

Solomiia Tkach<sup>1</sup>, Rudolf Giffinger<sup>2</sup>

<sup>1</sup> Department of Spatial Development

Dolishniy Institute of Regional Research of NAS of Ukraine

[tkach.solo@gmail.com](mailto:tkach.solo@gmail.com),  <https://orcid.org/0000-0002-8295-7820>

<sup>2</sup> Technische Universität, Wien

[rudolf.giffinger@tuwien.ac.at](mailto:rudolf.giffinger@tuwien.ac.at),  <https://orcid.org/0000-0002-2414-9163>

## A smart indicator concept for post-war resilient development of Ukrainian cities

**Abstract:** In recent decades, cities in Ukraine have undergone market-driven transformations, each following unique paths of development influenced by geographic, geopolitical, and regional factors. National and local policies have shaped these trajectories, with a growing emphasis on Smart City (SC) strategies. However, the onset of Russia's war against Ukraine in February 2022 disrupted the development of such strategies, introducing new challenges and uncertainties for Ukraine's cities. In the post war period they will face multiple challenges, including damaged infrastructure, decreased quality of life, and hindered economic development.

Facing these pre-conditions for urban development, this paper addresses the necessity of a place-based SC indicator concept, which follows the intrinsic logic of the disaster cycle for resilient urban development and integrative policies. Hence, the theoretical and methodological basis of the study is made up of the fundamental provisions of urbanism supported and triggered by the concept of smart and resilient cities. Based on the disaster cycle the meaning of a place-based understanding of SC development is introduced which strongly impacts the type and quality of indicators. The empirical part briefly introduces into the differentiated urban development of Ukraine cities and experiences with SC activities. A SC indicator concept, unlike the existing conceptions, is adapted to the Ukrainian statistical base, supplemented with indicators that take into account the specifics of post-war urban development at the stages of recovery, adaptation and transformation.

**Key words:** resilient development, smart city, post-war recovery, adaptation, transformation

### Introduction

In today's conditions, cities have to cope with different challenges in front of economic crises, social polarisation and degradation of environmental and health conditions. They are larger in scale and number (UN HABITAT 2015). In order to meet such challenges, since some decades cities are aiming at sustainable de-

velopment and along with technological progress the idea of Smart City was created promising digital tools in order to make urban development more efficient (Batty, 2012). More recently, the consequences of climate change and the need to reduce CO<sub>2</sub> emissions, which requires the adoption of important strategic decisions of urban development, are becoming more and more urgent and intangible (IPCC 2021). Economic re-structuring towards the service sector and the ‘freezing’ of the development of certain domains of the economy (i.e., tourism, culture, services) caused by the COVID-19 pandemic in recent years have contributed to changing the trajectory of urban development. In this context, Smart City concepts are becoming part of urban policies in the hope to make place- and evidence-based interventions more effective.

During past years, several Ukrainian cities also started to aspire smart development based on the implementation of new technologies (Tkach 2021). In particular, the 2021–2027 State Regional Development Strategy was adopted on the central level. Among its objectives, it provided for the “promotion of innovative technologies introduction in the systems of municipal development management based on the smart city concept (smart city)” (Government portal 2020). Since February 2022 these trends along with increasing socio-economic problems of the cities are confronted with the extremely difficult challenge of today – the Russia’s war against Ukraine. The different consequences of this war are not localized only within the territory of Ukraine but also in other countries, in particular in Europe. At the same time, Ukrainian cities are at the epicenter of the war. Russia’s attack with all its problematic social, ethnic and economic impacts is combined with and enforced through the destruction of its infrastructures and the urban system. Reconstruction of Ukrainian cities will take years or even decades; Concepts of Smart City will regain importance but one has to consider the dramatically worsened pre-conditions in the reconstructive process.

After the open large-scale Russian invasion of Ukraine on 24 February 2022, the urban network of the country has faced significant changes. The most heavily damaged housing stock was found in the cities of Mariupol, Kharkiv, Chernihiv, Sievierodonetsk, Rubizhne, Bakhmut, Maryinka, Lysychansk, Popasna, Izyum, and Volnovakha (see Fig. 1). For instance, preliminary estimates indicate that 90% of the housing stock in Sievierodonetsk was damaged, while cities like Bakhmut and Maryinka have almost no undamaged buildings (KSE 2024). Additionally, the number of damaged residential buildings (both multi-storey and individual houses) is increasing due to ongoing active hostilities in the Kharkiv, Luhansk, Donetsk, Zaporizhzhia, and Kherson regions, the temporary occupation of part of Ukraine’s territory, and regular rocket attacks throughout the rest of the country. According to Kyiv School of Economics Institute calculations, as of January 2024, the total amount of direct damage to infrastructure reaches \$157 billion. The largest part of the total amount of damage belongs to the housing fund and infrastructure – 60.9% (\$95.7 billion). In Ukraine over 50% of the housing stock in many cities and towns was damaged or destroyed due to the hostilities by the Russian Federation. This situation necessitates not only the repair of individual buildings but also the comprehensive restoration of cities, the development of

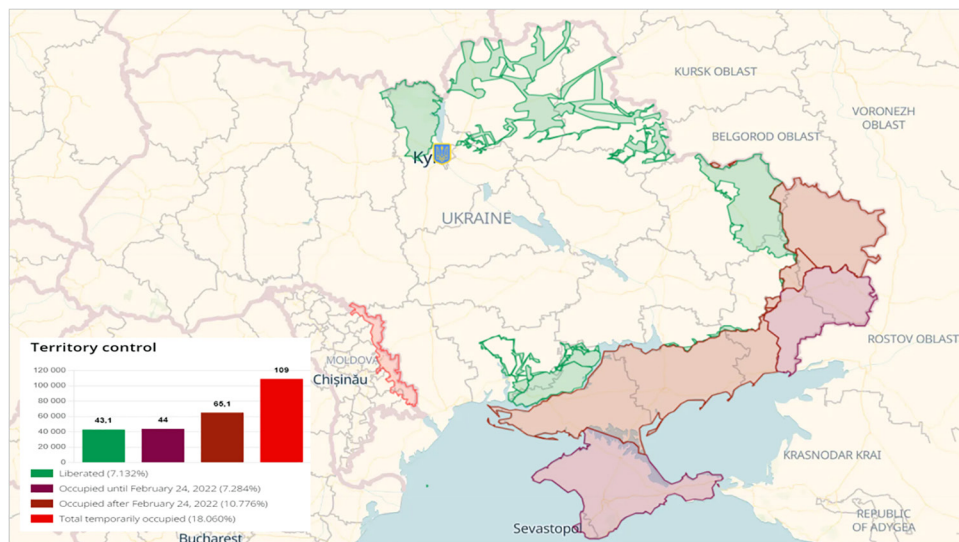


Fig. 1. Map of the war in Ukraine (as of 14 May 2024)  
Source: Deep State.

new urban planning documentation, and other measures. The war goes on and the scale of destruction can be evaluated only after it is over.

Undoubtedly, war can be equated to a man-made disaster – not similar but increasingly combined with impacts of Climate Change – asking for strategic management and policies coping with a wide range of different challenges in general, and in particular for Ukrainian cities in the short, medium and long run. In front of the strong impacts worsening the pre-conditions for sustainable development, Ukrainian cities will need evidence-based step-by-step strategies in next future in order to rebuild damaged or strongly impacted cities and to meet further challenges of a more resilient development. Policies aiming at Smart City development therefore need a clear processual understanding of resilient development according to a disaster cycle understanding similar to definitions in the ENSURE-project (Galderisi 2010).

