Financing the human environment development projects based on the concept of a smart sustainable city

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Abstract. Currently, the spread of the concept of a smart sustainable city as the basis for the development of the human environment is a worldwide trend. The issues of financing are of particular importance for the successful implementation of projects for the development of the human environment on the basis of this concept. The article discusses the concept of sustainability of the living environment in the modern conditions of the digital economy and also substantiates the relevance of studying the financial aspects of projects implementation within the framework of the concept of a smart sustainable city. As a result of the work, the authors analyzed the ways of financing projects for the development of the living environment on the basis of the concept of a smart sustainable city, highlighted the problems specified in these projects in the sphere of financial support, and concluded that the most promising ways for application are those, combining both public and private sources of financing in the face of growing demand for transformation of traditional urban infrastructure.

1 Introduction

The development of the human environment is an essential element of the formation of the digital economy, and more and more attention is paid by the authorities and the scientific community to the issues of increasing the sustainability of the living environment in connection with urbanization. According to the United Nations estimates, 60% of the world's population will live in cities by 2030 (50% in 2013), and this figure will increase to 66% by 2050 [1]. In addition, the highest rates of urbanization are predicted in Africa and Asia - 80% of global urban growth in the next 20 years, and many of the countries of these regions have a low level of technological equipment of the existing infrastructure [1].

Increasing the sustainability of the living environment has been a global task since the second half of the 20th century, when the professional community began studying actively the impact of human activities on the environment. If back in 1972 at the Stockholm Conference of the United Nations, the problems of sustainability were discussed as local, then already at the beginning of the 21st century they were recognized as global and requiring the use of joint efforts to eliminate them. The Paris Agreement, 2030 Agenda for Sustainable

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Development, New Urban Agenda, Sendai Framework for Disaster Risk Reduction 2015–2030 are emphasized among the international documents regulating the development of the human life environment in terms of sustainability [2].

Despite the increased relevance of sustainability as a characteristic of the human environment, the scientific community still does not have a complete understanding of the essence of this concept. The term sustainability was expressed for the first time in 1987 in the Brundtland Report, which was describing the contradictions between the striving of society for the constant development of the living environment and natural factors that restrict this process [3]. Over time, sustainability began to be considered as a state of the living environment that takes into account social, economic and environmental aspects [4-6]. Such a selection of just three components of sustainability is based on the theory of sustainability of an entity [7], however, the development of territories is not identical to the development of an entrepreneurial structure and therefore there is an opinion that the sustainability of the living environment should also include political and cultural aspects [8].

Accordingly, projects in the sphere of improving the sustainability of the living environment do not have a single and unambiguous theoretical basis, which affects the practical aspects of their implementation, including financing. The purpose of this work is to consider the concept of sustainability of the human environment in the modern conditions of the digital economy, as well as to analyze ways to finance projects for the development of the living environment based on the concept of a smart sustainable city.

2 Materials and methods

The spread of information and communication technologies in order to intensify the interaction of the subjects of the living environment functioning is an indispensable condition for the formation of a digital economy [9]. The main concept of territories in the digital economy is a smart city, which includes the improvement of infrastructure based on its digitalization - traditional interconnections are supplemented by digital ones in order to increase the comfort and safety of the living environment [10-12]. There is experience in the formation of smart cities of various levels - from fragmentary implementation to Greenfield projects, within the framework of which a smart city is being built in non-urbanized areas [13].

However, issues of sustainability in a smart city are considered indirectly, in particular, from the point of view of managing the consumption of natural resources (water and electricity) in housing and communal services. Consequently, at present, there is a process of forming the concept of a smart sustainable city, combining both aspects of a smart (information and communication technologies) and sustainable (long-term impact of technologies on the environment and socio-economic development) city [14-16].

The transport system and the consumption of natural resources are of the greatest importance within the framework of a smart sustainable city: in total, they account for 54% of projects in Europe (33% and 21%, respectively) [17]. Experts estimate that $ 2.5-3 trillion is spent globally on the development of infrastructure for smart sustainable cities, and over the next 15 years, it will be necessary to spend about $ 93 trillion on projects related to the reduction of air emissions from the functioning of the infrastructure; 70% of investments are made in already urbanized areas [2]. The OECD forecasts show that annual global spending on infrastructure in the next 5-10 years will be about US $ 3.3 trillion, or 3.5% of world GDP [18].

