

SPATIAL PLANNING BEYOND ALGORITHMIC LOGICS. ON THE BENEFITS OF USING PUBLIC PARTICIPATION IN CREATION OF SPATIAL PLANS IN UKRAINE

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Abstract

Ukraine is currently in a state of war and is experiencing significant demographic changes as well as shifts in residential living and the organisation of its industries. The impacts of the war will require the rebuilding of the country, and this presents opportunities to improve the living and working environment of Ukrainians while also introducing new sustainable solutions. There is a need to establish new strategies for spatial planning that include new technologies and broad public participation through the development of National Spatial Data Infrastructure. This paper explores the potential solutions, opportunities and risks of developing a new spatial planning approach in Ukraine.

Keywords:

Spatial planning, spatial data, public participation, spatial data infrastructure

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1. Introduction

The full-scale invasion of Ukraine in February 2022 resulted in the extensive relocation of inhabitants across the country's major cities. Providing these inhabitants with appropriate housing is regulated by the Law of Ukraine No. 77-VII (dated 28 December 2014) which notes the importance of ensuring the rights and freedoms of internally displaced persons and imposed the responsibility of local state administrations and local self-government bodies to provide such accommodation. The relocation of inhabitants has been compounded by the changing structures of industrial and employment centres across the country. The Ukrainian Cabinet of Ministers passed a resolution of martial state law that suspended access to the State Land Cadastre (Resolution No. 263 "On the maintenance and functioning of the State Land Cadastre under martial law", dated March 2022) which has been an impediment to the efficient management of accommodations for displaced persons.

The large-scale destruction of housing as well as cultural and governmental buildings requires the introduction of new goals, guidelines and methods to enable the reconstruction of cities once the war ends. This new approach to urban development needs to account for the significant changes in social structures that have occurred since 2022. The war period has had a significant impact on urban development policies and practices. Specifically, participation in these processes depend not only on city residents based on their rights and obligations, but also on attendance of new city users who use urban resources occasionally for professional purposes or tourism.

The Committee of the Verkhovna Rada of Ukraine (dated April 2023) on basis of the document "On State Power, Local Self-Government, Regional Development, and Urban Planning", established the Working Group on the Development of the Urban Planning Code of Ukraine to define guidelines for spatial planning. In November 2023, UN-Habitat established a headquarters in Ukraine to support governmental efforts and to launch the collaborative project "Towards Inclusive and Resilient Urban Recovery in Ukraine" (UN-HABITAT, 2023). One aim of this project is to align the reconstruction process with long-term spatial planning decisions. The project embraces the revitalisation of destroyed residential districts as well as planning for new recreational areas and multifunctional developments. The new investment plans will require changes in land use that will be informed by public consultations. Facilitating public consultations and enhancing feedback procedures are included in the second component of the UN-Habitat project.

