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Smart community as a modern model of sustainable development management at the local level

Społeczność smart jako nowoczesny model zarządzania zrównoważonym rozwojem na poziomie lokalnym

Introduction
Wprowadzenie

In the context of global transformations and digitalization of management processes, the SMART concept is increasingly seen as an effective tool for modernizing the local government system and ensuring sustainable development of territorial communities. The SMART approach goes beyond purely technological modernization, integrating the principles of sustainability, innovation, inclusiveness, and focus on the needs of residents.

SMART (*Specific, Measurable, Achievable, Relevant, Time-bound*), in the classical management sense, means setting goals based on five criteria: specificity, measurability, achievability, relevance, and time-boundness. However, in today's urban and territorial context, this acronym is transforming into a broader concept that encompasses digital technologies, data analytics, e-governance integration, environmental safety, sustainable mobility, energy efficiency, and social inclusion.

SMART community governance is based on the use of information and communication technologies to optimize decision-making processes, improve the quality of services, enhance transparency and openness of authorities, and increase the level of citizen participation in local governance. One of the key aspects is the introduction of real-time monitoring and management systems for urban infrastructure, which allows for more efficient management actions.

The SMART concept serves as a methodological basis for formulating community development strategies that combine digital transformation and sustainable development principles, taking into account the socio-economic specifics of the regions. Accordingly, a SMART community is not only a "technological" community, but also an intellectual, ecological and inclusive community capable of self-development based on knowledge, innovation and active interaction of all local government entities.

Thus, the SMART concept plays the role of an integrative tool for managing community development, contributing to the realization of sustainable development goals at the local level, efficient use of resources, and improving the competitiveness of territories and the quality of life of the population.

Literature review

Over the past decade, the SMART concept has become widespread in scientific, managerial and practical discourses, primarily in the context of smart city development. A significant number of scientific studies, strategic documents, international initiatives, and technical assistance programs focus on the implementation of digital technologies, innovative solutions, and sustainable development principles in large urban spaces.

A significant contribution to the development of the research topic was made by scientists, including Paiva S. et al. (2021), Sharif R. & Pokharel S. (2022), Silva B. et al. (2018).

The importance of intensifying the innovative development of Ukraine is substantiated in the publication (Dykha M. & Dykha V., 2023), the results of which are based on the analysis of the existing level of innovation of Ukraine's development in terms of components identified by leading institutions. In this context, it is important to develop startups that are inherently innovative, as described in (Dykha M., Dykha V., & Gonta S., 2024). Unfortunately, the Russian Federation's war against Ukraine caused significant destruction, challenges to ensuring the socio-economic development of Ukraine, which is described in the publication (Dykha M. et al., 2024), and the challenges for the energy sector are described in the publication (Dykha V. et al., 2024). At the same time, the authors of these publications developed proposals for the sustainable development of the energy system and optimization of the energy security management strategy, developed specific proposals that are relevant for managing community development in the context of the post-war reconstruction of Ukraine.

The range of issues related to the coverage of the components of the SMART concept, theoretical foundations and practical aspects of the introduction of innovative technologies into the urban environment are covered in the works of Dykha M. & Kizliar O. (2025); Dynnyk I. (2023); Yevsiukova O. (2021); Zvonar V. (2017); Krasilyuk V. (2024); Chukut S. & Dmytrenko V. (2016) and others. Particular attention in the publications is paid to the interaction of information and communication systems with management processes, which ensures the efficiency of urban development.

However, smart communities, as the newest form of local government organization at the level of rural, settlement and small urban areas, still remain insufficiently studied. In the context of decentralization of power, strengthening of the role of communities in ensuring sustainable development, and the need to integrate digital technologies into everyday management, this situation poses a number of challenges. The absence of a holistic theoretical and methodological basis for the formation and implementation of the SMART concept at the level of communities, non-urbanized areas and territorial associations reduces the possibilities for effective transformation of management processes, digital inclusion and socio-economic renewal of local environments.

The purpose of the article

Given the scientific and practical relevance of the topic, the purpose of the publication is to make a theoretical generalization of scientific approaches to understanding the essence of the SMART community concept, as well as to systematize and critically analyze the existing definitions of this concept in order to form the author's interpretation relevant to the current challenges of local development.