Financing projects of smart sustainable cities is one of the global challenges in the development of the human environment. In general, sources of financing investment projects are usually divided into public, private and mixed. The study by Deloitte based on data from
the European Commission revealed the following structure of financing sources for projects in the sphere of smart sustainable cities [19]:
- Private-public – 41%.
- Public - 49%, including state (federal) subsidies (15%), regional budget funds (15%), a combination of federal and regional budgets (19%).
- Private – 10%.

In order to achieve the United Nation’s Sustainable Development Goals (SDGs) US $ 1.1 trillion financing for smart sustainable cities projects is required (Fig. 1).

Fig. 1. The need for financing projects of smart sustainable cities [20].

Infrastructure financing in the United States has traditionally been carried out through municipal bonds, but in the context of digitalization, such methods as value capture, user and linkage fees are increasingly used. Financing through public-private partnerships (PPP) is widespread in South America, while in Europe the share of this method is decreasing due to the increasing importance of other financing schemes, which will be discussed in more detail in the next paragraph of this article. Russia and China mainly use budget financing, but the number of PPP projects is growing [21].

The issue of financing projects for the development of the human environment is of critical importance in countries with developing economies and low availability of even a basic infrastructure. On the other hand, the lack of traditional infrastructure typical for countries with developed economies, can, on the contrary, contribute to the implementation of smart sustainable city projects. So, there are no outdated telecommunication cables in Ethiopia, Libya and South Sudan, which makes it possible to implement 5G/LTE technologies immediately [22].

Advanced economies are striving to transform existing infrastructure. For example, in New York, outdated phone booths have been replaced with Links, which have Wi-Fi, sockets, transport information, a city navigator, and etc. The project was implemented under the PPP scheme. The expenses of a private investor - the CityBridge consortium - amounted to $ 200 million. The city will receive 50% of advertising revenue ($ 17.5 million) annually [23].

Thus, at present, the development of the human environment is associated with the implementation of projects in the sphere of smart sustainable cities. The projected growth in demand for investment in infrastructure projects determines the relevance of research into the financing issues of these projects. Each city and project is unique; therefore the financing methods must be used depending on the conditions and goals of project implementation.

### 3 Results

Selection of the financing method is an integral stage in the implementation of projects for the development of the human environment. The financing issues of projects in the
framework of smart sustainable cities are being studied to a greater extent by specialists from developing countries, which may be determined by a higher need for renewal and construction of infrastructure than in developed countries [24]. One of the main problems when selecting a method of a project financing for the development of a living environment is a commitment to economic benefits without taking into account the indirect results of the project, resulting in an increase in the sustainability of the living environment. [25]. Nevertheless, the experience gained in the implementation of projects of smart sustainable cities shows that such projects can simultaneously provide both profit for investors and increase the comfort and safety of the living environment [26].

Therefore, it is important to select a financing method suitable for a specific project for the development of the human environment in order to obtain benefits for all persons directly or indirectly involved in the project. The variety of projects for the development of the living environment within the framework of the concept of a smart sustainable city determines the availability of a wide range of financing methods (Table 1).

Table 1. Financing projects of smart sustainable cities.

| Source | Financing method |
|--------|------------------|
| K. A. Chauhan, A. K. Khambate, Shri. Partha Tripathy [27] | 1. Government subsidies (federal level): inter-budget transfers, targeted allocation of funds for a specific project.  
2. Government subsidies (regional and local levels): tax and non-tax revenues.  
3. External financing: PPP, debt instruments, real estate investment funds, venture financing.  
4. Auction, rent, sale, i.e. land monetization. |
| R. G. Rodriguez, P. Neves [28] | 1. Financing (funding) without return of invested funds: tax on real estate, land tax; business taxes; fees for using public services (for example - transport, toll roads); sale or lease of assets; government targeted subsidies; pay-for-performance.  
2. Financing with return of invested funds: attraction of funds from commercial or development banks; issue of municipal or project bonds; green bonds (for projects in the field of environmental conservation); vendor finance; Tax Increment Financing (TIF). |
| J. Berst [29] | 1. Government funding: general obligation bonds, revenue bonds, industrial revenue bonds, green bonds, qualified energy conservation bonds, social impact bonds, public benefit funds, linked deposit programs, energy efficiency loans, property-assessed clean energy programs, greenhouse emissions allowance auctions, user fees.  
2. Development Exactions: dedication requirements, tap fees, linkage fees, impact fees.  
3. Sharing private and public funds: public-private partnerships, pay for performance, securitization and structured finance, catastrophe bonds.  
4. Attracting funds from private investors: loan loss reserve funds, debt service reserves, loan guarantees, on-bill financing, pooled bond financing, pooled lease-purchasing finance, value capture, tax increment financing. |
| J. Skowron, M. Flynn [19] | 1. Subsidies: state, treasury, on the basis of grants.  
2. Debt financing: bonds, senior debt, export credit.  
3. With the involvement of private investors: capital of sponsors, infrastructure funds, multilateral financing.  
4. Hybrid financing: mezzanine loan, vendor finance, alternative lending. |

Thus, the implementation of projects for the development of the human environment presupposes the choice of the most suitable method of financing for specific conditions. Nevertheless, despite a wide range of funding sources and instruments, the most common
methods of project financing are direct budget financing, PPP, joint venture and operating agreement [19].