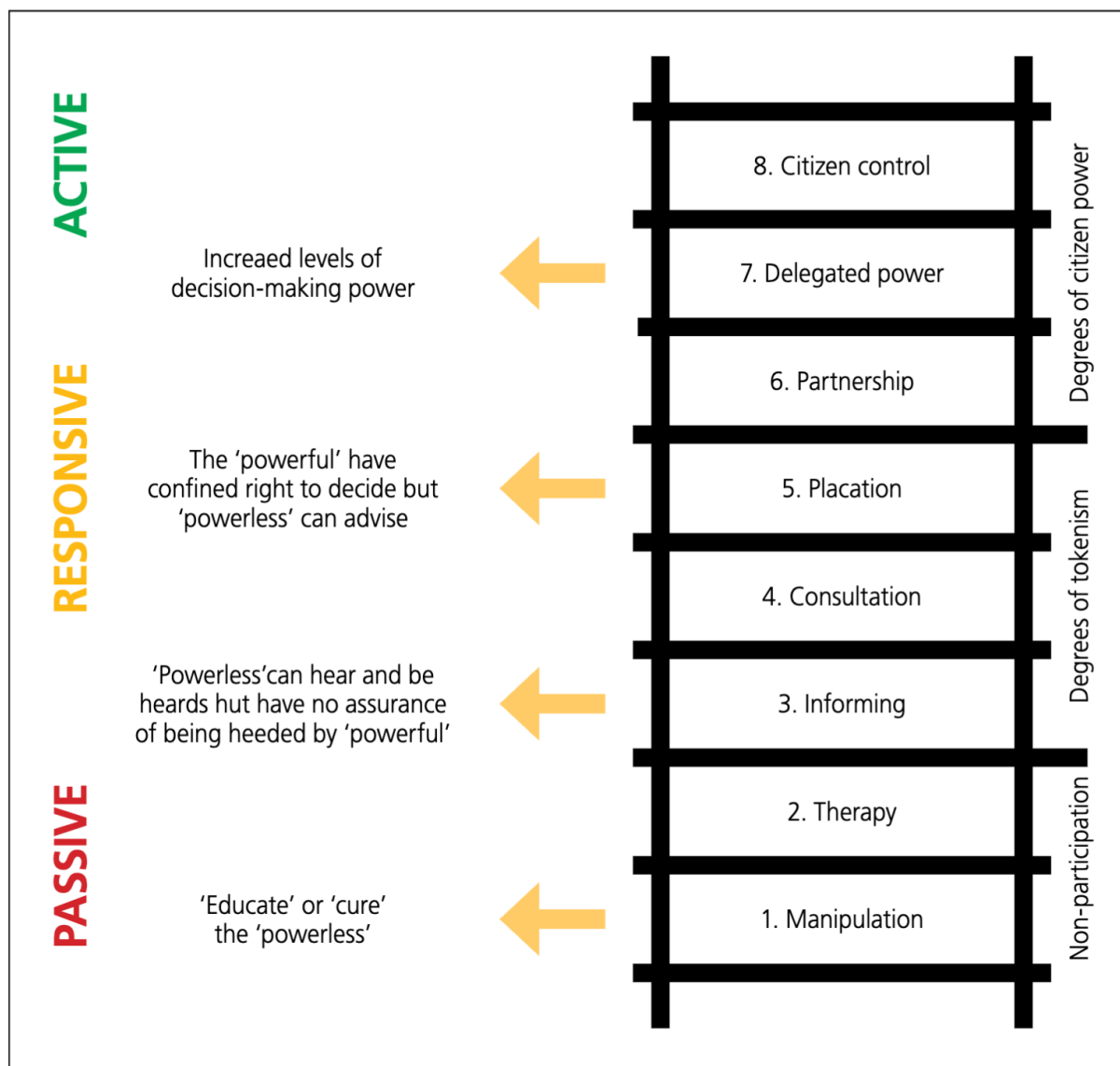
The outbreak of war did not impact the development of the National Spatial Data Infrastructure (NDSI). In 2021, the Ukrainian Parliament adopted Resolution "On Procedures for the Functioning of the NDSI" and the Law of Ukraine 'On the National Spatial Data Infrastructure' (Kondratenko et al., 2023). The continued development of the NDSI provides opportunities to enhance public participation in spatial planning processes.

2. Significance of public participation.

The significant changes to the social structures of Ukrainian cities due to the war has raised important questions about how residents can participate in spatial planning decision-making processes. There is a view that urban development should not only be conducted for the residents but also influenced by them. Public participation is strongly promoted in the latest amendment to the Resolution of Cabinet of Ministers of Ukraine (dated March 2025) which notes the importance of ensuring public participation in the formulation and implementation of state policy through the establishment of social councils in individual ministries and local government institutions. Public participation is also an important component of the Urban Recovery Framework (URF) which is led by UN-Habitat and comprised of a group of partners and stakeholders who are seeking to create a roadmap for "building back better". The URF has invited non-governmental institutions to cooperate in mediation between local authorities and community members. However, social mediation requires the development of a set of tools for assessing the needs of a given community. These tools should also serve to support and enhance public participation in decision-making.

