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Integrating Participatory Mapping into Urban Governance: opening data in Ostrava, Czechia

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Abstract:

Participatory mapping has emerged as a powerful approach for integrating citizen perspectives into urban planning and decision-making processes. This paper reflects on eight years of participatory mapping efforts conducted in Ostrava, Czech Republic, where over 8,000 respondents contributed more than 70,000 spatial responses. The study outlines the methodology and tools used to process and publish this collected data as open datasets via web-based solutions built with ArcGIS Online technology.

The paper discusses the main challenges and solutions for modern open data publishing strategies that ensure attribute consistency, understandable data visualisation, and user-friendly access to various datasets. By developing a unified attribute data model and implementing advanced filtering, visualisation, and export possibilities, the open data initiative improves accessibility. It encourages greater community engagement not only in urban planning. This strategy highlights the importance of participatory mapping as an essential tool for producing open and actionable spatial data and promoting transparent, inclusive governance in the 21st century, as specified in SDGs goal 11.

Keywords: Participatory mapping, emotional cartographies, Czech Republic, geoparticipation, open data, ArcGIS Online

1. Introduction

Participatory mapping (PM) can be understood as a broad term for technologies and approaches that enable citizens to engage in decision-making processes through map-based applications, which can be analogue or digital (Mukherjee, 2015; Kahila-Tani, Kytta and Geertman, 2019). It often involves making decisions about public spaces but can also be used to share information or perceptions about the surrounding environment (Pánek, 2016).

Geoparticipation, a closely related concept, utilizes spatial tools to facilitate citizen engagement in decision-making that affects them. Geoparticipation prioritizes community empowerment by incorporating local knowledge into formal planning frameworks to enhance the inclusivity and effectiveness of governance practices (Pánek, 2016; Olszewski *et al.*, 2017; Zhang, 2019; Babelon *et al.*, 2021). These applications can be used for one-off data collection, like creating a transportation strategy or revitalizing a housing estate, or for longer-term communication and information exchange between city/municipal authorities or researchers and citizens. Participatory mapping (in some research also referred to as PPGIS) can also be used in various stages of urban planning, or on a different scale, or working with various target groups (for more comparison see (Kahila-Tani, Kytta and Geertman, 2019)). Participatory mapping approach combines traditional Geographic Information Systems (GIS) with participatory methods, utilizing both analogue (sketch maps) and digital (online platforms) environments. The campaigns may involve online questionnaires promoted through official websites, social media, and leaflets. Alternatively, they may be conducted using paper map questionnaires distributed at community events or public spaces. The data collection methods and approaches can also be combined as a phygital engagement (Charlton *et al.*, 2023) as an approach to diversify and combine various participation methods to engage as wide and diverse target groups as possible.

Participatory mapping offers several advantages (Babelon *et al.*, 2021):

- Enhanced civic engagement by promoting broader citizen involvement in local governance processes.
- Improved decision-making by incorporating diverse perspectives resulting in more informed and comprehensive policy development.
- Community empowerment as local groups gain tools to express their concerns and actively influence decision-making outcomes using their local spatial knowledge.

These benefits enable participatory mapping to generate valuable spatial information and knowledge for strategic

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planning and spatial development, ultimately leading to improved quality of life in urban environments. It allows for identifying locations with a high fear of crime, as well as those where future development could occur.

However, participatory mapping also faces limitations:

- Respondent bias, where participants may be more inclined to mark areas within continuously populated spaces or where they frequent daily.
- Accuracy is another troubling topic for mental/participatory mapping, as drawings may have limitations in their precision, potentially leading to overlap and blurring the lines between distinct locations.
- Skills/technological limitations may prevent some users from fully understanding/grasping/manipulating both the technology and/or the concept of maps.

Despite these limitations, participatory mapping remains a valuable tool for citizen engagement and informed decision-making in urban planning and development.

One of the 17 Sustainable Development Goals (SDGs) is specifically dedicated to creating sustainable cities and communities (Goal 11), with the aim to "make cities and human settlements inclusive, safe, resilient and sustainable." Target 11.7 further specifies that by 2030, all nations should "enhance inclusive and sustainable urbanisation and capacity for participatory, integrated and sustainable human settlement planning and management" (United Nations, 2022).