Presentation of the main research material

The term "SMART community" is directly associated with the optimal, positive and sustainable development of a city, region or territorial unit. There are several approaches to defining the essence of this concept. For example, Smart Communities Guidebook (1997),

prepared by the California Institute for Smart Communities at San Diego State University, defines the concept of SMART communities: A "smart community" is a community in which government, business, and residents recognize the potential of information technology and consciously decide to use it to significantly and positively transform the way they live and work in their region.

The Implementation Guide (1997) of the same Institute states: "A SMART community is a community in which representatives of local government, business, education, health care, and the public realize the potential of information and communication technologies and form effective partnerships to use them to transform the community in meaningful and positive ways" (Smart Communities Guidebook, 1997). Thanks to these joint efforts, the community is able to access resources and implement projects that contribute to the development of telecommunications infrastructure and services earlier than would otherwise be possible. This approach promotes not gradual, but transformational changes that increase the level of choice, convenience, and control for community residents in all areas: work, education, travel, government, trade, and leisure. Smart communities or regions are also economically competitive in the new global economy, as they attract businesses due to the availability of a developed telecommunications infrastructure.

The Panel on Smart Communities (Industry Canada, 1998) provides the following definition of communities: "a community is a group of people united by a common interest that includes one or more of the following elements: geography, history, goals, culture, and socioeconomic structure. Accordingly, a "SMART community" is a community, from a single neighborhood to a national community, united by common interests, whose members, organizations and governance institutions work in partnership to use information and communication technologies to transform their environment in a meaningful way (Industry Canada, 1998).

The Smart Community International Network (SCIN, 2003) presents the following definition: A SMART community is a community that has a vision of the future in which information and communication technologies are used in an innovative way to empower its residents, institutions, and the region as a whole. Such communities make the most of new digital solutions and services, in particular in healthcare, education, training, and the creation of new business opportunities.

The European Smart Cities concept, developed at the Vienna University of Technology, defines a "smart community" as a management category, which means a community that effectively uses all the information available to better understand and control its functions and make optimal use of available resources, including those of its residents (European strategy for smart, sustainable and inclusive growth "Europe 2020", 2010).

Similarly, Australian researchers note that SMART communities are communities that have a vision of the future and seek to harness the potential of the Internet and other information and communication technologies in new and innovative ways to empower their residents, institutions, public organizations, and businesses.

The Smart Communities Alliance, a community of Japanese industry, government, and academia under the auspices of METI, defines a smart community as "...a community where various next-generation technologies and advanced social systems are effectively integrated and utilized, including: efficient use of energy, utilization of heat and untapped energy sources, improvement of local transportation systems, and transformation of citizens' daily lives..." (About smart community alliance Japan Smart Community Alliance, 2010).

In summary, we can state that the concept of a SMART community provides a holistic, integrated approach to the transformation of the socio-economic and governance environment through the use of information and communication technologies (ICT), focusing on the needs

of residents, resource features of the community and the principles of sustainable development within a particular territorial unit - a city, village, region or amalgamated community.

The concept of "digital community" is being actively implemented in the theory and practice of public administration by the Ministry of Digital Transformation of Ukraine. At the same time, as a scientific term, the "digital community" has not yet received proper coverage and systematic analysis in the national scientific literature.

The definition of a "SMART community" is not an officially enshrined term in the regulations or scientific publications of the Ministry of Digital Transformation of Ukraine. However, the concept of digital transformation of territorial communities in Ukraine covers aspects that can be attributed to the characteristics of a "SMART community". This concept envisages the systematic use of (ICT) in the areas of governance, infrastructure, energy, education, healthcare, and security to create a comfortable, safe, and environmentally friendly living environment for residents, taking into account their active participation in decision-making. In particular, the Digital Transformation Index of Ukrainian Communities, developed by the Ministry of Digital Transformation, assesses the level of digitalization in communities by the following components: digital economy, digital skills, digital infrastructure, and digitalization of public services. These indicators correspond to the characteristics inherent in SMART communities (Ministry of Digital Transformation of Ukraine, 2025).

As noted by S. Chukut and V. Dmytrenko, a SMART community is a concept that is directly related to the automation of community life and its certain robotization (Chukut S. & Dmytrenko V., 2016). A widespread vision of a "digital community" is one that introduces a certain set of the latest digital technologies into the work of the relevant local governments and municipal structures, along with e-government, electronic document management, electronic services, IT systems, etc.