Arnstein's ladder characterises various stages of public engagement, ranging from passive (nonparticipative) to active (public control) (Arnstein, 1969). Laura Puttkamer, a participatory planning consultant, notes that post-Soviet cities are implementing strategies to encourage inhabitants to engage in urban planning

processes. These strategies are typically undertaken by activists from non-governmental institutions, i.e. Cedoss (Khelashvili et al., 2023). However, there has been a notable lack of community members attendance at such meetings as well as general disinterest from the public with regard to engaging in such processes. Ukrainian planning processes typically involve tokenistic activities pertaining to information provision, consultation and placation (Puttkamer, 2017). Given this, there is a need to enhance these activities to encourage residents to be more engaged in decision-making processes while also ensuring that such greater engagement will not result in significant increase in time or financial inputs. Such a balance could be achieved through the development of an effective information strategy, data collection based on surveys and public enquires, and enrolling citizens in administrative and activist committees.



Source: IACD 2019

Fig. 1 Arnstein's ladder (source: https://journals.co.za/doi/10.10520/ejc-ajpa_v15_n1_a3)

Enhancing participatory planning in Ukrainian cities cannot, however, be achieved without an appropriate and legible environment of collaboration that is founded on transparent and de-centralised governance, new organisational approaches to support multisectoral, interoperative activities and the fostering of open and interactive arenas of information exchange (Janczar, 2021).

3. Smart City.

'Smart City' objectives are intended to optimise the management of strategic cities' services including storm water management, waste management, traffic regulation and the operation of emergency services. They also provide citizens with access to real-time information and assure that there are effective interactions between residents and collective resources (Sauvage, 2021). To achieve Smart City objectives, it is necessary to build an effective information network that allows for the rapid and efficient exchange of data. The development of such networks is expected to include Information and Communication Technology (ICT), the Internet of Things (IoT), consideration of human and social capital and the provision of opportunities for collaboration between the private and public sectors (Sauvage, 2021).

3.1. Stages of the Smart City development.

Boyd Cohen proposed three stages of Smart City development (Cohen, 2015):

Smart City 1.0: The first stage is experimental and involves the implementation of new technologies without awareness of the far-reaching implications or active engagement of citizens.

Smart City 2.0: In the second stage, the local authority takes on the role of technology and data governor. Administrative bodies take control of data access and sharing while also utilising the data to improve urban functions and the quality life of residents. Here, rigid legal regulations drive the Smart City agenda with minimal input from residents.

Smart City 3.0: The third stage involves the final development of the Smart City; residents are involved in decision-making. The local authority serves as an intermediary which connects residents and smart public services. This stage is characterised by bottom-up regulating which seeks to maximise inclusiveness and sustainability values.

Ukrainian cities are currently in the second stage of Smart City development; technology and data are controlled by national and administrative institutions including the State Geo Cadastre, the Ministry of Regional Development and Housing of Ukraine, the Ministry of Ecology and Natural Resources, the State Agency of Water Resources, the State Agency of Forest Resources, the Ministry of Culture of Ukraine, the Ministry of Health and State Service of Statistics (State Service of Ukraine for Geodesy, Cartography and Cadastre, 2018). The ongoing war and the necessity of assuring high levels of data security have, to date, prevented the transition to the third stage of Smart City development (Makarenko, 2022).

3.2. Data collection mechanisms.

According to Janczar, there are three types of data that play significant roles in the spatial planning decision-making processes: 2D data, 3D data and statistical data (Janczar, 2021). Statistical data is most impacted by the political situation in Ukraine, environmental factors and the interchangeable roles of consumers and prosumers in the extending circular economy. Statistical data requires constant updates with properly designed data collection tools adjusted to current social perceptions and conditions, i.e. customer attitudes and the dynamic structure of the given city's population.

State institutions including public administration, oblast- and regional authorities and hromada offices are typically responsible for collecting and archiving statistical data. These institutions acquire data from residents who are legally required to register their marital status in person while civil registry offices collect demographic data on births and deaths. The Ministry of Internal Affairs is responsible for vehicle registration. The Ukrainian Ministry of Justice and Department of State Registration collects data about company registration, business licensing and permits. The state social insurance authority collects data on public health and accidents.