Acknowledging this processual and path specific feature of resilient development, an adequate smart city understanding is necessary. Any smart city concept aiming at the implementation of new technologies and supporting efficient urban development, should be adapted to the specific requirements and needs on the urban respectively on the local level of a distinct city. (Batty et al. 2012). Such evidence-based smart policies designed for urban development in an effective way, need a comprehensive and precise description of recent problems and trends through corresponding indicators (Giffinger et al. 2007, 2019). Accordingly, the objective of this contribution is to provide a concept of indicators supporting smart urban development and to discuss some examples of different types of potential indicators according to its purpose strengthening its resilient path.

However, a comprehensive list of indicators catching most urgent problems of urban development will be necessary but seems not possible until the end of the Russian aggression. Hence, our concept with examples will show in a step-by-step perspective how indicators may trigger resilient and smart development when territorial sovereignty is regained by corresponding institutions.

## Ukrainian cities before Russia’s full-scale invasion

### The features of municipal development in Ukraine in the last decades

There are 461 cities on the territory of Ukraine. In 2021, the share of the urban population of the total population of the country was 69.4% against 67.5% in 1991 (the year the country gained independence and separated from the Soviet Union) (State Statistics Service of Ukraine 2022). As noted by the International Bank for Reconstruction and Development/World Bank (2015), all Ukrainian cities can be divided into 3 types depending on economic, spatial and demographic patterns of development. The first type includes cities that have trends of economic activity growth and territorial expansion (22% of the total number of cities in Ukraine belonged to them). These are mostly cities of the Western and Central regions. Cities of the second type are characterized by a drop in economic activity and a decrease in the urban footprint. Such cities are mostly located in the Eastern and Southern regions and partly in the Central region.

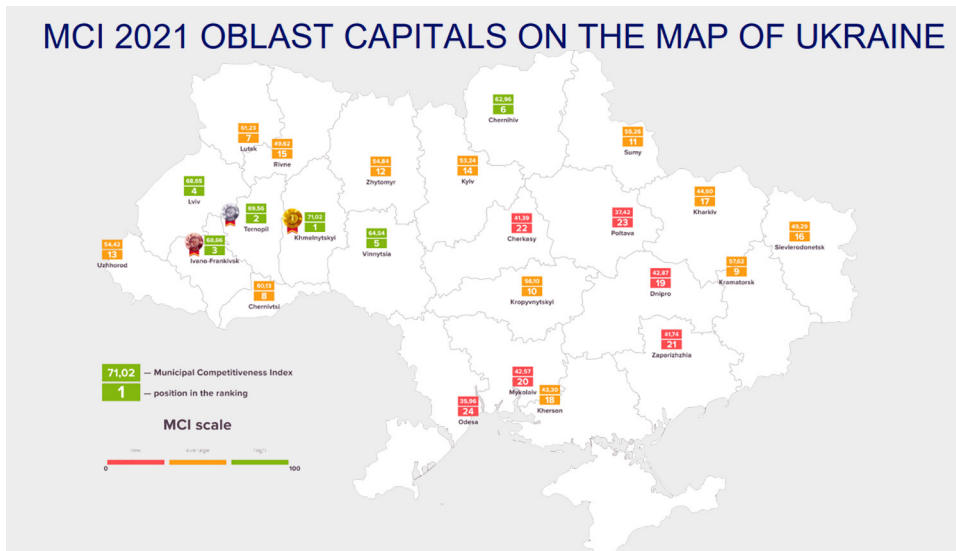


Fig. 2. The Ukrainian cities competitiveness rankings  
Source: Institute of Economic Research and Policy Consulting (2021).

They included 68% of the total number of cities in Ukraine. Cities of the third type are those where the footprint of the city is increasing despite a drop in economic activity. According to the Ukrainian cities competitiveness rankings (MCI) (Institute of Economic Research and Policy Consulting 2021) the highest competitiveness level in 2021 was mostly demonstrated by the cities of the Western Region (Ternopil, Ivano-Frankivsk, Lviv, Mukachevo), as well as some cities of the Central Regions of Ukraine (Khmelnyskyi, Chernihiv, Vinnytsya, Oleksandriya) and Eastern (Mariupol, Bakhmut, Melitopol) (see Fig. 2). The cities have peculiar demographic problems and face the curtailment of industrial output. In fact, due to many stagnating and shrinking cities, unequal distribution, and lack of growth poles, the system of cities in Ukraine is out of balance and at the stage of transformation.

At the same time, Ukraine has chosen a European integration course of development, including in urban governance. In the 2021–2027 State Regional Development Strategy to achieve the goal “Formation of a cohesive state in social, humanitarian, economic, ecological, security and spatial dimensions” is provided to “strengthen the integrating role of agglomerations and large cities” and “strengthen the use of the development potential of medium and small cities” (Government portal 2020). In particular, it is about the renovation of urban areas, the adaptation of the urban network to climate change, the introduction of innovative technologies into the management system of urban development based on the concept of a smart city (Smart City), improvement of the legislative and other regulatory framework in the field of spatial development planning. The rapid development of digitalization in Ukraine has created favorable conditions for the introduction of smart technologies in cities. The Digital Transformation Ministry and Committee of Ukraine has been actively working on the implementation and scaling of the smart city initiatives and the creation of the necessary legal and political preconditions. The Ministry of Communities and Territories Development of Ukraine (2020) has offered the Digital Transformation Strategy with its three major benchmarks: 1) e-infrastructure development and digitalization of the Ministry’s processes; 2) national digital transformation projects; 3) creation of regions’ digital development program. In addition, thanks to decentralization processes (began in 2014 and is still ongoing), city governments have acquired greater political influence and policy-making capacity (Markevych, Sidenko 2021 Tkach 2021 (2)).

In Ukraine, the urban governance system needs to be modernized to ensure resilient and inclusive development of cities. The war became an additional incentive for this. The post-war period is a unique opportunity to carry out this modernization at a faster pace. The Government of Ukraine, both in the Reconstruction Plan and in “the Programs for the Comprehensive Reconstruction of the Region”, emphasizes the need to implement such modern approaches and practices of urban development as “people-centeredness and social justice, rational spatial planning, ensuring the balance of resettlement and placement of workplaces, urban mobility, inclusiveness, energy efficiency, environmental friendliness, preservation of cultural diversity and national memory” (Government portal 2022, Recovery of



Ukraine 2022). Accordingly, there is a need to radically revise the existing system of urban governance in Ukraine, based on the individual characteristics of cities, post-war requirements and European experience.

### **The experience of the smart city concept implementation in Ukraine**

Ukraine has successful examples of municipal transformations based on the smart city concept. The following are the main domains and directions of digital transformation of Ukrainian cities: e-democracy and municipal management, education, health, ecology, urban mobility, and public security (Markevych, Sidenko 2021). Some smart infrastructure elements are already being introduced in Vinnytsya, Dnipro, Drohobych, Zhytomyr, Kyiv, Lviv, Ivano-Frankivsk, Mariupol, Kharkiv, and other cities. Here are some examples.

