

Development of the Smart City Concept in Sustainable Economy

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Abstract. The foundation of the new social structure of Russian State must be satisfaction of prioritized needs of Russian citizens that will enable moving into a higher level of development and increasing the number of people who carry out creative innovative activities. We suggest in that respect that, at the federal level, it is necessary to design and implement the unified concept and methodology of the real estate market management, including that subject to social and economic conditions of Russian constituent entities as well as the investment activities level. The authors carried out economic and mathematical modeling of the development of the Smart City concept. This will allow to substantiate a new theoretical approach to assessing The effectiveness of the implementation of Smart City projects. It is conclusion that with the development of new technologies, there is no unified approach to the process of urban area efficient management. Implementation of the Smart City concept is related to improving the efficiency of functioning (power efficiency) of certain buildings, infrastructure items, some city districts, and the city as a whole.

Keywords: it-technology, Smart technology, state, management, efficiency, model

1. Introduction

The present stage of evolution processes puts forward to the social conscience a problem of determining a further way for Russian society development because today it became urgently needed to rethink the accumulated experience and relevant transformation of the country economy management system for the purpose of national sustainable development. Transition of western countries to the fourth technological mode of social relationship development requires a new society to be built that is based on principle of legality, application of high moral and ethical ground, innovative approaches to the society management system, and broad application of IT-Technologies and Smart Technologies.

The foundation of the new social structure of Russian State must be satisfaction of prioritized needs of Russian citizens that will enable moving into a higher level of development and increasing the number of people who carry out creative innovative activities. We suggest in that respect that, at the federal level, it is necessary to design and implement the unified concept and methodology of the real estate market management, including that subject to social and economic conditions of Russian constituent entities as well as the investment activities level.

Application of the Smart system principles offers new opportunities for urban planning. This system is applied to develop all infrastructure sectors: traffic, power industry, housing and utilities sector, communications, land improvements, safety, environment parameters monitoring, and others. Today, all big companies and transnational structures actively invest in development of those technologies.



It is necessary to determine basic landmarks of managing real property items in Russian constituent entities. Therefore, the activities of entities at the real estate market that participate in and perform management is determined by financial and economic relationships and the following management levels: macro-level (federal level), meso-level (regional and municipal level), and micro-level (separate state-funded and business entities).

2. Methods

Presently, the real estate management system shows a number of unsolved problems related to various existing and project types of real property items, specific features of their management, number of participants involved in their regulation, as well as problems of the latest information processing, condition and position of the real estate market and its items as necessary for adequate management and regulation of such market [1] (Figure 1).