There is a growing trend to automate data collection processes. Energy and water distributors as well as municipal infrastructure network managers have installed devices with remote reading capabilities for private and institutional utility customers (Sauvage, 2021). The increasing number of e-services that have increased

accessibility and simplified handling procedures has resulted in a reduction in resident involvement in data collection processes.

Current data collection tools include new technologies that are based on wireless data transmission such as mobile phone networks that make it possible to determine the number of users within the given city, and the wireless internet network that records phenomena in the city such as rainfall levels, traffic volume, employment levels and the availability of health services (Komninos, 2019). Social media platforms provide copious amounts of information about social behaviour including places of concentration, preferred forms of housing, employment, and entertainment. In many cases, this type of data can be acquired without public participation or consent.

4. Infrastructure for Spatial Information.

The extensive rollout of digitalisation has involved the development of IT infrastructure. The elements of this infrastructure can be divided into two main groups: data sets and network services. A requirement of a well-functioning IT infrastructure means coherence across territorial and administrative (official) divisions. Spatial Information Infrastructure is organised via two models of information flow which are: product-based, and process-based (Janczar, 2021).

4.1. Generations of spatial data infrastructure.

Williamson et al., (2007) identified three generations of spatial data infrastructures. The first generation involves a product-based approach. Data is a resource, and public administrations are responsible for archiving, maintaining quality standards and developing protocols for sharing spatial data products such as maps, databases, datasets and public registers. These, in turn, are made available in their entirety without being customised to address specific needs. This first generation of spatial data infrastructure requires central data management. The second generation includes a process-based approach which incorporates a wide range of decentralised data collection and management and can provide e-services to support extensive, multi-criterial public participation. This generation of infrastructure development makes data more accessible to users but requires a higher degree of data customisation. The third generation of data infrastructure expands data management and responsibility beyond public administration. Data is produced in the same way as for state institutions, and is subject to the same rules regarding collection, standardisation and use. However, expanding responsibility beyond public administrations carries a range of consequences. A network of connections between data production and data use may blur boundaries between data producers and users. In addition, the higher volume of data disseminated to users makes it necessary to process and adapt the data to the needs of particular users.

This third generation of Spatial Information Infrastructure aligns with the objectives of Smart City 3.0. However, the proliferation of data operators and automation of data acquisition processes results in significant increases in the availability of spatial data, and this has the potential to lead to there being less control over the entire infrastructure as well as reduced opportunities for public participation. It also raises questions about how to process and customised data for specific applications. There is also a risk that single participants may build databases based on their individual needs, resulting in various actors competing with one another and producing either contradictory data or unnecessarily duplications of data resources. It follows, that there is a need to introduce regulatory standards and policies to manage the Infrastructure of Spatial Information.

4.2. Standardisation of spatial databases.

A specific example of spatial database standardisation is the European INSPIRE Directive which includes guidelines for member countries related to shared requirements for their data networks. With Ukraine being a potential candidate for membership of the European Union, these guidelines could serve as a foundation for an Infrastructure of Spatial Information in Ukraine and contribute to the Spatial Data Infrastructure in Europe.

The European INSPIRE Directive is a document containing specific guidelines; its implementation is expected to result in an increased level of interoperability of spatial data (INSPIRE, 2007). There are three types of

interoperability within the Spatial Data Infrastructure. Technical interoperability involves data management systems (devices, data transmission, operating system standards and data protocols), and their syntactic aspects (data language and format). Semantic interoperability requires a clear understanding of information exchanged and disseminated by users. Organisational interoperability requires consistent legal regulations, organisational, economic and personnel procedures, as well as the development of precise definitions of both dependencies and responsibilities within organisational structures.

Modern information systems offer services rather than products (also referred to as service-oriented architecture). Services related to spatial information include five main activities: searches of data sets and services; exploration of data sets represented by activities such as display, navigation, zooming in and out, scrolling and displaying symbol legends; downloading of data to personal devices; reshaping the content of data sets; and the launching of services related to spatial information.