The capital of Ukraine Kyiv was ranked 82nd by the Smart City Index 2021 (International Institute for Management Development 2021). In a year, the city has improved its ranking by 16 points and overtook Tokyo (84th position), Philadelphia (85th position), Istanbul (94th), Budapest (97th), and Rome (112th). The development of smart infrastructure in Kyiv started in 2015. The Kyiv Smart City 2020 Concept is being implemented in the city. Transformation in Kyiv smart city involves changes at three key levels (Official portal of Kyiv 2017): 1) Technology – City as system of systems : data collection, storage and analysis, open data, integrated architecture and operational city platform; 2) Governance – integration and optimization of city governance; 3) Society – participation platform, social media as a cooperation tool, innovation cluster, incubator and network, hackathons and citizens as smart end users. During this time, Kyiv implemented many smart technologies that improved the lives of the city’s residents. At the same time, issues of corruption, road congestion, air pollution, affordable housing and basic amenities remain problematic (International Institute for Management Development 2021).

Among other Ukrainian cities, it is worth mentioning Drohobych as the first city in the country to comprehensively introduce the smart city system. Drohobych approved the 2018–2023 Drohobych – Smart City Project Development Program. Overall, 300 online services for society are planned to be introduced. Now there are 37 online services (Official portal of Drohobych rada 2023). Million-plus city Kharkiv implemented the 2018–2020 Program for E-Governance Development in the Activity of Kharkiv City Council concerning the digital development following the public policy of information society development in Ukraine and the introduction of new e-services for citizens (Official portal of Kharkiv City Council 2023).

The Smart City Awards 2020 in Ukraine recognized Kharkiv as the best digital city. Kharkiv has become the first Ukrainian city to introduce Mobile ID technology or “mobile passport” (online identification of an individual with a mobile phone). Moreover, the city organized activities launching the procedure of approving the 2030 Kharkiv Sustainable Energy Development and Climate Action Plan with the European Commission within the European initiative Covenant of

Mayors (Official portal of Kharkiv City Council 2023). Lviv is on the way to its transformation into the smart city, which is confirmed by the 2021–2025 Lviv Municipal Community Digital Transformation Program. According to Smart City Awards 2020 (Association of Ukrainian Cities 2020), Lviv is the leader in the following categories: the best mobile city (transportation, public transport, carsharing, electricity and bicycle infrastructure development), the best eco-friendly city (introduction of progressive eco-technologies, smart waste management), and the best architectural city (successful implementation of smart systems in architecture/urban planning). The city also systemically introduces various e-services like the creation of e-budget, public procurement system, e-petitions, personal online offices of citizens, and transferring administrative services online, etc.

In 2019, Mariupol was awarded the Best Transport Model of the City and City of Startups (Association of Ukrainian Cities 2019). In particular, the city launched the Pikas computerized control system, mobile app for the citizens, electronic travel documents, and QR code payment for travel, and installed electronic display panels at stops. The Safe City program is being implemented to install smart cameras, the data from which are processed by the Single Analytical Service Center (Official portal of the Mariupol rada 2020).

Odesa differs from the other Ukrainian cities at the stage of smart technology introduction by its ambitious plans to become the first city in Ukraine and among the first in the world to create its digital copy. The ‘doppelgänger’ platform consolidates digital information about the city from various sources: geoanalytics, transport model, housing and utilities system management, human migration model (residents and tourists), architectural planning (recording of existing buildings, evaluation of impact the emergence of new buildings has on all municipal systems), recording and planning of social infrastructure facilities, road traffic, water and air condition monitoring, etc. (Vodafone.ua 2021). The city’s digital copy can acquire layers with the ongoing digitalization of information about all municipal systems.

## **Indicator concept for smart and resilient urban development**

### **Requirements on SC concepts in a resilience perspective**

After any kind of impact and incidences through war or Climate Change, cities have to evaluate the extent and quality of impacts worsening the development conditions of each city. They have to consider these following years of reconstruction as a path dependent way of urban development. This implies acknowledging the different problems of cities due to their deconstructive impacts and their specific capacities to develop under the new conditions. This asks for a resilience-based understanding of urban development. What does that mean? As United Nations Office for Disaster Risk Reduction, UNISDR Terminology and

Disaster Risk Reduction (2009, p. 24) points out, resilience is the “ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of hazards promptly and efficiently by preserving and restoring essential basic structures”. A more comprehensive definition of Meerow et al. (2016) emphasizes that “... resilience refers to the ability of an urban [and regional] system and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity”. Also, the disaster cycle (Galderisi 2010) demonstrates that resilient development is a cumulative process: the extent and quality of any impact at any stage is dependent on the resistance and robustness of urban infrastructures; response is dependent on the available resources to adapt and recover from damages even at a higher level than before; and last but not least, the quality and extent of recovering measures are influencing the capacities and initiatives in order to be prepared in front of new challenges.

This analytical understanding of resilient development is based on Camagni’s (2009) discussion of territorial capital:

It is understood as the accumulation of privately fixed capital (buildings in the economic and housing, enterprises, etc.), human capital (well-educated citizens, entrepreneurial know how, etc.), social overhead capital (functioning and quality of physical or digital infrastructures, i.e., transport, energy, water, communication), natural and cultural capital as well as social capital (institutions representing common values, reputations and social artefacts). In addition to these mentioned components of capital Camagni (2009) regards also corresponding forms of cooperation and networking as specific components of relational capital. Hence, on the background of a wide range of climate or war dependent incidences the reconstructive path needs a processual understanding with specific pre-conditions across specific periods and corresponding resilience understanding in the social-technical and in particular in the social-ecological context (Davoudi 2012).

In front of this wide range of more or less unknown extent and quality of damages in next future, new technologies will be needed in order to foster urban development in an effective and sustainable way. Besides, an exclusively static and technology driven smart city does not meet future requirements of smart development: cities always have been places of technological and social innovations based on their potentials regarding self-organization of urban development (Fagerberg 2005, Simmie 2001). Correspondingly, within the Smart City discussion cities are regarded as places of knowledge production and innovations enabled through the use of adequate technologies and through a wise management approach (Caragliu et al. 2011, Nam et al. 2011, Batty et al. 2012, Giffinger 2019). However, without going into further details of differences in the Smart City understanding (Kummitha et al. 2017), there is a crucial distinction when it comes to the elaboration of an adequate Smart City concept. “There is thus a major distinction between digital technologies being used for the short-term routine management of cities and those for longer-term strategic planning, and



this difference is reflected in much of the data, information and knowledge that pertains to the functions that smart city technologies are able to inform” (Batty et al. 2017, p. 454).

This analytical understanding of smart urban development shows specific characteristics.

New technology should support sustainable development; otherwise, it may produce lock-in effects for the future. Investment and implementation of new technologies must be adequate in order to meet most urgent challenges and to enable its meaningful use triggering innovations.

A wise management needs evidence-based decision making in order to foster sustainable development in the short, medium and long run. This implies to establish indicator systems, which distinguish between information for strategic decision finding in the medium and long run and fast produced information for real-time decision making.

To describe the requirements of urban policies supporting resilient and smart development in a nutshell: from a strategic planning point of view of any city, a clear processual understanding is necessary in the run of the disaster cycle whereby the meaning and use of new digital technologies should be discussed and selected critically regarding the cumulation and quality of the different components of territorial capital. Correspondingly, adequate indicators providing purposive information are needed in order to identify strengths and weaknesses, most urgent needs but also the acceptance and effectiveness of new technologies supporting sustainable development. Purposive indicators should be framed through a concept, which is powerful enough to describe all relevant dimensions, and should use specific types of indicators according to the basic understanding of smart and resilient development.

