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Integrating smart city and smart citizen into the digital economy

Интеграция умного города и умного горожанина в цифровую экономику

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Abstract

The study aims to enhance interactions within smart city infrastructures by systematically analyzing associated challenges and proposing strategic solutions. Employing methodologies such as system analysis, synthesis, optimization, modeling, and decision-making—while considering process uncertainties—we dissect the "smart city" and "smart city dweller" concepts, charting their evolutionary cycles. The results outline a structural framework for interactions between citizens, the state, businesses, and society, integrating key subsystems into a unified infrastructure. We also evaluate feedback mechanisms in urban projects like "Active Citizen" and "Garbage. Not.Net," and investigate smart city self-regulation using the Hurwitz criterion. These insights provide actionable guidance for assessing and advancing smart city projects.

Keywords: smart city, citizens, interactions, governance, evolution, infrastructure.

Аннотация

Исследование направлено на улучшение взаимодействия в инфраструктуре "умных городов" путем систематического анализа сопутствующих проблем и предложения стратегических решений. Методология включает системный анализ, синтез, оптимизацию, моделирование и принятие решений с учетом неопределенности процессов. Мы анализируем концепции "умный город" и "житель умного города", отслеживая их эволюционное развитие. Результаты представляют структурную схему взаимодействия граждан, государства, бизнеса и общества, интегрируя ключевые подсистемы в единую инфраструктуру. Также оцениваются механизмы обратной связи в городских проектах, таких как "Активный гражданин" и "Мусор. Нет.Сеть", и исследуется саморегулирование умных городов с использованием критерия Гурвица. Эти выводы предоставляют практические рекомендации для оценки и развития проектов умных городов.

Ключевые слова: умный город, горожане, взаимодействия, управление, эволюция, инфраструктура.

Introduction

The digital economy is the result of technological, innovative effects seen in sectors of the economy such as trade, transport, finance, manufacturing, education and health. The consequences of digital transformations are also beyond their information-logical and communication applications. In particular, as in the development of the model "smart home", "smart office" and "smart production" to the level of "smart city".

Since the beginning of the pandemic (COVID-19), global demand for digital services has grown by almost a third. Social and network activity has

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also grown: reposts, applications, comments, social and public initiatives, fakes. It is not always positively oriented, especially when it comes to fakes. Anonymity and opacity of actions on the Internet reduces responsibility for extremist actions, fakes, and uncontrolled information flows increase negative consequences in society.

The purpose of the work is a systematic analysis of the forms and categories key to the task of studying the digital activity of citizens in the "smart city" environment and the development of the entire digital society, the capabilities of digital process actors. The main result is the analysis of models of citizens' interactions with society, business and the municipality.

The possibilities of online platforms, strengthening connections and the growth of a variety of such interactions, in particular, crowdfunding platforms, are also analyzed. The political and legal features of supporting the digital activity of Russians are also considered.

Theoretical foundations

Many studies are devoted to the problems of "digital citizens", their differences from the problems of "non-digital citizens" and civic engagement, in particular (Couldry, 2014; Jones, 2016). The category "digital citizen", firstly, reflects the new infrastructural and legal status of an online user, and secondly, reflects the phenomenon of "Generation Internet 2.0", including a citizen's network protest. We are more interested in the systemic content of the "digital city dweller" category, reflecting the systemic efforts of the city and the authorities.

Most experts consider social media to be an effective environment for:

1) informing the public;
2) creating and supporting social movements;
3) management and decision-making;
4) regulation of political life.

Activity (activation) in social networks is a process associated, in particular, with the procedures for posting multimedia, media content. They are important for citizens, society, the entire state (Burkhardt, 2014), as well as for attracting other, potential actors to participate. Activity can start offline, but then be transferred online or vice versa.

All these forms are integrated, forming hybrid forms (Afzalan, 2017), for example, in the field of consumption, production, health care, energy, the development of intellectual and human capital of the world community (Eriashvili, 2021).

Civil participation in networking takes place at various levels, using various platforms and services (digital participation platforms) (Falco, 2018). Including models of interactions such as "crowdfunding" (fundraising for a project) and other models, in particular, based on smartphones (Jones, 2015).

The category "civil participation" is interpreted as both "digital" and traditional ("non-digital") participation. Digital participation is distinguished by cooperation both with other citizens, institutional structures, and with socio-network communities, communications (Smoleva, 2022). All interactions should be aimed at increasing their and leaders (communicators) digital role, for example, comfort of access to digital resources, communication chains and awareness of citizens. This is manifested in the growth of significance and content, the diversity of the structure of the citizen's goals, in particular, his virtualization (Hjerpe, 2018).