To enable these activities, there is a need for strategies which both harmonise metadata and regulate the structure of dispersed data sets. Metadata is defined as 'information describing spatial data sets and related services enabling recognition of their location, inventory and imposing their usage' (Janczar, 2021). In contrast, the harmonisation of spatial data requires establishing metadata in ways that guarantee the coherence of all datasets within the Spatial Information Infrastructure, identifying methods of data collection, and identification of the institutions that are responsible for the creation, administration, maintenance and distribution of data sets and services (Janczar, 2021). The INSPIRE Directive emphasizes the significance of spatial data set conformity by implementing rules to control the quality and validity of spatial data sets and specifying the limitations of public access as well as providing justifications for those limitations. The rules also establish conditions for access and using the spatial data sets and spatial data services, as well as applicable fees.

Spatial data sets include information from a wide range of fields including land-use and spatial governance, cultural heritage and environmental protection, technical infrastructure, agriculture, natural water bodies and forest governance, environmental risks due to flooding, fire and landslides and social and military security. These data sets are stored by various institutions with distinctive competences. It is also important to maintain the coherence of the data as it is circulated from regional spatial development plans (план просторового планування області), through area spatial development plans (план просторового планування району) to the spatial plans of individual municipalities (генплан міста/села). It is important to note that different municipalities have different data management systems. To facilitate data interoperability, a clear and legible system of data identification is required (Janczar, 2021).

The data identification model is intended to protect data from changes in functional value by specific administrators. An example of such a model is the GCM (Generic Conceptual Model) which was introduced by the European Commission in 2014 and defines requirements for external object identifiers. These external object identifiers are supposed to identify the main features of the object including, for example, uniqueness, durability (unchangeability), identifiability and enforceability. These features do not influence the structure and content of existing data sets, but identify subject groups that can be used for specific processes or procedures. Applying identifiers to data also creates labels that can be utilised in subsequent algorithmic processes.

4.3. Data processing.

The city processes are assumed to be driven by integrated human, machine and collective intelligence (Komninos et al., 2019). Human intelligence plays a role in creativity and city innovation, while collective and collaborative intelligence establishes quality levels for the functioning of public and administrative institutions. Machine intelligence (or Artificial Intelligence) supports data processing and analysis, while also providing a foundation for decision-making processes.

4.3.1. Machine Learning

Machine learning involves a specific set of Artificial Intelligence tools that produce algorithms to apply to provided data. Machine learning involves learning from the provided data instead of the machines being programmed (Kmetz, 2023). There are four methods of machine learning and supervised learning is the most common method to create algorithms using labelled data to find correlations among them. In this method, the inputs and outputs of the algorithm are specifically defined.

Ensemble-based methods such as Decision Trees and Random Forests are the most popular algorithms used to select data within supervised models. They are frequently used in spatial data analysis. Both of those algorithm types are used for data classification and to extract numerical values that can provide future predictions. They are useful in the implementation of smart urban forms and procedures to increase inclusiveness within urban environments. Other algorithms support geospatial applications by using morphological tools such as Support Vector Machines (SVM) and neural networks. These are used in Urban Planning to identify patterns and trends from spatial data sets, and for the classification of land uses (Casali et al., 2022). They are used to plan roads, and to delineate road network acquisitions. Convolutional Neural Networks (CNN) are efficient tools by which to extract specific features from spatial data while Recurrent Neural Networks (RNN) are used to produce precise urban simulations.

Decision-making processes are crucial in the establishment of spatial plans based on public participation. They provide simplified depictions of urban environments to encourage interaction between stakeholders, citizens and the governing administrations. Decision-Support Systems (DSS) can be used to integrate various databases and simplify interactions between stakeholders during debates about spatial solutions. Classification and Regression Trees (CART) are further tools to classify land use and develop future predictions.