## **An indicator concept with specific types of indicators**

Since many years, indicator systems are primarily aiming at the description of sustainable development of cities (Gerlein 2004), but also a wide range of indicator systems exists with regard to concepts of smartness or resilience. According to their understandings, they follow specific methodologies regarding (1) the considered domains and aggregation levels of urban development and (2) the types of indicators (for instance, Figueiredo et al. 2018, Albert et al. 2021).

Due to the above discussion in section 2.1 the following frame defining a matrix of potential domains of urban development, will be elaborated:

Referring to the understanding of smart development, the European Smart City approach, issued first in 2007, is considered as sufficiently comprehensive in order to describe most relevant domains. Originally, this approach had the objective to elaborate specific ranks and profiles comparing European cities. Aggregation algorithm adding up different dimensions to components and domains, were defined as a base for the visualisation of distinct urban performances. This benchmarking approach assessing urban performances in six different domains (economy, mobility, living, environment, people and governance) by means of

quantitative data, provides an easy-to-use assessment tool in a transparent and interactive way (Giffinger et al. 2009; or Giffinger, Kramar 2022). Here we use these differentiated domains as rows of the matrix.

Due to the understanding of resilient development, these domains need a differentiated description according to the disaster cycle structure. This means, resilient development facing corresponding incidences, needs to distinguish the periods of ‘response’ characterized by the quality of destructive impacts and the robustness of infrastructure systems, the period of ‘recovery’ characterized by existing resources and adaptive capacities, and the period of ‘preparedness’ characterized by innovative and learning capacities for transformation (Galderisi 2017). We use these three periods of resilient development as three columns of the matrix. Hence, smart and resilient urban development distinguishes eighteen domains of description (Table 1).

Table 1. SMART-resilient matrix of indicator groups

Stage of cycle SC Domains	Response and robustness	Recovery and adaptation	Preparedness and transformation
smart people	<i>outcome related:</i> technical infrastructure systems: capacities; extent;	<i>outcome related:</i> technical infrastructure systems: performances, costs;	<i>outcome related:</i> infrastructure systems: quality, costs and acceptance of services, energy and mobility transition;
smart economy	capital stocks: human, economic, cultural, natural, relational capacities;	different capital stocks: quality features, living conditions, economic levels;	innovation system: resources, funding, learning initiatives, circle economy, ....
smart governance	...	...	...
smart environment	<i>output related:</i> extent of physical and human losses;	<i>output related:</i> improving security and planning; efforts;	<i>output related:</i> transdisciplinary collaborative activities, nature based and inclusive projects;
smart mobility	quality of emergency systems; re-gain of areas with mines	strengthening social, economic and environmental capital;	...
smart living	...	re-organization of research & innovation systems;	...

Source: own elaboration.

### Stage dependent types of indicators

Which types of indicators should be used in respective domains? Answering this question means to select specific types from four different main types distinguished in a comparative OECD-study done by Figueiredo et al. (2018):

- input indicators measuring resources spent on policies;
- output indicators measuring what policies produce by using certain inputs;
- outcome or result indicators measuring what general results are achieved;
- process indicators measuring if and how actions have taken place.

In order to guarantee a well-structured empirical evidence we recommend using two types of indicators: (1) outcome indicators describing the general extent, quality of endowment provided by distinct infrastructure systems or its performance. (2) output indicators describing the activities and results of distinct policies/projects in the respective stage within a certain stage of the cycle.

However, characteristics of endowment or performance on the urban level can be described in two ways: first, through objective measuring the quality or performance itself or, second, through representative evaluation of such infrastructure services by respective customers and actors in such domain.

The following tables provide an overview of examples of indicators differentiated by the Smart City domains along the three different stages and for the two types of indicators. Anyhow, these tables will only show the frame how to conceptualize/operationalize a comprehensive indicator set and give selected examples but no comprehensive list of indicator dimensions. This must be done in collaboration of experts from corresponding scientific disciplines (planners, geographers, etc.) with experts having practical expertise in order to identify its most urgent needs supporting resilient development.

### Stage of response and robustness

Independently which unexpected impact may occur, questions, which should be answered, are “Which damages with which consequences in the social, economic and environmental context are dominant, needing intervention?” As this is the first period, corresponding urgency assistance must be organized based on actual information describing the functioning resp. the quality of brake-downs. The better formerly implemented information systems are delivering corresponding information, the better infrastructures are resisting against incidences and black out, the easier management concepts of emergency assistance could be applied.

Table 2. SMART-resilient matrix of indicator for stage of response and robustness

Domains of Smart City	Dimensions	
	type	examples
people	outcome	Demographic structures, qualification
	output	Displaced or disabled residents
economy	outcome	Basic economic structure, active enterprises
	output	Closed or restricted enterprises, missing labour forces
governance	outcome	Functioning of administration systems and information
	output	Missing social, educational and health services
environment	outcome	Air pollution, non-accessible areas
	output	Loss of green infrastructure
mobility	outcome	Operation of transport networks
	output	Interrupted public transport systems
living	outcome	Provision of water, energy and housing
	output	Restricted energy and water provision & destroyed buildings

Source: own elaboration.

Corresponding activities may respond to such problems as effective as possible on given information. First of all, this information regarding the outcome of an incidence is necessary for effective emergency assistance.

Hence, indicators should describe endowment and the quality of the basic problems in corresponding infrastructure systems. In this context, real-time digitalized information systems indicating “What kind of incidence?”, “Where?” and “Which extent?” become more important than specific indicators for strategy building which finally will become important in next stages. Already at this stage the digitization of infrastructure systems and in general, information and communications systems of a city become crucial in order resist and to respond as effective as possible. Information and communication infrastructure therefore become crucial in their robustness. This type of information and corresponding indicators could be part of a modern and comprehensive technical Smart City implementation providing real-time information, fast data retrieval and algorithm-based decision finding (Table 2). This might be the output of the transformation stage.

### Stage of recovery and adaptation

In this stage after first response the most important questions are “How can a city adapt to new conditions?” and “Which resources are available to recover and adapt against incidences?” Based on the given information the new challenge at this stage is to mobilize resources and capacities in order to bring forward resilient development. As experiences of the impacts showed that urban structures have not been able to resist, additional efforts in urban management are necessary in order to improve resilient development. More flexible and redundant infrastructure systems should/will provide urban services and performances as good as possible.

Table 3. SMART-resilient matrix of indicator for stage of recovery and adaptation

Domains of Smart City	Dimensions	
	type	examples
people	outcome	Structure of education/qualification,
	output	Improving educational facilities, awareness activities
economy	outcome	GDP, Employment in knowledge intensive sectors
	output	R&D expenditure, new business support, FDI
governance	outcome	Quality of transparency, corruption, public services
	output	Participation facilities, inclusive projects
environment	outcome	Summer smog, heat, respiratory diseases, quality green IS
	output	Decreasing air pollution, redevelopment non-accessible areas
mobility	outcome	Quality public transport network, costs, interregional accessibility
	output	Quality improvement public transport, road safety
living	outcome	Mortality, life expectance, housing conditions
	output	Quality improvement housing, culture, social safety

Source: own elaboration.