According to I. Dynnyk, the main directions of implementation of the "SMART community" concept are: "...development and implementation of innovative technologies in agriculture and other industries, which will increase productivity and reduce production costs; development of infrastructure and access to modern communication technologies; development of green energy and use of alternative energy sources; creation of infrastructure for cycling tourism, which will enhance the development of small and medium-sized businesses, increase demand for hotel and restaurant services; ensure sustainable development (a balanced approach to the use of natural resources) (Dynnyk I., 2023). According to V. Krasilyuk, "SMART communities" are a new form of community of the future, which is the use of Internet technologies to improve work and life experience in many areas, including personal health, home care, hospitals, urban networks, and housing (Krasylyuk V., 2024).

Based on a detailed analysis of scientific sources and existing approaches, it is possible to formulate a comprehensive and scientifically sound definition of the concept of "SMART community" - an integrated territorial community (city, village, region or amalgamated community) that, based on a strategic vision of sustainable development, systematically implements information and communication technologies to improve the efficiency of governance, the quality of public services, economic competitiveness and living standards of community residents. Such a community ensures close cooperation between local governments, businesses, educational and medical institutions, and civil society to achieve transformational changes in all areas of life.

A SMART community is characterized by:

–conscious and innovative use of digital technologies for analysis, planning and decision-making;

–ensuring openness, transparency and public involvement in management processes;

–rational use of resources, including human, natural and infrastructure potential;

–focus on sustainable development, social justice, environmental safety and a comfortable environment for residents.

Thus, a SMART community is not only a technically "digitalized" structure, but also a new form of management and social organization that meets the challenges of the modern global economy and the digital transformation of society.

In the scientific literature and applied documents on the development of SMART communities, there are a number of key components that reflect the holistic architecture of functioning of such entities. The most recognized components of a SMART community in scientific sources include the following (Table 1).

Table 1. Structural and functional components of a SMART community in the context of sustainable socio-economic development

Components	Description
Smart Governance	This component involves the digital transformation of management processes, openness and transparency of public administration, citizen participation in decision-making, development of e-democracy and e-government tools. This includes the introduction of electronic services, institutional support for civic-tech solutions, and active participation of citizens in local policy making.
Smart Economy	This component covers the introduction of digital tools in production and business processes, innovative entrepreneurship development, investment attraction, creation of an environment for startups, and stimulation of the circular economy. Particular attention is paid to artificial intelligence technologies, automation, and the development of digital platforms as infrastructures for economic activity.
Smart Mobility	It is considered as the introduction of intelligent transport systems, development of public transport, promotion of sustainable mobility (pedestrian zones, bicycle infrastructure, electric transport), and traffic management using ICT. The goal is not only to reduce the traffic load, but also to increase the environmental friendliness of mobility.
Smart Environment	This component concerns the use of innovations for sustainable management of natural resources, reduction of anthropogenic impact on the environment, energy efficiency, waste management, and environmental monitoring. Smart environmental monitoring systems, smart grids, and eco-technologies are used.
Smart Living	Focuses on the quality of life of residents: access to healthcare, education, cultural services, security, leisure infrastructure and social protection. Smart solutions are being implemented in the system of medical services (e-health), education (e-learning), security (smart surveillance), and in the organization of living space
Smart People	This dimension covers the development of human capital, including digital and civic competencies, educational attainment, innovation, creativity, social engagement, and openness to change. A smart community is based on the active participation of educated citizens in transformational processes.

Smart Infrastructure	It is about deploying digital infrastructure (fiber optic networks, sensors, platforms for data collection and analysis), modernizing engineering infrastructure, and integrating physical and virtual systems into a single community management space. Smart infrastructure is the basis for the functioning of all other components.

Source: compiled by the author based on: Silva B. et al. (2018), Paiva S. et al. (2021); Sharif R. & Pokharel S., (2022); Dykha M. & Kizliar O., (2025).

The rapid spread of the SMART concept in territorial development practices actualizes the need for a systematic tool that would allow to identify the level of community maturity, its ability to implement SMART-oriented transformations, as well as to outline the profile advantages and limitations of a particular spatial formation. Such a model serves as an analytical basis for formulating targeted management decisions, optimizing strategic planning, establishing cross-sectoral cooperation, and efficient resource allocation.