Digital civic engagement is implemented by models of interactions: citizens with government (C2G); citizens and society (C2S); citizens and business (C2B) and others (Kaziev, 2017).

Internet functions that stimulate political activity of citizens are:

1) mobilization, motivational;
2) informational, infological;
3) communicative, initiative;
4) evolutionary, self-organizational.

Almost digital participation of citizens is carried out by the generation and signing of petitions, charity, digital voting, etc. Systematically and theoretically implemented through the concept of citizenship, based on alternative participation (Akhremenko, 2022).

The degree of civic participation is often determined by the model of active citizenship, the diversity and evolution of civic engagement (Dalton, 2015), and the opportunities for citizens to participate in activating and recognizing democratic change (Youngs, 2019).

Civic activity is not only "digitalized", but also personified. Civic engagement in the digital ecosystem becomes effective even with "weak connections", quickly transformed to a higher level of political activity (Kahne, 2018).

There is also imaginary ("lazy-communicative") activity or the process of mechanical posting of "likes", signatures, etc. Many Internet users are only interested in the possibility of social networking, entertainment and information, but this is not civic engagement (Menteş, 2019).

The transfer of online activities to the surrounding real world can contribute to public significance (Teocharis, 2015), adding a new audience, as happened in various movements or, increasing activity, if a citizen was already involved in the process in the traditional way. Virtual, digital promotions can become more powerful, more representative than their traditional online versions, and online participation can stimulate activity offline (Basheva, 2020).

The work distinguishes between the concepts of "smart" and the SMART paradigm of goal setting and goal achievement. The SMART concept is an acronym for Specific, Measurable, Achievable, Relevant, and Time-bound. Applied to city management - the specificity of goals, measurability of resources, consistency and flexibility of goals, realism and manufacturability, controllability and manageability of urban infrastructure.

Methodology

Online actors can use the following approaches, methods and operations:

1) change the profile in support of a specific initiative;
2) arrange hashtags;
3) form and maintain petitions;
4) launch sites or disable access to them;
5) retweets;
6) organize groups in social networks;
7) post on social networks, etc.

Used Internet services (sites) are supported with helping:

1) volunteers;
2) "complaints" (public web receptions);
3) collecting public funds (crowdfunding platforms);
4) collection of open data;
5) geo-coordination (web maps, guidebooks, etc.);
6) "civic entertainment" (libraries, video clips, audio on civic topics, etc.

A method of correlation and regression analysis is needed between the search for information in social networks and the accompanying political participation, between the developments of civil social network platforms. For example, it is necessary to use cognitive maps and GIS to combat landfills, as it is implemented by the social movement in Russia "Garbage.Not.Net".

The study also uses systems analysis and synthesis methods. Methods and platforms of relevant digital discourse, increasing digital, media literacy, in particular, social forecasting and situational modeling, are used.

Using these methods and Big Data (Data Mining), the necessary decision-making methods and procedures are organized and activated. It is also important to consider the "curse of dimension" in an effective and powerful, distributed mobilization of new opportunities and forms of civic engagement.

Results and Discussion

For effective, and most importantly, effective influence on the citizens of the "smart city", you need hybrid functionality, the transition from online participation to offline participation, and vice versa. At the same time, we assume that "massive" socio-political activity can be "passive", without real actions in the group.

Internet activity contributes to awareness, improvement of relevant worldview and even user participation in the event (discussion, statement, etc.). We offer a project such as "Active Citizen" to solve the problems of the city, feedback from citizens in urban issues and surveys, with points exchanged for services and goods.

As a way to increase civic engagement in the infrastructure of a digital, smart city, the following methods and mechanisms are proposed, in particular:

1) blockchain (for example, municipal blockchain voting, organization of housing and communal services);
2) online network activities of volunteers;
3) provision of public services and creative self-realization online;

4) reducing the scale and pace, damage to the spread of fakes, inaccurate information;
5) testing civil readiness for the safe use of digital environments of the city (digital environment of personal development, competencies, business creation, etc.), etc.

Russian citizens by 2030 predict about 149 million people (Rosstat). Now the dynamics is different (Fig.1, the author's schedule according to Rosstat).