In our opinion, PPP is the most promising way of financing projects for the development of the human environment. According to World Bank, PPP is a long-term or medium-term agreement between the state and business structures, concluded with the aim of implementing a socially significant project on mutually beneficial terms [30]. A typical scheme for financing a project for the development of a human life environment on the basis of PPP is shown in Fig. 2.

![Fig. 2. Scheme of financing a project for the development of the human environment based on PPP [31].](image)

A structure (special purpose venture - SPV) is created within the framework of the PPP, which contains all the processes for the project implementation. As you can see, the project participants include not only financial institutions, but also consultants on various aspects of the project. Accordingly, the application of PPP in the sphere of smart sustainable cities requires the use of an interdisciplinary approach, since these projects are complex in nature, covering the tasks of improving the entire living environment as a whole [32]. The PPP mechanism allows involving many experts, suppliers, contractors and other project participants in the development of the living environment, which, in our opinion, is an important criterion when choosing a financing method on a long-term and mutually beneficial basis.

Thus, there are many ways of financing projects for the development of the living environment within the framework of the concept of a smart sustainable city, which are mainly divided into public, private and mixed financing in all varieties of forms of their application. We believe that the most promising are methods that combine both public and private sources of funding in the face of growing demand for the transformation of traditional urban infrastructure.

### 4 Discussion

The financing of projects for the development of the living environment within the framework of the concept of a smart sustainable city is a potential source of profit, which cannot but contribute to the interest of private investors in participating in such projects. According to McKinsey estimates 55% of smart city projects generate economic benefits and 45% generate non-financial benefits [33]. In the context of the transformation of cities and the growing need for financial resources to improve infrastructure, one of the problems of the development of the living environment may become difficulties in involving private investors in projects of smart sustainable cities. In addition, at present, there is already a
shortage of financing for infrastructure projects in the world, which is especially important for developing countries [34].

Also, the stagnation of the processes of interaction between the private and public sectors of the economy within the framework of the development of the living environment is facilitated by the long-term nature of projects and a high degree of uncertainty about the benefits of participation and the lack of experience gained in such cooperation [35]. When there is a deficit in regional budgets, the urgency of tasks of developing the living environment with the help of advanced technologies decreases and, accordingly, the intensity of the search for private partners for the joint implementation of large-scale and capital-intensive infrastructure projects decreases [27].

Moreover, it is extremely difficult for a private investor to attract credit funds in case of the most modern technologies introduction that have no analogues [29]. Also, the implementation of projects for the development of the living environment is accompanied by technological, operational, legislative risks, the possibility of force majeure circumstances occurrence [18].

Thus, despite the growing need for financing the development of the living environment, and on the bases of partnerships between the state and private investors, smart sustainable city projects are characterized by a number of risks leading to the lack of funding sources and, as a consequence, decrease in the rates of transformation of the human environment.

5 Conclusion

The development of the human environment is an integral vector of the digital economy formation. The introduction of modern technologies in order to improve the comfort and safety of the living environment is currently based on the concept of a smart sustainable city, which combines both technological aspects and tasks in the sphere of increasing the sustainability of cities from an environmental and socio-economic point of view.

The implementation of projects for the development of the living environment on the basis of the above concept can be founded on the use of various methods of financing, however, in our opinion, the most significant are financing schemes based on the joint participation of private investors and the state in the project, including those based within the framework of PPP in the context of urbanization and the growing demand for large infrastructure projects.

Despite the existing problems in attracting private investment in projects for the development of the living environment, experience is gradually gained in the successful implementation of such projects; new methods of financing are being developed. In conclusion, it should be said that the introduction of technologies into infrastructure is a global trend in the development of the human environment, therefore, the issues of financing smart sustainable cities projects are subject to further study by the scientific community. In matters of financing these projects, it is necessary to establish the fullest possible correspondence between the goals of private investors, the state and the population, since it is exactly the residents who are the main end users of the updated infrastructure.

The article was written as part of the work on the Grant of the President of the Russian Federation MK-462.2020.6.

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