Tools using Machine Learning are commonplace today and are often used to recognise speech and natural language, to conduct medical analyses, to manage self-driving vehicle processes and to predict natural phenomena (Komninos et al., 2019). The collection and processing of data are central to the functioning of smart cities. Nonetheless, many complex aspects of cities such as sustainability, social inequality, poverty, industrial distribution and employment have significant impacts on spatial planning and need, therefore, to be considered in wider contexts. There is a need for properly formulated questions and the selection of appropriate input data. These initial actions need to be informed by a combination of human and collective intelligence.

4.3.2. Data processing within Smart Cities.

Smart Cities utilise various fields of technology: the Internet of Things (IoT) encompasses connected devices, diverse blockchains are responsible for information transition, whilst digital platforms and social media networks allow for public access to information sources as well as its production (Komninos et al., 2019). All these fields are subservient to the underlying algorithmic logics that govern their functions. The most prominent threats of technological governance perform the lack of transparency and control over data processing, the misalignment of technological and social optimisation goals, and the questionable proportion of control capacity. In the regression conducting tools such as Decision Trees and Random Forests (combinations of Decision Trees) predictions and classification results are clear and credible because the processing patterns are determined in advance. Conversely, the tools that draw upon Deep Learning and Neural Networks only allow for the manipulation of Input and Output Layers while processing nodes are located within a Hidden Layer. It follows, that the entire process of pattern production remains illegible.

Data processing that relies solely on Machine Learning tools lacks transparency and clear correlations between input and output information (Komninos et al. 2019). Technological optimisation does not always go hand in hand with social optimisation. Concentrating efforts on technological optimisation has the potential to ignore human aspects and can result in social polarisation when it comes to output decisions. Algorithmic logics should be supported by human agents and human communities through the establishment of networks of humans, communities and machines. This perspective nevertheless raises questions about how to establish effective platforms for public participation.

5. State Land Cadastre and data management in Ukraine.

The Ukrainian State Land Cadastre was created in 2013 as a result of the World Bank Project (State Service of Ukraine for Geodesy, Cartography and Cadastre, 2018). The cadastre is owned by the Ministry of Agrarian Policy and Food but is governed by the Ukrainian State Service for Geodesy, Cartography and Cadastre, the executive authority on topography, geodesy, mapping, land relations, land management, control of land-use and land protection. Article 1 of the Law Of Ukraine 'On the State Land Cadastre' defines this digital source of spatial information as following: 'The State Land Cadastre is the single state geoinformation system of land

information located within the state borders of Ukraine, their designated purpose, and also governs restrictions on their use as well as data on the quantitative and qualitative characteristics of land among owners and users' (State Service of Ukraine for Geodesy, Cartography and Cadastre, 2018).

5.1. State Land Cadastre and Land Reform.

The objects included in the State Land Cadastre define the land within the state borders of Ukraine, land within the boundaries of administrative-territorial units, restrictions on land-use and information about each land plot. This information is structured using 46 indicators such as registration number, the standardised names of geographical objects in Ukrainian and Latin alphabets, the types of geographical objects, the administrative status of settlements, administrative-territorial reference numbers, geographical coordinates (longitude and latitude), historical names, and so on (State Service of Ukraine for Geodesy, Cartography and Cadastre, 2018).

The State Land Cadastre is the largest spatial data set and includes approximately 20 million land parcels which cover 73% of Ukrainian territory. The system has enabled online services to be established, such as the possibility to extract information from the State Land Cadastre, including personal information about land parcel owners, the online registration of land parcels, creation of normative land valuation and digital verification of land users based on personal ID number (State Service of Ukraine for Geodesy, Cartography and Cadastre, 2018). Access to the Cadastre is supervised by anticorruption authorities, local governments, the police, fiscal services, notary officers and land surveyors. The State Land Cadastre plays a significant role in the regulation and implementation of legislation involving land use (Kondratenko et al., 2023).