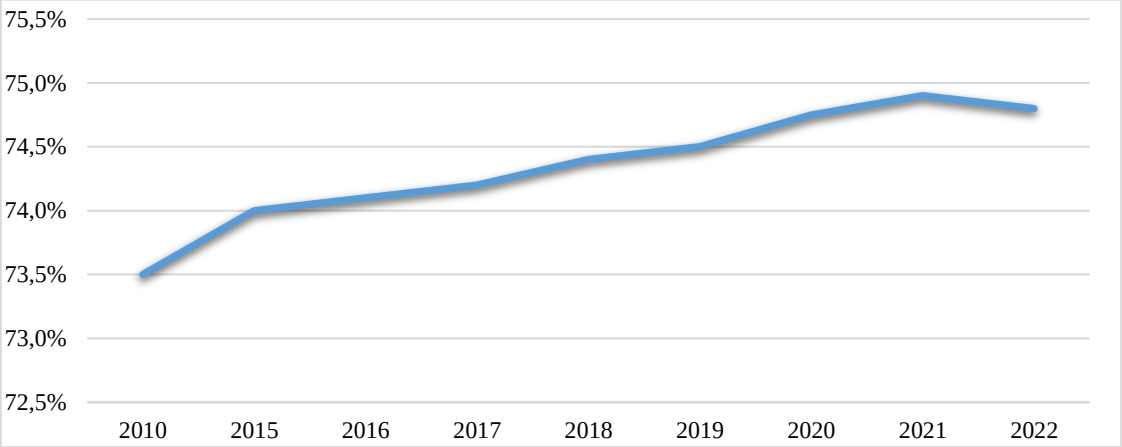

Fig. 1. The share of urban population in Russia.

These are drivers of digital innovations, despite the risks of a "smart city" - the growth of the unemployed, a decline in demand, the vulnerability of business processes, etc.

The problem of adaptive manageability of the "smart city" has been investigated. Let's highlight its subsystems:

1) "smart municipality";
2) "smart infrastructure";
3) "smart citizens";
4) "smart management (smart management of the municipality)", etc.

For example, a server that receives data from a cloud service analyzes it using Data Mining, GIS, etc., and then reverse regulation is carried out:

1) switching traffic lights (by pace, not by expectation);
2) GLANASS/GPS and GIS situation display;
3) heuristic analysis of situations with redistribution of flows, etc.

Smart city transport (cargo transportation service) and UBI (Usage Based Insurance) insurance for the use of cars creates effective urban transport systems.

The following structure of the Smart City class is proposed (Fig. 2).

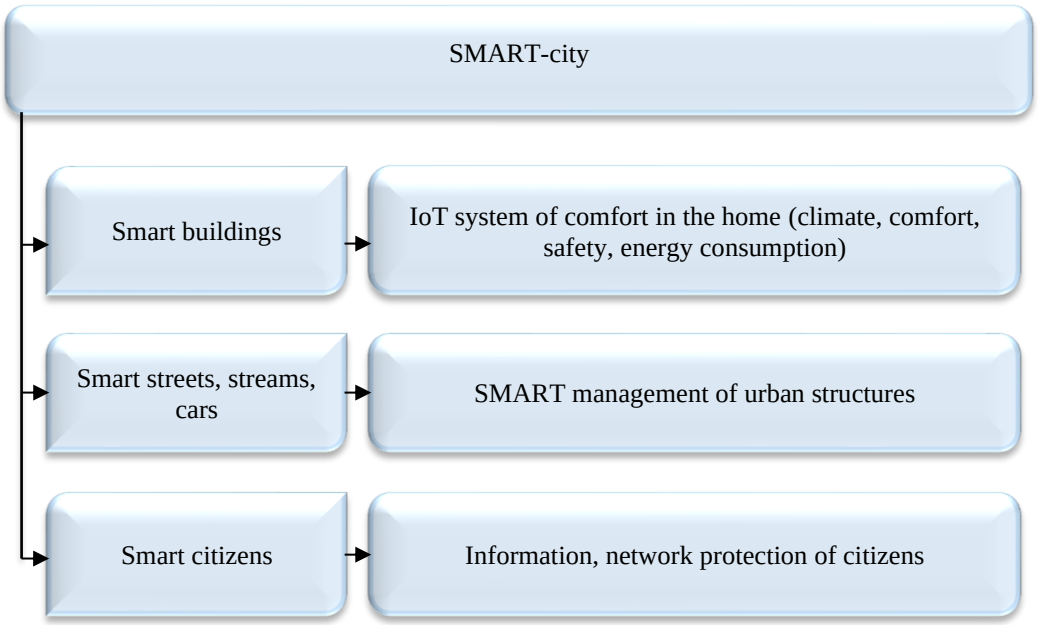

Fig. 2. SMART-city stages and tasks.