Indicators should predominantly describe existing and functioning endowment and in particular their performance as outcome of general development. Dimensions of indicators should identify qualities and performance within the domains of smart people, economy, governance, environment, mobility and living (incl. housing stock). Besides, output indicators should describe for each domain “Which measures and projects contribute to better performances at this stage?” Outcome indicators should identify and evaluate goal-orientated activities facing new conditions and high efficiency in strategic projects supporting adaptation. Within this stage, outcome and output indicators can be measured based on corresponding statistics but also by the evaluation of such dimensions based on perception of corresponding actors and residents (Table 3).

### Stage of Preparedness and Transformation

Based on adequate adaptive development at a next stage the most important questions are “How can a city meet new and often unknown challenges through systemic improvements?” and “Which processes are necessary in order to transform infrastructure systems, society and economic structures through improved governance?” The new challenges at this stage are obviously the mobilization of innovation and learning processes in order to bring forward resilient development. Based on the experiences of recovery, in this last stage additional efforts of strategic planning should enhance learning capacities, strengthen innovation systems and knowledge production in a diverse and inclusive milieu. Accordingly, more flexible and creative processes through bottom-up initiatives are necessary enabled by local platforms and city labs combining accumulated collective knowledge with creativity and expertise of local actors strengthening their cohesive development through networks on the neighborhood and urban level.

Table 4. SMART-resilient matrix of indicator for stage of preparedness and transformation

Domains of Smart City	dimensions	
	type	examples
people	outcome	Use of internet, diversity, open mindedness
	output	Improving life-long-learning and participation
economy	outcome	Creative young businesses, circle economy, innovative projects
	output	Research networks, patents, knowledge intensive jobs
governance	outcome	Funding of research and technical and social innovations
	output	Urban living labs, community building, transparency
environment	outcome	Quality of energy transition (renewable sources), green infrastructure
	output	Quality of nature-based solutions, initiatives on awareness building
mobility	outcome	Quality of mobility transition (efficiency, active and e-mob.)
	output	Initiatives on awareness building, smart concept implementation
living	outcome	Socioeconomic segregation & disparities in housing conditions
	output	Risk assessments, quality of affordable housing and participation

Source: own elaboration.



Hence, outcome indicators should predominantly describe existing digital endowment and usability of internet in different domains, the quality of governance efforts enabling inclusive platforms and cooperation, which will strengthen research, learning and innovation systems. Output indicators on policies strengthening the transformation, will identify the qualitative improvement of learning systems as well as of the financial, technical and organizational support of cooperative initiatives and community building through corresponding platforms (Table 4). In particular, such outcome indicators will describe their existence and quality level (acceptance by actors) in order to identify strengths and weaknesses of a city's preparedness.

## **SC indicator requirements for resilient urban development of Ukrainian cities**

Correspondingly, strategic planning is challenged to develop policy-related indicators providing information on urban development in terms of use and acceptance by the stakeholders concerned (e.g. participation in elections and political bodies, satisfaction with public supplies, actual use of facilities). In order to provide relevant decision-making tools for the individual positioning of cities, all information used must be made comparable to other cities. Only then, can the data shed a light on urban assets and deficits and therefore allow specific profiling and benchmarking of cities. Furthermore, a place-based approach should be applied through the integration of local data, which are transformed into policy-related indicators. In order to strengthen the goal of sustainable urban development, the data should also cover qualitative information, which considers the interests, conflicts and preferences of city actors. In that context Giffinger (2015, p. 14) underlines that “[...] a place based Smart City initiative has to enable urban innovations as a transition process. [...] by the interplay of technical innovations and adaptive governance efforts enabling smart communities in a corresponding social learning process”. This triggers a need for a place-based approach, which is able to meet the dual challenge of urban policy (Giffinger 2015): a place-based approach has to describe its position and profile based on its characteristics and, it has to stimulate the public discussion of urban policies. This claim follows the insight that strategic planning has to cope with complex developments in different urban key fields in an integrative manner. Base on this, the challenge of both improving the competitive position of a city and strengthening the integrative urban development requires a place-based approach and an adequate understanding of urban policies, which is able to make specific characteristics of different urban societies, governance systems and economic structures comparable to each other. For that purpose, the quantitative evaluation of individual perceptions and subjective assessments of urban features from surveys (as provided by Eurobarometer) can be a feasible way to achieve a comprehensive comparability of differently structured cities.

In this context, the initiative of the Government of Ukraine regarding the development of the Procedure for the development, public discussion, and approval of programs for the comprehensive restoration of the region and the territory of the territorial community (is approved 14<sup>th</sup> October 2022) is relevant and necessary (Government portal 2022). But as outcome of this national initiative a national document should empower cities in their activities. Hence, this national document should (i) define general national priorities regarding smart and resilient development, (ii) ask for a report (monitoring) of most actual problems and needs based on the above mentioned indicators, and (iii) ask for local initiatives and proposal of local projects, and finally (iv) offer conditions of financial support for local activities and investments.

At the stage of post-war reconstruction, the primary national task is to bring back people who left because of the war and to ensure proper conditions for internally displaced persons. After all, without adequate human capital, the restoration of cities is impossible. Between February 24, 2022, and February 15, 2024, nearly 6.5 million refugees from Ukraine were recorded worldwide. The majority of these refugees (6 million or 93%) were recorded in Europe. More than 5.5 million refugees from Ukraine applied for asylum, temporary protection, or similar national protection schemes in Europe as of February 15, 2023. The three main countries where people registered for temporary protection or similar national protection schemes were Poland (1.6 million), Germany (1.1 million), and Czech Republic (590,000) (UNHCR, 2024.). As of December 2023, approximately 3.7 million people were internally displaced within Ukraine. Of these, 80% had been displaced for over a year, and 39% had been displaced more than once (IOM 2023). This significantly affected the change in the socio-economic status of cities (see Fig. 3). In some cities of Ukraine, the population has decreased sharply, while in others there has been an increase in the population, which in some places is close to 25% (State Statistics Service of Ukraine 2023). This is despite the fact that before the war in most cities of Ukraine there was a tendency to decrease in population (Turok, Mykhnenko 2008).

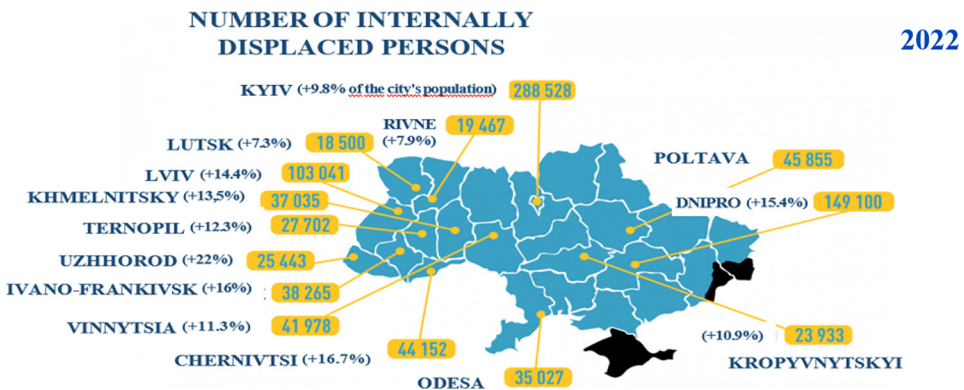


Fig. 3. Growth of the population of Ukrainian cities due to internally displaced persons  
Source: own elaboration.