The State Land Cadastre service is divided into 24 territorial departments which represent each region. Due to the Administration and Land Reform in Ukraine that decentralised governmental power, 1,47 million hectares of agricultural land were transferred from the central government to 648 conglomerated territorial communities. Some Land Reform acts weakened the operability of the State Land Cadastre (Kondratenko et al., 2023) by transferring land ownership. In 2020 a Decree of the President of Ukraine dated October 15, 2020, No. 449/2020 "On Certain Measures to Accelerate Reforms in the Sphere of Land Reform" was issued. The decree accelerated the transfer of state-owned agricultural land plots to municipalities through the State Land Cadastre. The transfer process required changes to ownership status, normative valuation and taxation, the identification of lease rates and the transfer of management responsibilities for territorially defined parts of cadastre to new local governing structures. Further development involved the implementation of the National Spatial Data Infrastructure which sought to improve the disposal of resources control and to manage data more effectively (Kondratenko et al., 2023).

5.2. National Spatial Data Infrastructure.

In 2007 the Ukrainian Cabinet of Ministers adopted the European INSPIRE Directive (Directive 2007/2/EC) which includes guidelines for the creation of National Spatial Data Infrastructure. Despite several trials to develop concepts of NSDI Law, the draft of the law was not produced until 2018. This draft was based on European best practices with some specific features also being derived from post-Soviet land structures. A group of stakeholders was appointed to create the NSDI including the Cabinet of Ministers to approve the methodology, the Ministry of Agrarian Policy and Food to write NSDI policy, the State Service of Ukraine for Geodesy, Cartography and Cadastre to implement the NSDI policy and the State Enterprise under State Geo Cadastre to administrate the NSDI (State Service of Ukraine for Geodesy, Cartography and Cadastre, 2018). The NSDI project standards of data harmonisation are based upon international standards including ISO 19 100 'Geographical Information / Geomatics' and the State Land Cadastre is designated as the principal data holder. In 2020 the Resolution "On procedures for the functioning of the National Spatial Data Infrastructure" was adopted and since 2021 the Law of Ukraine "On the National Spatial Data Infrastructure" has been in force. In 2023 the Central Service of the State Land Cadastre signed the Protocol of Information Interaction between the Information System of the State Land Cadastre and the NSDI Pilot Project. The Protocol is intended to provide objectivity, reliability and completeness of information in State Land Cadastre and regarding the National Spatial Data Infrastructure (Kondratenko et al., 2023).

The National Spatial Data Infrastructure is designed to meet citizens requirements, as well as being used as decision support system for public administration and crisis that is based upon information from economic,

social, defence, scientific, and environmental fields. The greatest challenge for the cadastral structure is the fragmentation of local information about the state and its territories. This requires coherence in data indication methods and registration systems with both following clearly defined legislative procedures. Another challenge involves the creation of an effective and properly secured system for interested organisations to obtain information. One of the most urgent issues involves the development of an efficient information exchange protocol between the State Land Cadastre and the National Spatial Database Infrastructure. This is crucial for the development of territorial communities and the involvement of community members in decision making processes. It follows, that there is a need to provide relevant information and analytical support that is accessible to territorial communities, business representatives, investors and research institutions (Kondratenko et al., 2023).

6. Discussion pertaining to the prospects of increasing public participation in Ukraine.

The ongoing war in Ukraine has resulted in a need for the creation of a range of guidelines and requirements to support public participation. A key factor is data security and control procedures that allow for data accessibility and use specifically with respect to downloading and sharing data as well as launching new data distribution services. Cybersecurity requires restricted use of statistical and spatial data to a limited number of public institutions that can control data flow and access as well as various stages of data processing. Data access is governed through procedures to detect, select, register and legitimise users.

Innovative security in Ukraine goes beyond data security and is a necessity in the establishment of a stable economic platform that will allow the country to participate in the European arena (Vavdiichyk, 2022). Ukraine is an EU membership candidate, and this opportunity requires the country to innovate in various fields so that it may build resilience to internal and external threats, implement sustainable solutions and regulate research and scientific activities. Competing in the international arena is a crucial aspect of strengthening a country's security. To protect both national interests and meet the needs of society, it is also vital to spread knowledge of data policies among citizens.