What does “participatory, integrated, and sustainable human settlement planning” encompass? Democratic approaches to community planning can be traced to the 1930s and 1940s in the United Kingdom and the United States. However, during this period, such approaches were not inclusive of all citizens, particularly in the United States. In the 1940s, Demerath (1947) identified community participation as one of the six primary challenges in urban planning. As a professor of sociology with a specialisation in community and urban planning, Demerath observed that “city planners are looking to the social scientists for help.”. Seventy years later, Olszewski et al. (2017) introduced the concept of social participation, which prioritises integrating residents’ perspectives into plans for urban revitalisation and spatial development. Building on this, Olszewski and Turek (2018) defined social geoparticipation as an approach that facilitates the development of spatial planning strategies. Expanding upon these ideas, Gnat, Leszek and Olszewski (2016) argued that urban agglomerations aspiring to become smart cities must incorporate advanced geoinformation technologies to enable effective social (geo)participation. However, achieving this goal requires not only the development of sophisticated technological tools but also their widespread utilisation and acceptance within local communities.

This paper describes the eight years of experience using participatory mapping in the city of Ostrava, Czech Republic and how the results are currently published as open data to be used by citizens as well as in urban planning. To publish the data from the participatory mapping events, a web-based mapping application (ArcGIS Hub) served as a visualisation tool for all perceptual data collected in Ostrava. It enabled data filtering by date, location, and theme, as well as data export. For more advanced functionalities, such as exporting data for a selected area or sharing links to user-defined selections, raw open data sets were available. As the open data hub was only established recently, we possess no data on the usage or outcomes of the opening of the datasets.

2. Study location – Ostrava, Czech Republic

Ostrava, the third-largest city in the Czech Republic, is situated near the northeastern border with Poland. Established in 1267, the city has historically been associated with coal mining. The broader metropolitan area has a population of approximately 500,000 residents (Czech Statistical Office, 2024). Since the 1990s, following the rapid decline of traditional industrial sectors such as iron, steel production, and coal mining, Ostrava has undergone significant transformation, evolving into a modern cultural and university hub. Today, the city boasts numerous theatres, galleries, and other cultural institutions. Administratively, Ostrava is organized into 23 boroughs, which are further subdivided into 37 administrative districts (State Administration of Land Surveying and Cadastre, 2024).

Mappa was established in 2019 as Ostrava's primary centre for urbanism, architecture, and city development. It collaborates with municipal bodies, developers, independent experts, and citizens to implement urban projects, collect city-related data, and improve public spaces. The initiatives focus on enhancing the quality of life in Ostrava by promoting better housing, accessible transportation, and safe, attractive public areas, benefiting both residents and visitors. (Mappa Ostrava, 2024) Mappa plays an active role in engaging Ostrava’s citizens in discussions about future development, opening (geo)data, as well as facilitating urban planning process.

3. Participatory mapping in Ostrava

Since 2016, a total of 11 participatory mapping events have been conducted in Ostrava, engaging over 8,000 respondents and collecting over 70,000 responses. Some of these events were focused on a single theme, such as cycling infrastructure, public safety or urban heat islands, while others addressed multiple topics. Certain surveys were designed to encompass the entire city of Ostrava, whereas others concentrated on specific districts, such as Ostrava-Poruba, or particular locations, such as the central

boulevard (see Table 1). This topicwise as well as graphical scale variations follow also the results of Kahila-Tani, Kytta and Geertman (2019). Unlike the research from Finland, in case of Ostrava, most of the participatory mapping events were used in the initial (planning) phase. The participatory mapping events were organised by various actors – some of them were organised by the City of Ostrava, later by Mappa, while the "neighbourhood" events in Ostrava-Poruba were organised by the local administration in collaboration with the National Healthy Cities Network – a WHO-certified platform that organises Local Agenda 21 activities in the Czech Republic. One event in 2018 was also organised by the Technical University of Ostrava as a part of their research activity supported by the Technology Agency of the Czech Republic (Pánek, Ivan and Macková, 2019; Linhartová, Ivan and Pánek, 2022).

Year of the PM	Area	Number of respondents	Number of points
2016a	*Ostrava-Poruba*	*380*	*1,119*
2016b	Ostrava	447	7,712
2017	Ostrava	1,558	3,794
2018a	*Ostrava*	*590*	*5,636*
2018b	*Ostrava-Poruba*	*341*	*1,796*
2021	*Ostrava-Poruba*	*346*	*4,051*
2022a	Central Boulevard	193	1,684
2022b	Ostrava	1,655	23,865
2023	Ostrava	1,230	15,295
2024a	Ostrava	N/A	381
2024b	*Ostrava*	*1,852*	*5,910*

Table 1. List of Participatory mapping events organized in Ostrava. a/b = the letters have no specific meaning except to differentiate the two events within one year. Participatory mapping events written in italics are not yet included in the open-data portal, as the data ownership is not finalised yet.

Year of the PM	Main topics covered
2016a	Safety, Transportation, Plesant places, Unplesant/ugly places
2016b	Plesant places, Unplesant/ugly places
2017	Urban Heat Islands
2018a	Safety
2018b	Safety, Transportation, Plesant places, Unplesant/ugly places
2021	Safety, Transportation, Plesant places, Unplesant/ugly places
2022a	Safety, Transportation, Plesant places,
2022b	Transportation
2023	Plesant places, Unplesant/ugly places
2024a	Transportation
2024b	Safety

Table 2. List of Participatory mapping events with their main topics.