In accordance with this, restore safe conditions for living, provide housing for war victims, create conditions for the activation of business and provide people with work, attract investors, establish international cooperation with other cities, etc. This should include monitoring and assessing war damage, developing strategies and reconstruction plans, ensuring safe and accessible infrastructure and services, coordinating and supporting the actions of stakeholders in urban reconstruction, establishing business support centers, etc. In addition, special attention should be paid to ensuring social stability in post-war conditions. To create platforms for providing psychological and other types of assistance to war victims, to encourage and facilitate the support of the actions of stakeholders in the reconstruction of cities.

During the adaptation stage, it is crucial to undertake a comprehensive review of the existing city planning system and develop urban development strategies that incorporate military and environmental risks, as well as military protection. It is also important to revise the requirements for urban planning documentation to include the possibility of creating special shelters in new buildings in the event of war, ecological disasters, or other emergencies, and to improve the existing shelter systems. Additionally, early warning systems for potential risks should be improved, and a system of response measures should be developed. Critical infrastructure must also be better protected, and the economic potential of the city should be increased. Another important aspect of the adaptation stage is to promote an ecological culture among the population, and to provide training on how to behave in critical conditions, including war or environmental disasters.

It should be noted that a lot of Ukrainian cities either do not have master plans at all, or their data is outdated. Namely, over half of the Ukrainian cities have master plans, and only 6 of 27 regions approved them after 2011. Moreover, the regions with the largest number of cities (Lviv and Donetsk oblasts) had relatively low rates of availability of master plans more recent than 10 years old (Tkach 2021 (2), p. 402). The current urban planning system in Ukraine fails to adequately support the implementation of strategies that would mirror the realities of a declining population and economic recession. The existing city plans are harmonized with the national growth policy, so they stipulate the increase of the housing stock and the expansion of economic activity in all cities.

In addition, not all Ukrainian cities have strategies yet. Accordingly, on the basis of our proposed approach to evaluating the development of cities, there is an opportunity to update and develop strategic documents that would meet the realities of the time and the challenges of the future.

At the stage of transformation, it is important to strengthen the stability of the socio-economic potential, innovative power of Ukrainian cities, shifting the focus to expanding cooperation and training. As it well known, Ukraine has significant scientific and educational potential. However, before the war, the share of research and development expenditure was 0.43% (Pisarenko et al. 2022). Thus, the post-war restoration of Ukrainian cities is a great opportunity for restarting the state's attitude to the scientific and educational sphere and its revival. In

addition, new horizons for cooperation are opening up. Accordingly, there is an increasing need to analyze these processes in cities and to create an appropriate statistical base.

## Conclusion

The post-war period is a significant challenge for Ukrainian cities. A city, which experienced strong destructive impacts on the pathway of sustainable development, needs urban management based on an integrative and place-based approach, addressing the respective challenges of smart and resilient development of next years – not only in terms of war but also in terms of Climate Change. The traditional disaster management cycle consists of four main stages: mitigation, preparedness, response and recovery. The duration of each phase depends on the scale of the disaster/war. Each phase has particular needs, requires distinct tools, strategies, and resources and faces different challenges. At the same time, usually the last stage is cumbersome and the longest. In Ukraine, in the pre-war period, a course of smart city development was announced and appropriate measures were taken at the state and local levels. In the National Recovery Plan, this course is further supported and planned to develop. In particular, measures for the restoration of Ukrainian cities should take into account the previously declared course of sustainable smart development of cities in front of the loss of physical, social and relational capital on the one side, and in front of climate change and European integration requirements on the other side. At the same time, as noted by Friedman (2010) “place-making is everyone’s job, local residents as well as official planners, and that old places can be »taken back« neighborhood by neighborhood, through collaborative people-centered planning“. Accordingly, research on the question of how to evaluate the smart development of Ukrainian cities at various stages of post-war resilient development is relevant.

This paper concentrates on developing a place-based SC indicator concept, which is based on the intrinsic logic of the disaster cycle for resilient urban development. During the study, the requirements of urban policies supporting resilient and smart development were described. The use of the “liveable city” approach, which combines “smartness” and “resilience”, made it possible to select key evaluation criteria: three periods of resilient development and six different areas of a smart city (economy, mobility, life, environment, people and governance). In this way, a SMART-resilient matrix of indicator groups with eighteen areas of description was formed. In addition, we tried to conceptualize/operationalize a comprehensive indicator set and give selected examples, distinguished by Smart City domains at different stages (response and robustness, recovery and adaptation, preparedness and transformation) and for two types of indicators (outcome, output). However, the final choice of indicators rests by each city according to its most urgent needs supporting resilient development.

We allocated a significant place in the article to the study of the perspectives of SC indicator implementation in Ukrainian cities. In particular, an overview of

the features of municipal development in Ukraine in the last decades was carried out, and the practical experience of Ukrainian cities in implementing the concept of a smart city was shown. Hence, using the “Smart city” approach allows for a comprehensive approach to the post-war reconstruction of Ukrainian cities, taking into account (i) the maintenance of the country’s pre-war course on the development of smart cities, and (ii) the individual characteristics and needs of cities, their level of damage from the war.

Considering the creative power of cities with their citizens, indicator systems need a place and path related understanding enabling a correct and path specific monitoring and assessment of strengths and weaknesses for decision making and new effective activities. Modern urban planning approaches are needed for inclusive and sustainable development. The proposed indicator approach makes it possible to assess (with the help of qualitative and quantitative indicators) the extent to which, thanks to innovative technologies and local government decisions, post-war resilient development of Ukrainian cities is fostered and ensured whereby the success of the implementation of the smart and resilient city concept in the practice of Ukrainian cities depends on many factors (physical infrastructure, the level of human capital, the development of the smart technology market, the state of institutional, legislative and financial support). However, Ukrainian cities will constantly be at risk of military aggression as evidenced by current events and the history of Ukrainian-Russian relations. Therefore, a conflict sensitive approach should be used when developing urban policy.

## References

- Albert S., Pandey M. (eds.) 2021. *Performance Metrics for Sustainable Cities*. Routledge, London, New York.
- Association of Ukrainian Cities. 2019. Smart city awards (<https://auc.org.ua/novyna/konkurs-smart-misto-2019-podacha-zayavok-do-15-veresnya>; accessed: 20.09.2022).
- Association of Ukrainian Cities. 2020. Smart city awards 2020 (<https://www.auc.org.ua/novyna/vyznachenno-peremozhciv-konkursu-smart-city-awards-2020>; accessed: 20.09.2022).
- Batty M., Axhausen K.W., Giannotti F., Pozdnoukhov A., Bazzani A., Wachowicz M., Ouzounis G., Portugali Y. 2012. Smart Cities of the Future. *European Journal of Physics Special Topics* 214: 481–518.
- Batty M., Hugel St., Hudson-Smith A., Roumpani F. 2017. Visualising Data for Smart Cities. [In:] A. Vesco, F. Ferrero (eds.), *Handbook of Research on Social, Economic and Environmental Sustainability in the Development of Smart Cities*. IGI Global, Hershey, p. 339–362.
- Camagni R. 2009. Territorial capital and regional development. [In:] R. Capello, P. Nijkamp (eds.), *Handbook of Regional Growth and Development Theories*. Edward Elgar, Cheltenham/Northampton, p. 118–132.
- Caragliu A., Del Bo Ch., Nijkamp P. 2011. Smart cities in Europe. *Journal of Urban Technology*, 18(2): 65–82.
- Davoudi S. 2012. Resilience: A Bridging Concept or a Dead End? *Planning Theory & Practice*, 13(2): 299–333.
- Deep State Map. 2024. Map of the war in Ukraine (<https://deepstatemap.live/#6/49.438/32.053>; accessed: 14.05.2024).
- Fagerberg J. 2005. Innovation: A Guide to the Literature. [In:] J. Fagerberg, D.C. Mowery, C. Nelson, R. Richard (eds.), *The Oxford Handbook of Innovation*. Oxford University Press, Oxford, p. 1–27.