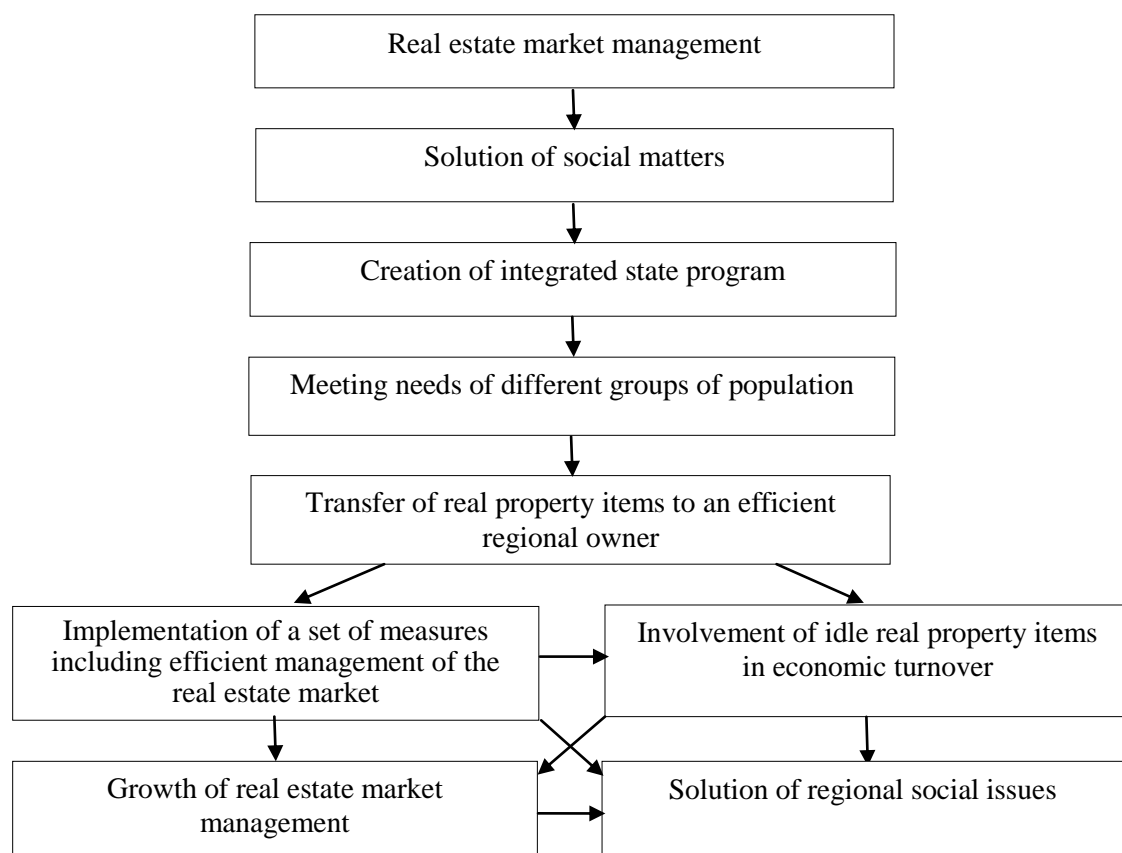


Figure 1. Model of efficient management of the regional real estate market

We suggest in that respect that, at the federal level, it is necessary to:

1. Determine the structure and appearance of modern real property items that facilitate increasing demand for such items, investment activities in construction and growing profit from real estate market activity.
2. Develop a concept of efficient management of state real property items in order to increase the state budget revenues.
3. Create environment for development of professional and competency-based management.

In our opinion, the system of national sustainable development must include such elements as the state, society, a human, economy, information technologies, and environment [2].

Therefore, in order to increase the life quality in the society, it is necessary to develop a new efficient science-based managerial tool to forecast possible negative risk events as precisely as possible, and to minimize them [3]. Today, the sustainable development planning process requires new theoretical science-based approaches, methodology and technology. Studies in the mentioned definitions allow the authors to articulate a new science-based approach to assessment of efficiency of the real estate market management that involves detecting qualitative and quantitative changes in the real estate market as an independent economic and legal phenomena and as an element of urban economy sustainable development using so called smart technologies (Smart City concept) that allows detailing the notion of efficient management of the real estate market which is the conjunction of work and innovative technologies related to completion of various activities by the real property's owner that are carried out for that owner's benefit on a payable basis.

The "real estate market management at the regional level" should be understood as planning and strategic activities carried out by regional authorities related to implementation of managerial processes (planning, coordination, control, and assessment) in respect of state real property items that is represented as creation of methodology for operating real property items that is based on regulatory framework of the Russian Federation and its constituent entities and which main objective is gaining profit and increasing the regional budget revenues, and such activities are carried out within the general social and economic strategy of the region development.

In the course of study, the authors developed an economic and mathematical model of the Sustainable Economic Development: Using the Smart Technology in Russia.

The problem of the economic and mathematical model is represented as follows: *Скорректировать*

$SED_{si}(x)$ is an index of sustainable economic development:

$$SED_{si}(x) \rightarrow extr, \quad s = \overline{1, \lambda}, \quad (1)$$

where $s = \overline{1, \lambda}$ are the numbers of indicators/standards of sustainable economic development optimality that may be represented is follows.

Change of the state strategy, improvement of life quality:

$SED_{sI}(x)$ means the maximization of putting into operation the "green housing" for i group of consumers:

$$\begin{cases} SED_{sI}(x) = \sum_{j=1}^m \sum_{t=1}^T \frac{d_{ijt} V_t}{P_{jt}}, & i = \overline{1, n}; \\ SED_{sI}(x) \rightarrow max. \end{cases} \quad (2)$$

where $i = \overline{1, n}$ mean groups of people living or buying housing which is so called "green housing";

$j = \overline{1, m}$ mean real property items that are constructed using innovative approaches to power saving (power efficiency) under the Smart City program development [4];

$t = \overline{1, T}$ means the year when the Smart City program is implemented;

d_{ij} means a share of capital investments granted under the Smart City program for the group of urban residents i of j -type residential real property ("green housing") at t -period ($0 \leq D \leq 1$);

V_t means a forecasted amount of funds granted under the Smart City program for construction of the "green housing" during t -period;

P_{jt} means the forecasted value of 1 m² of j -type "green housing" during t -period.