In this context, the approach proposed by Zvonar V. (2017), which is based on the identification of two basic criteria for assessing the socio-economic profile of a "smart community", is of particular importance. The scientific work (Zvonar V., 2017) proposes a two-criteria model for determining the socio-economic profile of a "smart community", which is based on an analytical generalization of the characteristics of SMART communities and approaches to their classification in modern scientific and managerial thought.

The first criterion, according to the author, is the socio-settlement aspect, which covers the spatial and territorial parameters of SMART structures. This criterion distinguishes two dominant approaches to the formation of the image of a "smart community": urban, which is focused mainly on large urban areas (in particular, the SMART-city concept), and convergent, which allows for a combination of urban and non-urban elements in the context of digital transformation.

The urban vision envisages the implementation of innovative management and technological solutions primarily within megacities and cities that have significant demographic, infrastructural, and political potential. Dykha M. & Kizliar O., (2025) thoroughly revealed the theoretical foundations of the smart city concept as a tool for innovative development of the territory, analyzed the world experience of implementing the smart city concept, the current state and trends of its implementation in Ukraine, and substantiated the directions of activating the innovative development of the ecosystem as an environment for implementing smart city projects.

The convergent approach expands the focus of the study to smaller territorial units (including rural areas), provided they are able to adapt digital and management tools. The second criterion is functional and social, which refers to the degree of social orientation of the key components of the SMART community model. According to the approach of Zvonar V. (2017), three components are subject to analysis: 1) the range of communicatively active stakeholders; 2) the goals of integrating e-communication technologies; 3) algorithms for the functioning of the community in the context of digitalization. Within this criterion, two possible analytical approaches are outlined: an engineering vision that focuses on the speed and efficiency of technology implementation, and a humanistic vision that focuses on the development of human and social capital, quality of life, and inclusiveness.

Despite the integrity of the proposed approach, it is advisable to further improve the methodological tools, in particular by identifying an additional criterion that would provide a more comprehensive coverage of the key factors of SMART communities. First of all, this refers to the economic aspect, which is considered indirectly in the proposed model, mainly through functional characteristics, but is not distinguished as an independent area of analysis.

Given the dominance of the sustainable development paradigm, it is advisable to supplement the model with an economic and innovation criterion that allows assessing the level of economic viability, the community's suitability for diversifying the economic base, creating investment attractiveness, fiscal autonomy, and the innovation environment (Table 2). This criterion covers both traditional industrial parameters and indicators of the development of the creative, digital, and green economy. Its implementation will increase the analytical sensitivity of the methodology, help identify internal sources of growth and formulate adaptive strategies for the sustainable functioning of SMART communities.

Table 2. Model for determining the socio-economic profile of a SMART community

Criterion	Content content	Indicative strategic focus
1. Social and settlement	Determines the type of spatial organization of the community (urban or convergent format) depending on its size, infrastructure and demographics.	Development of spatial strategies for integrated development of territories
2. Functional and social	Evaluates the level of social orientation of ICT-integrated management processes and community life, stakeholder activity, and the targeted focus of digital solutions.	Formation of a socially oriented digital community ecosystem
3. Economic and resource	Determines the community's ability to be economically self-sufficient, innovative, efficiently manage resources, entrepreneurship, and investment attractiveness.	Stimulation of the local economy, investment, green transformation
4. Governance and institutional	Reflects the level of digital maturity of local self-government, the availability of a strategic vision, participatory mechanisms, institutional and regulatory frameworks.	Increasing institutional capacity and implementing innovative governance

Source: supplemented by the author according to Zvonar V. (2017); Dykha M. & Kizliar O. (2025).

At the same time, the fourth component is also important - the managerial component, which allows assessing the quality of public administration, the efficiency of management processes, the availability of a strategic vision and management institutions capable of ensuring the implementation of the SMART community concept. This criterion covers both the institutional structure (level of decentralization, autonomy, competence of governing bodies) and procedural aspects (transparency, accountability, digitalization of governance, implementation of data-driven approaches). The existence of an effective management mechanism is a prerequisite for the implementation of both technological and socio-economic transformations in the community.