- Figueredo L., Honiden T., Schumann A. 2018. Indicators for Resilient Cities. OECD Regional Development Working Papers, 2018/02. OECD Publishing, Paris. <https://doi.org/10.1787/6f1f6065-en>
- Friedmann J. (2010) Place and Place-Making in Cities: A Global Perspective. *Planning Theory & Practice*, 11, 2: 149–165. <https://doi.org/10.1080/14649351003759573>
- Galderisi A., Ceudech A., Ferrara F.F., Profice A.S. 2010. ENSURE – Enhancing resilience of communities and territories facing hazards. WP 2, Del. 2.2, EC 7thFP – Cooperation ([https://www.academia.edu/17885547/Integration\\_of\\_different\\_vulnerabilities\\_vs\\_natural\\_and\\_na\\_tech\\_hazards](https://www.academia.edu/17885547/Integration_of_different_vulnerabilities_vs_natural_and_na_tech_hazards); accessed: 5.09.2022).
- Galderisi A. 2017. Nexus Approach to Disaster Risk Reduction, Climate Adaptation and Ecosystems' Management: New Paths for a Sustainable and Resilient Urban Development. *Springer Tracts in Civil Engineering*, 1. [https://doi.org/10.1007/978-3-319-41022-7\\_2](https://doi.org/10.1007/978-3-319-41022-7_2)
- Gerlein U. 2004. Nachhaltigkeitsindikatoren zur Steuerung kommunaler Entwicklung (Sustainability indicators for controlling municipal development). VS Verlag für Sozialwissenschaften, Wiesbaden.
- Giffinger R. (2015). Smart City Concepts: Chances and Risks of Energy Efficient Urban Development. [In:] K. Krempels, M. Helfert, C. Klein, B. Donnellan, O. Gusikhin (eds.), *Smart Cities, Green Technologies, and Intelligent Transport Systems*. Springer Verlag, Switzerland, p. 3–16.
- Giffinger R. 2019. Smart City: The Importance of Innovation and Planning. [In:] M. Helfert, C. Klein, B. Donnellan, O. Gusikhin (eds.), *Smart Cities, Green Technologies and Intelligent Transport Systems*. Springer International Publishing, Switzerland, p. 28–39.
- Giffinger R., Kramar H. 2022. Benchmarking, profiling, and ranking of cities: The “European Smart cities” approach. [In:] S. Albert, M. Pandey (eds.), *Performance Metrics for Sustainable Cities*. Routledge, London, New York, p. 35, 52.
- Giffinger R., Fertner Ch., Kramar H., Kalasek R., Pichler-Milanović N., Meijers E. 2007. Smart cities – Ranking of European medium-sized cities ([http://www.smart-cities.eu/download/smart\\_cities\\_final\\_report.pdf](http://www.smart-cities.eu/download/smart_cities_final_report.pdf)).
- Government portal. 2020. On approval of the 2021–2027 State Strategy for Regional Development. Resolution of the Cabinet of Ministers of Ukraine, adopted on 2020, Aug 5, p. 695 (<https://www.kmu.gov.ua/diyalnist/regionalna-politika/strategichne-planuvannya-regionalnogo-rozvitku/derzhavna-strategiya-regionalnogo-rozvitku-na-2021-2027-roki-ta-plan-zahodiv-z-yiyi-realizaciyi>; accessed: 7.08.2022).
- Government portal. 2022. On the approval of the Procedure for the development, holding of public discussion, approval of programs for the comprehensive restoration of the region, the territory of the territorial community (its parts) and making changes to them. Resolution of the Cabinet of Ministers of Ukraine, adopted on 2022, Oct. 14, p. 1159 (<https://www.kmu.gov.ua/npas/pro-zatverdzhennia-poriadku-rozroblennia-provedennia-hromadskoho-obhovorennia-pohodzhennia-prohram-kompleksnoho-vidnovlennia-oblasti-1159-141022>; accessed: 14.10.2022).
- Institute of Economic Research and Policy Consulting. 2021. Municipal competitiveness index 2021 ([http://www.ier.com.ua/files/Projects/2021/IKM/MCI\\_2021\\_ENG.pdf](http://www.ier.com.ua/files/Projects/2021/IKM/MCI_2021_ENG.pdf); accessed: 7.09.2022).
- International Bank for Reconstruction and Development/World Bank. 2015. Ukraine. Overview of urbanization processes (<https://documents1.worldbank.org/curated/en/787061473856627628/pdf/ACS15060-REVISED-PUBLIC-UKRANIAN-ukr-web-text-cover.pdf>; accessed: 7.09.2022).
- International Institute for Management Development. 2021. Smart City Index 2021 (<https://www.imd.org/smart-city-profile/Kiev/2021>; accessed: 17.08.2022).
- International Organization for Migration. 2023. Ukraine – Internal Displacement Report – General Population Survey Round 15 (November–December 2023) (<https://dtm.iom.int/reports/ukraine-internal-displacement-report-general-population-survey-round-15-november-december?close=true>; accessed: 10.05.2024).
- Intergovernmental Panel on Climate Change. 2021. Summary for Policymakers. [In:] *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. In Press. 10th of December 2021.
- Kummitha R.K.R., Crutzen N. 2017. How do we understand smart cities? An evolutionary perspective. *Cities*, 67(March): 43–52. <http://doi.org/10.1016/j.cities.2017.04.010>