Besides, the authors introduced a criterion of the change in the state strategy, improvement of life quality that means maximization of putting into operation the "green housing" for i group of consumers:

Within development of theoretical basics of the Smart City project implementation, we should note that it is necessary to develop a system of criteria/indicators of "green" power efficiency of capital

construction projects. The list of such eco criteria/indicators based on the global experience studied, in particular basing on the article, is below (Table 1).

Table 1. List of eco indicators of capital construction projects

Eco indicator	Description
Criterion I_{CO2} – greenhouse gas emission	Volume of greenhouse gas emission. This indicator must not exceed
Criterion I_{SFB} – structural flexibility in buildings	Introduction of strict restrictions on structural flexibility in buildings
Criterion I_{HEAT} – level of structural heat insulation	Level of heat insulation in building envelopes, floor structures and cover
Criterion I_{SOLAR} – solar control criterion	Restriction of aggressive sun beams impact in spring and summer
Criterion I_{TAI*} – restriction on costs related to communications junction and maintenance costs	Restriction on construction materials used, costs related to communications junction
Criterion I_{SAN} – standards related to maintenance and the servicing of capital construction projects	Criterion reflects sanitary and epidemiologic requirements to a construction project and its operation.
Criterion I_{EKSP} – maintenance costs reduction	Saving on electricity generation to satisfy the building's needs
Criterion I_{UTIL} – indicator of power resources utilization	Reflects the volume of exhaust gases transfer to room temperature gases, efficiency factor

In our opinion, this list, first of all, must be referred to and assess the level of housing power efficiency. The economic and mathematical model developed is a basis of carrying out the state monitoring of the “green housing” development market by private developers who participate in the investment and development cluster. The study undertaken allows the authors to develop a model representation of the sustainable economic development paradigm using the Smart Technology.

3. Results

Up to now, both abroad and in Russia, there is no clear definition of the notion of “Smart City” [3]. The term “Smart City” implies, first of all, development of cities in sustainable economy; therefore, the city itself must be sustainable, competitive, efficient (including power efficiency), and comfortable for living. For that reason, *the authors’ define the Smart City* as the integral political and economic system of management of urban infrastructure that is based on innovative (information) approach, implements the principles of power saving and power efficiency in production and business processes, enables increasing investment attractiveness and competitive ability as well as creating environment comfortable for living and infrastructure that would provide for forecasting and minimizing risk events [5, 6].

Therefore, the concept of Smart City must include a set of basic and necessary elements as presented in Figure 2:

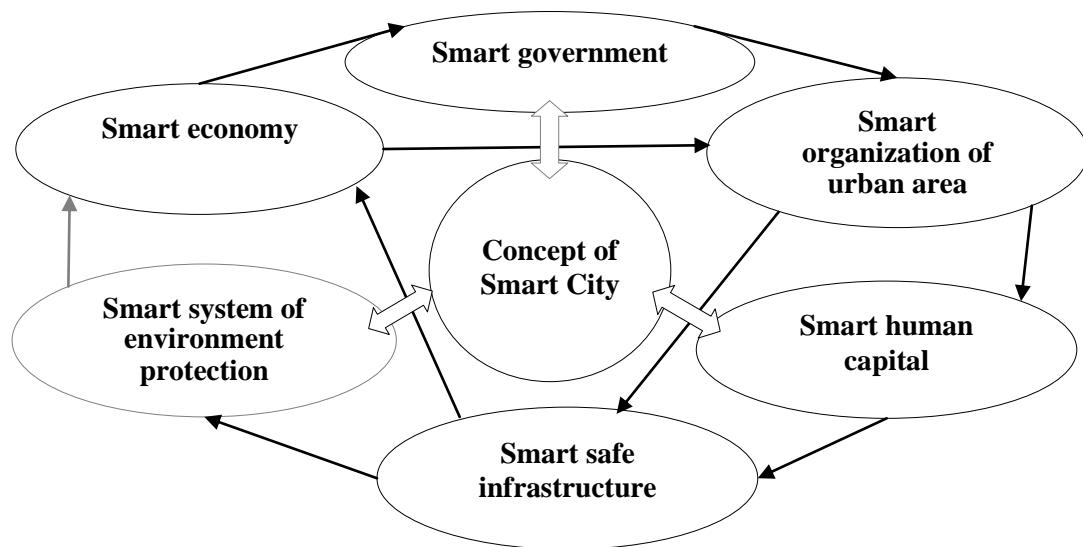


Figure 2. Basic elements of Smart City concept

1. Smart (electronic) government involving population in the process of adopting city development strategic plans and strategic decisions.

2. Smart economy (information, digital economy that represents conjunction of business environment adjusting to rapidly changing external and internal factors of functioning, flexible mobile job market, etc.).

3. Smart organization of life in the city involving implementation of information technologies in healthcare institutions, cultural sites, and educational centers.

4. Smart environment preservation based on the principles of natural resources saving, pollution control, and sustainable development of national economy.

5. Smart safe transport and information infrastructure that increases availability of the city in general and its districts for individuals from outside.

6. Smart human capital, recognition of rights, open mindedness, and cosmopolitanism.

Each element of the concept implies significant economic function that enables implementation of specific influence on humans' life quality and business in increase of life quality as well as increase in business economic potential. In Russia, the concept of Smart City was implemented, first of all, in such projects as Greenfield (Republic of Tatarstan), Innopolis, SmartCityKazan (construction of a new district in Kazan), Skolkovo project (Moscow Region), a new city of Ust-Luga (Leningrad Region), Olympic items clusters (Sochi, Krasnodar Krai), a residential neighborhood of Smart City (Ulyanovsk).

City development is recognized as sustainable if the balance of interests of economy and society development as well as environment preservation is kept. This definition enables assessment of efficiency of municipal authorities' policy, detection of city development problems and prospects, determination of disproportions in the city or the whole region development. The most balanced regions include Khanty-Mansi Autonomous Okrug, Central and Volga Federal Districts. So called differentiated (requiring individual approach to determine the development strategy) regions include cities in the Sverdlovsk, Belgorod, Vologda and Orenburg Regions. Transition of western countries to a new technological mode and development of Smart economy demonstrated an imminent need for changing Russian business-oriented economy, which is characterized by formation of conditions and prerequisites for private business with profit maximization as their key goal, stable functioning of a company at the market, and development of equity (speculative) market, for the next stage: sustainable economic development. Therefore, the main hypothesis of this research study is the need for changing the "resource economy" paradigm, which is characterized by non-efficiency of an owner (state or private business) for the paradigm of "sustainable development innovative economy" [7]. The model

of evolutionary development of state economic policy's interests and formation of a new theoretical approach to establishment of sustainable economy that is based on innovations foundation is represented in Figure 3 [8].