4. Key aspects and considerations of data opening in Ostrava city

Open data, as defined by the Open Knowledge Foundation (Open Knowledge, no date), are data published on the internet in a manner that does not restrict any user in how they are used (technically or legally) and grants all users the right to distribute them further, provided that the original author of the data is credited and that other users are granted the same rights to handle the redistributed data. This means that the redistribution must not limit these rights, for instance, by restricting their use exclusively for non-commercial purposes.

Opening any dataset requires optimal data harmonisation and the selection of appropriate technologies. The Sunlight Foundation's Open Data Policy Guidelines (Sunlight Foundation, no date) outline key principles for effective open data policies. The most critical properties include completeness, primacy, timeliness, accessibility, machine-readability, non-discrimination, open standards, open licensing, permanent accessibility, and minimal cost (Sunlight Foundation, no date; Burian *et al.*, 2022). Ensuring intuitive and straightforward access to specific datasets, such as those derived from the participatory mapping of Ostrava, in a unified format and structure is essential for their optimal opening process.

Before publication, it was essential to ensure attribute consistency across seven selected point datasets, which were either solely owned by Mappa Ostrava or derived from the participatory mapping conducted via EmotionalMaps.eu platform. A unified attribute data model was developed based on seven common attributes, enabling straightforward updates, filtering, or aggregation in the future. Establishing this uniform structure also ensures consistency in participatory mapping activities moving forward and facilitates their seamless integration into the open portal.

The shared attributes include the mapping project's **name**, the mapping's **year**, the **category** to which the participatory mapping belongs, the participant's **gender**, **age**, **comments** on the designated locality, and the **municipal district** of Ostrava. Additional optional attributes are allowed, but the seven listed above are mandatory, forming the core characteristics of the participatory mapping project and the spatial record created by its participants.

5. Publishing the participatory mapping data with ArcGIS Online

The technological solution was selected based on Esri technology - ArcGIS Online, which Mappa Ostrava has already utilised to publish its various datasets. The use of

ArcGIS Online was therefore a logical choice given that these technologies are also employed by several applications of the City of Ostrava's map portal, managed by Mappa Ostrava (https://mapy.ostrava.cz/), as well as by the geoportal of the Moravian-Silesian Region, where Ostrava is located (https://geoportal.msk.cz). Datasets hosted on ArcGIS Online are easily accessible and distributable across various platforms, offering extensive sharing and download options while maintaining high data integrity. Additionally, they can be seamlessly updated online and directly from the desktop ArcGIS Pro application.

In a comprehensive overview of Czech map portals, Burian et al. (2022) identified Esri as the dominant technology, with a particular emphasis on the ArcGIS Hub solution. Alternatively, with the inspiration of many foreign countries, utilise CKAN (Comprehensive Knowledge Archive Network) technology or simply share basic map services.

The chosen approach combines the use of ArcGIS Hub and ArcGIS Experience Builder. This dual solution ensures maximum user flexibility in filtering and accessing published datasets while offering a high degree of customisation in the visualisation of published layers. Also, from the perspective of maximum inclusivity of the users who may not be technically savvy, using easy-to-use Esri technology was favoured by Ostrava, in contrast to another solution. The developed ArcGIS Hub (https://pocitove-mapy-mappaova.hub.arcgis.com/) is a web gateway to individual datasets. As a single-page website, it integrates **full-text search**, dataset **downloads**, dataset **descriptions**, and direct access to **original** emotional mapping **surveys**.

However, ArcGIS Hub does not support advanced customised cartographic visualisations and offers a relatively complex user interface, which can be limiting for inexperienced users. As illustrated in Figure 1, it provides extensive filtering options, which can be applied to data downloads in nine possible formats or shared through a direct link. This ensures both the accessibility and adaptability of the published data.

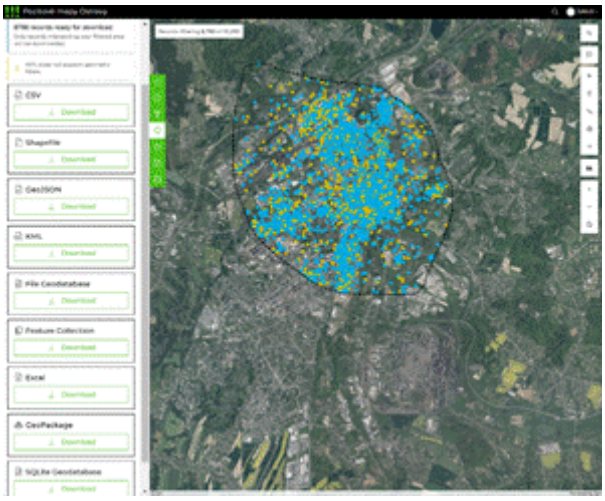

Figure 1: Data visualisation and graphical filtering with download options in ArcGIS Hub.

