing. A very good example, how should it be done, are datasets published by ČÚZK as OD. Since ČÚZK is required to publish spatial data under INSPIRE directive and therefore with proper metadata, the datasets they opened just previous year 2023 also conform to the directive.

We cannot omit paying attention to questions of ethics and privacy. The OD brings transparency into decision-making process, but protecting privacy have to be considered at the same time (Janssen and van den Hoven, 2015). The OD in the Czech Republic are very often spread in generalised geographical or statistical unit that could become a subject of the privacy issues. The only few examples are crime rate data (Policie ČR, 2024a), traffic accident data (Policie ČR, 2024b) or address points from RÚIAN and/or Cadastre (ČÚZK, 2023a). These data are always anonymized properly. The crime rate data, for instance, are aggregated to the Voronoi polygons. The polygons can be downloaded as well.
Final notes are devoted to the 3D data. The 3D data are still generally very new to urban planning in the Czech Republic as in the other countries has been already done (Schrotter & Hürzeler, 2020). Even though it seems that the proliferation of them into this field is going hand in hand with releasing them as the OD from the very beginning. This might open unprecedented opportunities in future.

5. Conclusion

This article links OD with urban planning. It shows some basic examples of their application in urban planning and how the open data helps connect government and public sector with citizens. The state of the OD problematic in Czech Republic was outlined. It can be concluded that the OD are supported on the state level as the preparation of the sixth edition of the Action Plan for Open Government shows. On regional level, the OD are mostly published and updated by three biggest cities (Prague, Brno and Ostrava). The other more active ones are Pilsen and Jihlava.

Even though much has been already done, there are still caveats. The most critical ones are not setting whole lifecycle of data (not only publishing but also updating them) and delivering data with proper metadata. The former was especially critical on regional level at the capitals of smaller cities. This makes often impossible to use the OD and loses its potential.

The OD has already opened new horizons in the Czech Republic. On both levels the hackathons are organised. They were identified as fruitful tool for leveraging hidden potential in the OD and give opportunities to wide professional and lay public to contribute to the change of their living environment. It was also showed that the landscape of the OD for urban planning in the Czech Republic is more and more rich and varied each year.

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