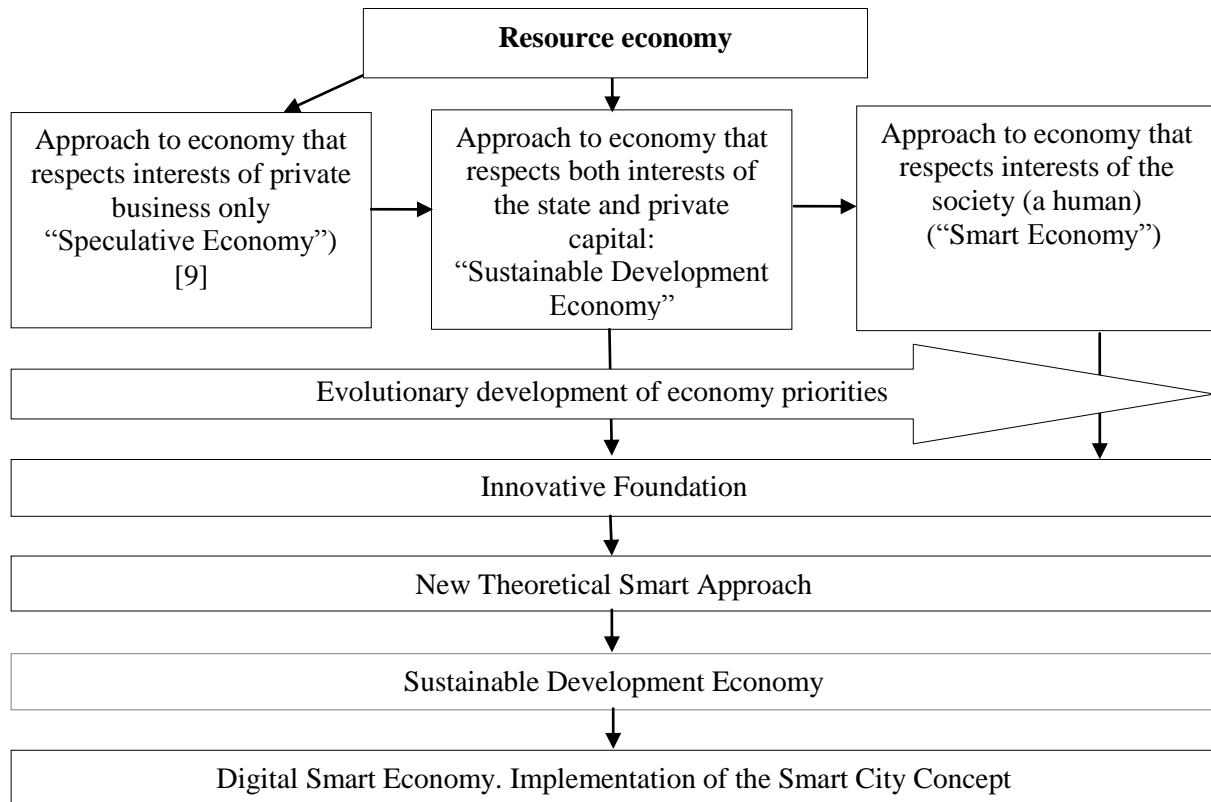


Figure 3. Model of evolutionary development of state economic policy

Basing on this dynamic model, an economic and mathematical model of sustainable development model with the Smart Technology applied was developed and successfully tested. Shift of the balance of system n of indicators/standards of sustainable economic development using the Smart Technology moves to the state economic policy with the lapse of time [10] as represented in Figure 4.

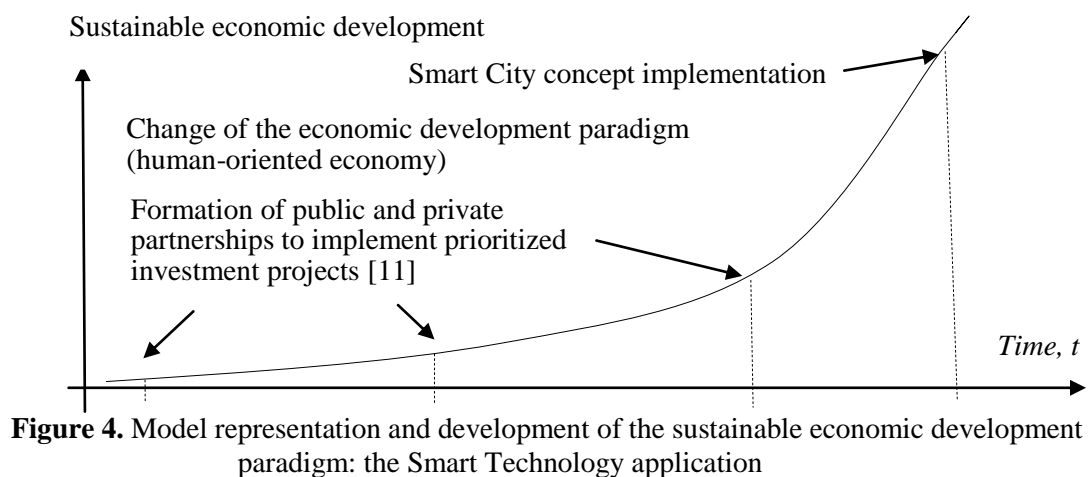


Figure 4. Model representation and development of the sustainable economic development paradigm: the Smart Technology application

This model is a basis of developing a new science-based managerial tool to forecast possible negative risk events as precisely as possible, minimize and efficiently manage them.