To enhance user-friendliness and facilitate navigation among the emotional mapping datasets, the ArcGIS Experience Builder environment was utilised to create a web map application based on the same datasets: https://arcg.is/0G0XGT. The datasets have been cartographically edited with a unique symbology while maintaining consistent attribute information. A key added value is including a comprehensive layer aggregating all published participatory mappings, visually summarising responses within the city of Ostrava and categorising them by their respective mapping projects (see Figure 2).

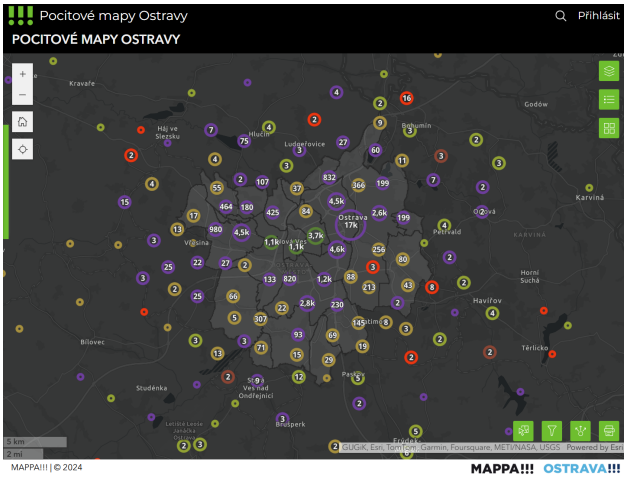

Figure 2: Visual representation of participatory mapping in Ostrava, created using ArcGIS Experience Builder.

The user interface is designed to be minimalist and intuitive, enabling users to toggle layers, switch basemaps, and explore attributes via pop-up windows with ease. Predefined filters facilitate detailed exploration of datasets, even for less technically proficient users. User selection is supported through graphical tools, with options to share or download data in formats such as CSV, JSON, GeoJSON, or directly to an ArcGIS Online environment. Additionally, users can export customised map views as

graphic map compositions in PDF format, complete with a legend, map scale, and credits.

The application functions as a standalone tool and is an interactive component directly integrated within the ArcGIS Hub. It provides users, especially those coming from the general public, with a seamless experience accessing the datasets.

6. Summary

The participatory mapping data portal for the city of Ostrava (https://pocitove-mapy-mappaova.hub.arcgis.com) serves as a centralised platform for publishing open data generated from participatory mapping initiatives in the city. It aggregates various participatory mapping datasets into one unified space, offering advanced filtering options that allow users to perform custom exports based on their needs. Designed for both the general public and experts, the portal ensures broad accessibility while adhering to the visual and organisational standards of Mappa Ostrava.

This portal supports the city's vision of unifying and expanding participatory mapping data and integrates seamlessly with Ostrava's municipal data portal. By providing data in a standardised visual format, the platform enhances decision-making in urban planning and helps develop modern infrastructure that aligns with citizens' needs, promoting data-driven governance and community-centred development.

The paper explores the potential of participatory mapping as a tool to incorporate citizen perspectives into urban planning and governance. Over eight years, participatory mapping initiatives in Ostrava have engaged over 8,000 respondents and collected more than 70,000 spatial responses, enabling actionable insights for urban development. Unfortunatelly, we currently cannot analyse the usage of the open data as the portal has been presented to the public only on the beginning of 2025.

The findings underscore the ability of participatory mapping to identify spatial patterns, such as areas with heightened perceptions of safety concerns or potential for development. Furthermore, challenges related to data precision and participant engagement necessitate continuous technological and methodological improvements. Publishing participatory mapping (crowdsourced) data as open datasets has proven transformative for urban governance in Ostrava. The ArcGIS-based platform not only aggregates diverse datasets but also enables users to perform custom analyses, supporting both public accessibility and expert-driven urban planning. This approach aligns with the city's vision of transparent and community-focused development, bridging the gap between stakeholders and facilitating data-driven decision-making. The study illustrates the transformative potential of participatory mapping in urban governance, particularly in fostering inclusivity and sustainability. By integrating citizen inputs with advanced geospatial technologies, Ostrava exemplifies how cities can embrace participatory methods to align infrastructure development with community needs. However, future efforts must address TECHNOLOGICAL limitations and promote widespread adoption to maximise the impact of participatory mapping. Future studies should also focus on the usability of the open data by the general public and data reliability.

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