Thus, the presented model of socio-economic profile based on four basic criteria - socio-settlement, functional-social, economic-innovation and managerial - expands the possibilities

of a comprehensive assessment of SMART communities, taking into account not only spatial and social factors, but also critical economic and managerial determinants.

However, the effectiveness of implementing such a model directly depends on the ability to take into account the current challenges of spatial inequality, which are increasingly manifested in the disparities between dynamically developed urbanized centers and less developed peripheral areas. It is in this context that there is a need not only for a scientific understanding of the causes of such gaps, but also for smart-oriented tools to overcome these structural imbalances (Table 3).

Table 3. Comparative characteristics of smart communities and smart cities in the context of implementing the principles of sustainable development

Comparison criterion	SMART community	SMART city
Spatial scale	Extended territorial unit (city, village, agricultural area)	Large urbanized environment (city, metropolis)
Sustainable development focus	Conservation of the natural environment and biodiversity, environmentally balanced land use, local economic development, social cohesion.	Energy efficiency, decarbonization strategies, mobility, circular economy, green infrastructure implementation
Economic component of sustainability	Support for local entrepreneurship, agro-innovation, and cooperative initiatives	Development of the technology sector, venture capital investments, 4.0 industry, attraction of investments in green technologies
Social component of sustainability	Citizen engagement in governance, inclusion, development of e-services for access to basic social services	Urban activism, digital participation platforms, cultural mobility, inclusive educational and medical services
Environmental component of sustainability	Rational land use, renewable energy, ecotourism, environmental education, bio-waste management, energy-efficient lighting	Energy-efficient buildings, smart lighting, air quality monitoring systems, waste management through digital solutions, urban mobility system, urban climate policy
Digital infrastructure	Moderately developed, gradual digitalization of basic services	Integrated smart systems: IoT, Big Data, AI, Smart Grid
Governance mechanisms	Decentralized governance, strategic planning based on local needs, dependence on state support	Access to international projects, centralized management platforms, process automation, use of big data for management purposes

Innovation potential	Local initiatives, pilot projects in energy, education	Startup ecosystems, research clusters, technology hubs
Involvement in global sustainability strategies	Focus on climate change adaptation, local implementation of the SDGs	Systemic integration of European and international policies Green Deal, SDGs
Integration with the Sustainable Development Goals (SDGs)	Focus on SDGs 11, 7, 13: sustainable settlements, energy efficiency, climate change	Integration of SDGs 9, 11, 12: innovation, sustainable urbanization, responsible consumption and production
Key challenges	Digital divide, youth outflow, limited investment	Urban load, transport saturation, high resource consumption

Source: author's proposal.

In the modern world, there is an increasingly deep spatial imbalance between large urbanized centers and small towns that are losing their pace of development. Globalization, digitalization, and economic concentration have contributed to the transformation of cities into powerful centers of innovation, high technology, and social mobility. However, small settlements are often left out of infrastructure, economic, and social transformations, leading to increased depopulation, depopulation, and socioeconomic marginalization.

The outflow of young people from peripheral areas to large cities, which offer a wider range of opportunities for self-realization, professional growth, and quality of life, is particularly acute. Such internal migration exacerbates demographic aging in small communities, reduces labor potential, and complicates local modernization processes.

An analysis of the table comparing SMART communities and SMART cities shows that although both categories are aimed at introducing innovative technologies and sustainable development practices, they differ in scale, functional priorities, and management approaches. SMART communities are focused on adapting local potential, ensuring social cohesion, and maintaining ecological balance at the level of smaller territorial units, while SMART cities focus on integrated infrastructure solutions, economic dynamics, and the integration of high technologies into large-scale urban systems. This spatial divide poses a serious threat to the implementation of principles of sustainable development, such as inclusiveness, equality of opportunity, and balanced regional growth. This distinction emphasizes the need for a differentiated approach to planning and implementing SMART initiatives, taking into account the context of sustainable development, socio-economic and spatial features of the respective territories. That is why it is necessary to rethink the role of the SMART communities concept as a universal tool for overcoming inequalities, activating local potential and integrating small territorial units in the digital era.