Note the features of the "smart city":

1) extensive, digital and intelligent infrastructure;
2) digital mobility and flexibility of citizens;
3) intelligent management and decision-making;
4) interactive feedback from city structures and citizens;
5) openness of city authorities;
6) developed logistics;
7) integrated distributed security system, etc.

"Smart City" dialectically, spirally develops, like everyone else, cyclically.

Note the following development cycles:

1) new structural methods in the old infrastructure;
2) new methods in infrastructure development;
3) new consumer preferences of citizens;
4) new investment and other attractiveness of the city;
5) a new level of competitiveness of the city.

The evolution of the "smart city" requires systemic integration of resources and analytics, decision-making in the face of multi-criteria and uncertainty. To reduce "noise", various approaches can be used, criteria, for example, Hurwitz, Pareto, etc.

Here is an example of using the Hurwitz criterion to assess the evolutionary potential of a smart city:

$$G_i = \gamma \min_{1\le j\le n}\{a_{ij}\} + (1-\gamma)\max_{1\le j\le n}\{a_{ij}\},$$

where $0 \le \gamma \le 1$ is a parameter (we find from statistics).

Optimal (according to Hurwitz) strategy (maximum among G_i):

$$g = \max_{1\le i\le m}\left\{\gamma \min_{1\le j\le n}\{a_{ij}\} + (1-\gamma)\max_{1\le j\le n}\{a_{ij}\}\right\}.$$

Test situation. For the winning matrix of various options for the development of a "smart city" of the form:

$$A = \begin{Vmatrix} 38 & 36 & 32 \\ 32 & 42 & 45 \\ 27 & 35 & 45 \end{Vmatrix},$$

with $\gamma = 0.5$ (neutrality) we get efficiency $g = 38.5$, with $\gamma = 0$ (optimism), we get $g = 45$, and with a pessimistic approach ($\gamma = 1$), we get $g = 32$.

The resulting metric integrates errors and risks.

Smart cities are designed and built in various countries: Zurich, Singapore, Oslo, Geneva, Copenhagen, New York, Tokyo, Shanghai, Amsterdam, Barcelona, etc. In Russia, more than 240 projects of "smart cities" are being developed (Ismagilova, 2019) (Moscow, Dubna, Krasnoyarsk, Samara, Nizhny Novgorod, Perm, Voronezh, St. Petersburg, Novosibirsk, etc.).

Some countries are taking measures to regulate Internet communications and online activity. The prospects for the participation of "digital citizens" in public administration and social development are growing as digital transformations in society and e-government evolve.

The digital environment, ecosystem contributes to the mobilization of citizens according to the degree of participation in socially significant projects and through various channels of cooperation.

The construction of the digital infrastructure of the municipality, the digital environment of citizens does not guarantee digital democracy yet. We need systemic efforts of the authorities, business, and society. Therefore, we need systematic research in this direction.

Conclusions

This study has demonstrated that the effective integration of smart cities and smart citizens into the digital economy requires a systematic and multidimensional approach. The analysis conducted has allowed for the identification of associated challenges and the proposal of strategic solutions to address them.

One of the main contributions of this work is the development of a structural framework for interactions between citizens, state, businesses, and society in the context of smart cities. This framework suggests that the integration of key subsystems into a unified infrastructure is crucial for the success of these initiatives. Furthermore, the importance of feedback mechanisms in urban projects such as "Active Citizen" and "Garbage.No.Net" has been highlighted, as they promote citizen participation and contribute to more efficient management of smart cities.

The study has also explored the potential of mathematical and decision-making approaches, such as the Hurwitz criterion, to investigate the self-regulation of smart cities. These approaches can help optimize the functioning of these cities and adapt to changing needs. Additionally, a class structure for the "Smart City" has been proposed, and its development cycles have been analyzed, providing a solid foundation for understanding and managing the evolution of these initiatives.

To foster citizen participation in the infrastructure of a digital and smart city, various promising methods and mechanisms have been identified, such as the use of blockchain, online volunteer activities, and the provision of digital public services. However, the study also acknowledges that the construction of digital infrastructures and environments alone does not guarantee true digital democracy. Systemic and coordinated efforts by authorities, businesses, and society are required to achieve this goal.

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