- Kyiv School of Economics Institute. 2024. Report on damages to infrastructure from the destruction caused by Russia's military aggression against Ukraine as of January 2024 ([https://kse.ua/wp-content/uploads/2024/05/Eng\\_01.01.24\\_Damages\\_Report.pdf](https://kse.ua/wp-content/uploads/2024/05/Eng_01.01.24_Damages_Report.pdf); accessed: 10.05.2024).
- Le Galès 2002. *European cities, social conflicts and governance*. Oxford University Press, Oxford.
- Markevych K., Sidenko V. 2021. *Smart-infrastructure in the sustainable urban development: global experience and perspectives for Ukraine*. Publishing House "Zapovit", Kyiv.
- Meerow S., Newell J.P., Stults M. 2016. *Defining urban resilience: A review*. *Landscape and Urban Planning*, 147: 38–49.
- Nam T., Pardo T. 2011. *Conceptualizing Smart City with Dimensions of Technology, People, and Institutions*. *The Proceedings of the 12th Annual International Conference on Digital Government*, p. 282–291.
- Official portal of Drogobych rada. 2023. *Catalog of smart city services* (<https://drohobych-rada.gov.ua/smart-city/>; accessed: 25.02.2023).
- Official portal of Kyiv. 2017. *On the Approval of the Concept KYIV SMART CITY 2020*. Order of the Kyiv City State Administration adopted on 2017, Jun 28, p. 918 ([https://kyivcity.gov.ua/npa/pro\\_skhvalennya\\_kontsepsi\\_kiv\\_smart\\_siti\\_2020\\_346605/](https://kyivcity.gov.ua/npa/pro_skhvalennya_kontsepsi_kiv_smart_siti_2020_346605/); accessed: 1.09.2022)
- Official portal of the Dnipro. 2021. *City Smart City Club: Dnipro has joined the online expert platform for communications among the largest cities of Ukraine* (<https://dniprorada.gov.ua/uk/articles/item/43669/smart-siti-klub-dnipro-doluchiv-sya-do-onlajn-ekspertnogo-majdanchika-dlya-komunikacij-sered-najbilshih-mist-ukraini>; accessed: 1.08.2022).
- Official portal of the Kharkiv City Council. 2020 (<https://www.city.kharkov.ua/uk/document/osnovni-pokazniki-ekonomichnogo-i-sotsialnogo-rozvitku-m-kharkova-za-9-misyatsiv-2020-roku-60051.html>; accessed: 1.08.2022).
- Official portal of the Mariupol rada. 2020. *Smart city elements to be introduced to Mariupol infrastructure* (<https://mariupolrada.gov.ua/news/v-infrastrukturu-mariupolja-vprovadzat-elementi-smart-city>; accessed: 1.10.2022).
- Pisarenko T., Kuranda T. and ets. 2022. *Наукова та науково-технічна діяльність в Україні у 2021 році: науково-аналітична доповідь (Scientific and scientific-technical activity in Ukraine in 2021: scientific-analytical report)*. UkrINTEI, Kyiv, p. 93.
- Recovery of Ukraine. 2022. *National Recovery Plan* ([recovery.gov.ua](https://recovery.gov.ua); accessed: 1.08.2022).
- Simmie J. (ed.) 2001. *Innovative Cities*. Spon Press, London.
- State Statistics Service of Ukraine. 2022. *Population of Ukraine 2021*. Kyiv.
- State Statistics Service of Ukraine. 2023. *Population of Ukraine 2022* (<https://www.ukrstat.gov.ua/>; accessed: 22.02.2023).
- The Digital Transformation Ministry and Committee of Ukraine. 2021. *Research of the Malik Institute on the development of Smart City in Ukraine* (<https://thedigital.gov.ua/news/doslidzhennya-institutu-malika-pro-rozvitok-smart-city-v-ukraini>; accessed: 25.09.2022).
- The Ministry of Communities and Territories Development of Ukraine. 2020. *The Ministry of Regions outlined the priority directions in the field of digital transformation and digitalization of regions* (<https://www.minregion.gov.ua/press/news/minregion-okreslyv-priorytetni-napryamy-u-sferi-czyfrovoyi-transformaciyi-ta-czyfrovizaciyi-regioniv/>; accessed: 20.09.2022).
- Tkach S. 2021 (1). *Urban development management based on the concept of Smart City in the Western region of Ukraine*. *Regional Economy*, 2. <https://doi.org/10.36818/1562-0905-2021-2-9>
- Tkach S. 2021 (2). *Пріоритети управління розвитком міст обласного значення Західного регіону України на засадах концепції 'Smart City' (Management priorities for the development of cities of regional importance in the Western region of Ukraine based on the concept of 'Smart City')*. [In:] M. Melnyk, *Трансформація структури економіки міст Західного регіону України (Transformation of the economy structure of the Western region of Ukraine cities)*. NAS of Ukraine, Lviv, Ukraine, p. 401–433.
- Turok I., Mykhnenko V. 2008. *East European Cities – Patterns of Growth and Decline, 1960–2005*. *International Planning Studies*, 13(4): 311–342.
- UN HABITAT. 2015. *UN-HABITAT Global Activities Report 2015. Increasing synergy for greater national ownership* (<https://sustainabledevelopment.un.org/content/documents/1726Habitat%20Global%20Activities%202015.pdf>; accessed: 1.08.2022).

- United Nations High Commissioner for Refugees. 2024. Operational data portal. Ukraine refugee situation (<https://data.unhcr.org/en/situations/ukraine>; accessed: 10.05.2024).
- United Nations Office for Disaster Risk Reduction. 2009. UNISDR Terminology and Disaster Risk Reduction ([https://reliefweb.int/report/world/2009-unisdr-terminology-disaster-risk-reduction?gclid=Cj0KCQjAjbAgBhD3ARIsANRRqEsN7Zy5ScwUcGOfZiQ2O1nxbmNOvPbjEpJ9z4oEZm-QSYnKQRBtkSmAaApdWEALw\\_wcB](https://reliefweb.int/report/world/2009-unisdr-terminology-disaster-risk-reduction?gclid=Cj0KCQjAjbAgBhD3ARIsANRRqEsN7Zy5ScwUcGOfZiQ2O1nxbmNOvPbjEpJ9z4oEZm-QSYnKQRBtkSmAaApdWEALw_wcB); accessed: 5.08.2022).
- Vodafone.ua. 2021. Odesa will be the first city in Ukraine to get a digital copy (<https://www.vodafone.ua/news/digital-double-in-odessa>; accessed: 1.08.2022).

## **Koncepcja inteligentnego wskaźnika dla powojennego odpornego rozwoju ukraińskich miast**

**Zarys treści:** W ostatnich dziesięcioleciach miasta na Ukrainie przeszły transformację napędzaną przez rynek, a każde z nich podążało unikalną ścieżką rozwoju, na którą wpływają czynniki geograficzne, geopolityczne i regionalne. Polityki krajowe i lokalne ukształtowały te trajektorie, kładąc coraz większy nacisk na strategię inteligentnych miast (smart cities). Jednak agresja Rosji na Ukrainę w lutym 2022 r. zakłóciła rozwój takich strategii, wprowadzając nowe wyzwania i niepewność dla miast Ukrainy. W okresie powojennym staną one przed wieloma problemami, w tym zniszczoną infrastrukturą, obniżoną jakością życia i utrudnionym rozwojem gospodarczym.

W obliczu tych warunków w niniejszym artykule poruszono kwestię konieczności opracowania koncepcji wskaźników SC (smart cities) ukierunkowanej terytorialnie, która jest zgodna z wewnętrzną logiką cyklu katastrof na rzecz odpornego rozwoju obszarów miejskich i polityk integracyjnych. Stąd teoretyczną i metodologiczną podstawę badania stanowią główne założenia urbanistyki wspieranej i uruchamianej przez koncepcję inteligentnych i odpornych miast. W oparciu o cykl katastrofy przedstawia się znaczenie terytorialnego rozumienia rozwoju SC, co silnie wpływa na rodzaj i jakość wskaźników. Część empiryczna krótko wprowadza w temat zróżnicowanego rozwoju urbanistycznego miast Ukrainy i doświadczeń z działalności SC. Koncepcja wskaźnika SC, w odróżnieniu od dotychczasowych koncepcji, dostosowana jest do ukraińskiej bazy statystycznej, uzupełnionej o wskaźniki uwzględniające specyfikę powojennego rozwoju miast na etapach odbudowy, adaptacji i transformacji.

**Słowa kluczowe:** odporny rozwój, inteligentne miasto, odbudowa powojenna, adaptacja, transformacja