Conclusions
Podsumowanie

Thus, the concept of SMART communities is a relevant theoretical and practical tool for ensuring sustainable development of territories in the digital era, contributes to improving the quality of life and efficiency of management and requires further scientific understanding, generalization of best international practices and adaptation to the national context. The

SMART community concept is a comprehensive model for the transformation of territorial units based on the integration of information and communication technologies into all spheres of public life. It envisages not only technical digitalization but also profound social and administrative changes aimed at improving the efficiency of governance, engaging citizens in decision-making processes, and ensuring sustainable development. A SMART community integrates the interests of local authorities, businesses, educational and medical institutions, creating a platform for partnership and interaction that stimulates innovation and increases the competitiveness of the region. The defining characteristics of such a community are a focus on sustainable development, rational use of resources, transparency of governance, and social justice. In addition, a SMART community creates a favorable environment for improving the quality of life of its residents through the implementation of innovative solutions in education, healthcare, transportation and the environment. Thus, the implementation of the SMART concept contributes to the formation of an efficient, open and competitive territorial community capable of adapting to the challenges of the digital age. This creates a solid foundation for further development and integration into European and global digital transformation trends.

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Smart community as a modern model of sustainable development management at the local level

Summary

The article presents a comprehensive analysis of scientific and practical approaches to the definition of the concept of "SMART community", which confirms the multifaceted and interdisciplinary nature of this concept. It is determined that a SMART community is an integrated territorial community that systematically uses information and communication technologies to improve the efficiency of management, the quality of public services and the competitiveness of the economy, improve the living standards of community residents and ensure sustainable development. It is emphasized that the main characteristics of such a community are innovative implementation of digital solutions, openness and involvement of citizens in decision-making processes, rational use of resources, focus on social justice and environmental safety. In particular, the structural and functional components of a SMART community are identified, which include smart governance, economy, mobility, environment, life, people, and infrastructure. These components form a holistic architecture that ensures transformational changes in all spheres of life of an administrative-territorial unit. The article also emphasizes that the domestic scientific space and practice of digital transformation do not yet have a clearly regulated definition of a SMART community, but existing initiatives in Ukraine, in particular the activities of the Ministry of Digital Transformation, contain key elements that coincide with this concept.

The article identifies promising areas for further research - improving methods for assessing the level of maturity of SMART communities, developing integrated models of their development and adapting digital innovations to the specifics of Ukrainian territorial units.

Społeczność smart jako nowoczesny model zarządzania zrównoważonym rozwojem na poziomie lokalnym

Streszczenie

Artykuł przedstawia kompleksową analizę naukowych i praktycznych podejść do definiowania pojęcia „społeczność SMART”, co potwierdza jego wieloaspektowy i interdyscyplinarny charakter. Ustalono, że społeczność SMART to zintegrowana wspólnota terytorialna, która systematycznie wykorzystuje technologie informacyjno-komunikacyjne w celu poprawy efektywności zarządzania, jakości usług publicznych oraz konkurencyjności gospodarki, podnosząc tym samym standard życia mieszkańców i zapewniając zrównoważony rozwój.

Podkreślono, że głównymi cechami takiej społeczności są innowacyjne wdrażanie rozwiązań cyfrowych, otwartość i zaangażowanie obywateli w procesy decyzyjne, racjonalne wykorzystanie zasobów, a także ukierunkowanie na sprawiedliwość społeczną i bezpieczeństwo ekologiczne. W szczególności zidentyfikowano strukturalne i funkcjonalne komponenty społeczności SMART, do których należą: inteligentne zarządzanie, gospodarka, mobilność, środowisko, jakość życia, ludzie oraz infrastruktura. Komponenty te tworzą spójną architekturę, która zapewnia transformacyjne zmiany we wszystkich sferach życia jednostki administracyjno-terytorialnej.

W artykule zaznaczono również, że krajowa przestrzeń naukowa i praktyka transformacji cyfrowej nie posiadają jeszcze jasno uregulowanej definicji społeczności SMART, jednak istniejące inicjatywy na Ukrainie, w szczególności działalność Ministerstwa Transformacji Cyfrowej, zawierają kluczowe elementy zbieżne z tą koncepcją. Wskazano również obiecujące kierunki dalszych badań – doskonalenie metod oceny poziomu dojrzałości społeczności SMART, opracowanie zintegrowanych modeli ich rozwoju oraz dostosowanie innowacji cyfrowych do specyfiki ukraińskich jednostek terytorialnych.