In the pre-war Ukrainian economy, the consumer approach was a common social behaviour based upon liberal market trends, the dominance of the private sector and the existence of a highly competitive nature of service. There was an emphasis on producing finished products and services independently rather than co-creating them. This approach had its roots in the pre-war conditions of economic instability and the insufficient domestic activities of many of Ukraine's industrial branches. Insufficient financial support for small- and medium-sized businesses as well as minimal guarantees for the protection of intellectual property shifted the focus of civic entrepreneurship from production to commerce (Vavdiichyk, 2022). A product-oriented customer approach increases entitlement and reduces confidence in an individual's agency, thereby providing a basis for reduced social participation. Today, constructive participation is crucial to develop and strengthen existing urban structures and there is a need to find appropriate tools to encourage it.

The spatial planning process can be divided into two stages: the first stage involves public administration, while the second involves public participation (Janczar, 2021). Elements of public participation include the submission of proposals to be assessed in the initial stages of spatial plan development, the assessment of existing public perceptions of planning conditions, discussions of solutions in the draft phase of spatial plans that are under public scrutiny, the formulating and submitting of public comments on the given plan and involving citizens in the work of the individual municipal council.

Early engagement of citizens in spatial planning processes makes them more effective as participants. Participation is encouraged in the final amendment to the Resolution of Ukrainian Cabinet of Ministers No. 996 dated 2010 with the amendment dated 2025 that was entitled "On ensuring public participation in the formulation and implementation of state policy". It remains important to develop a clear and comprehensive approach to present proposed planning solutions. There is also a need to ensure a transparent decision-making process to enhance trust in the administrative authorities as well as confidence in citizen agency.

Geoparticipation is also an important way to regulate adequacy and correctness when using automated systems to interpret spatial data (Komninos, 2019). Providing up-to-date data from individuals (human intelligence) as well as collective intelligence is necessary to accurately depict societal expectations, deficiencies, ideas and sentiments.

A key factor in the development of platforms for such debates is shifting the nature of development plans from products to processes (Janczar, 2019). The database in such an approach is the sum of the individual outputs of the geoparticipatory processes. There are also opportunities to integrate such a database with public participation tools such as e-panels, e-petitions and e-surveys that can be developed in the NSDI. However, the shift to a process focus requires the harmonisation and standardisation of data to ensure interoperability, the standardisation of the scope of spatial data used by municipalities, consistent defining of data sets and adopting unambiguous data identifiers.

7. Conclusion.

The reconstruction of Ukraine will require the introduction of new land use plans. For this to be achieved effectively, there will be a need to implement innovative technologies such as mobile applications, IoT devices, social media monitoring and Geographic Information Systems while also developing processes to gather, store and process spatial data in data bases. Such data also needs a capability of being translated so that it can be used by a wide range of end users in both public and private sectors as well as members of civil society. The data bases need to be designed for different purposes, i.e. creation of mobile network, coordination of different modes of public transport, the detection and registration of weather conditions, organising of housing cooperatives as well as in data production. The range of end users may include car drivers and cyclists, public transport users, industry actors, governmental offices, health centres, municipal infrastructure network operators and housing stock managers. Spatial Data Infrastructure will need to be standardised to ensure the interoperability of the collected data. The Ukrainian State Service for Geodesy, Cartography and Cadastre will be responsible for the standardisation of metadata to manage statistical information at different territorial levels. Through such innovations, the nature of spatial planning will change from analogue- to process-based, while the data content will need to be tailored to specific needs, resulting in significant increases in the usability and availability of data.

Data processing is another important factor in spatial planning. In the era of intensive automation and the development of communication techniques, data processing is increasingly conducted through machines and algorithms. However, these mechanisms do not always produce results that are aligned with the expectations and needs of society. It follows, that the implementation of innovative technologies needs to be accompanied by effective techniques and mechanisms which will encourage public participation. The draft National Spatial Data Infrastructure provides an opportunity to develop broad and effective public participation approaches when developing new spatial plans. Citizen decision-making is an effective way to ensure that urban spaces are designed and built to meet the needs of end users.

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