4. Discussion

The main factors of effective implementation of priority innovative projects are sustainable development of the country's economy as a whole, a specific Russian region, and sustainable urban development. It should be noted that the presence of uncertainty and risk in the economy leads to the emergence of centripetal forces of economic entities, leading to the formation of integrated structures, including with the participation of state capital. Stable sustainable development, on the contrary, leads to the emergence of centrifugal forces, the disintegration of large integration organisms. At the same time, the amount of state funding is significantly reduced, the proportion of "state capital / private capital" is shifting towards the private player in the market. In Figure 5 shows the model of the shift in the proportion of financing innovative projects "state-private business", depending on the state of the economy.

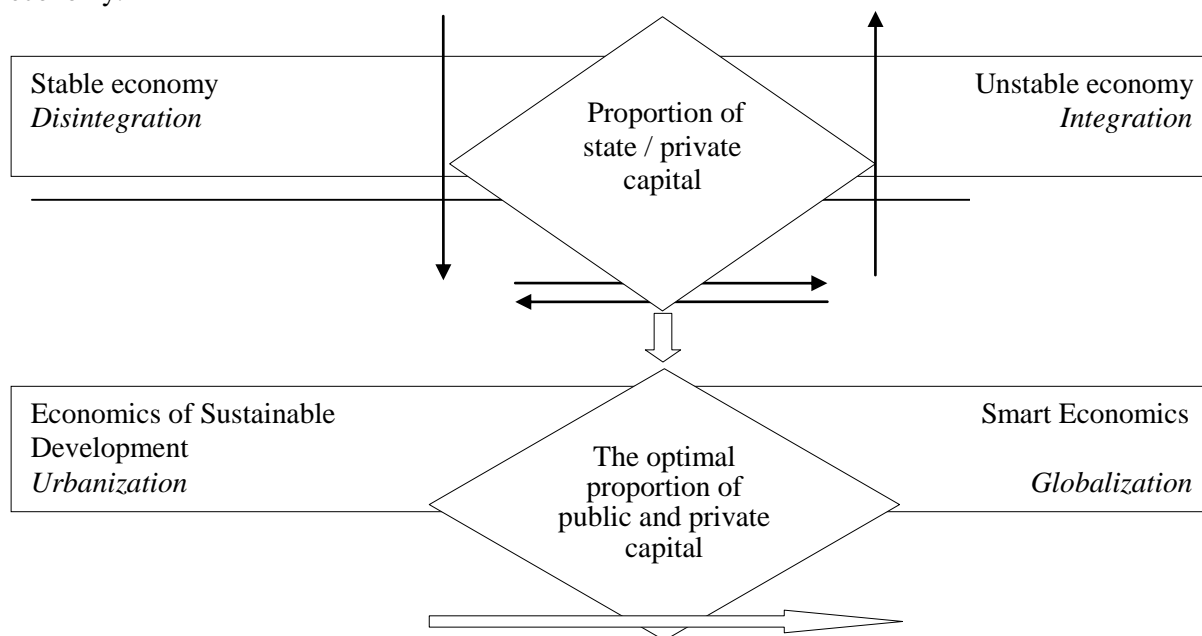


Figure 5. Displacement of the proportion of financing of "state-private capital" projects depending on the state of the economy

Simulation models under the Ashby law can also visually demonstrate the sustainability of the economic development of a particular region of the country (the "pyramid" principle). Simulation modeling of the stability of the region's economic development, within the territory of which an innovative project based on the "pyramid" principle is implemented, is shown in Figure 6.

Description of the state of sustainable development of the region:

$$\begin{cases} h = \sum F_i \rightarrow \min, \\ \sum F_i \leq H_{lim}, S \rightarrow \max, \\ U \rightarrow \max, \end{cases} \quad (3)$$

where h – Center of gravity (CG);

$\sum F_i$ – External factors $\sum F_i$ (conditions of uncertainty and risk);

H_{lim} – the limiting value of the total influence of factors;
 S – project manageability (the effectiveness of the innovative project management system), the area of the pyramid's support, is characterized by the financial stability of the project;
 U – Strategy: sustainable economic development of the region.

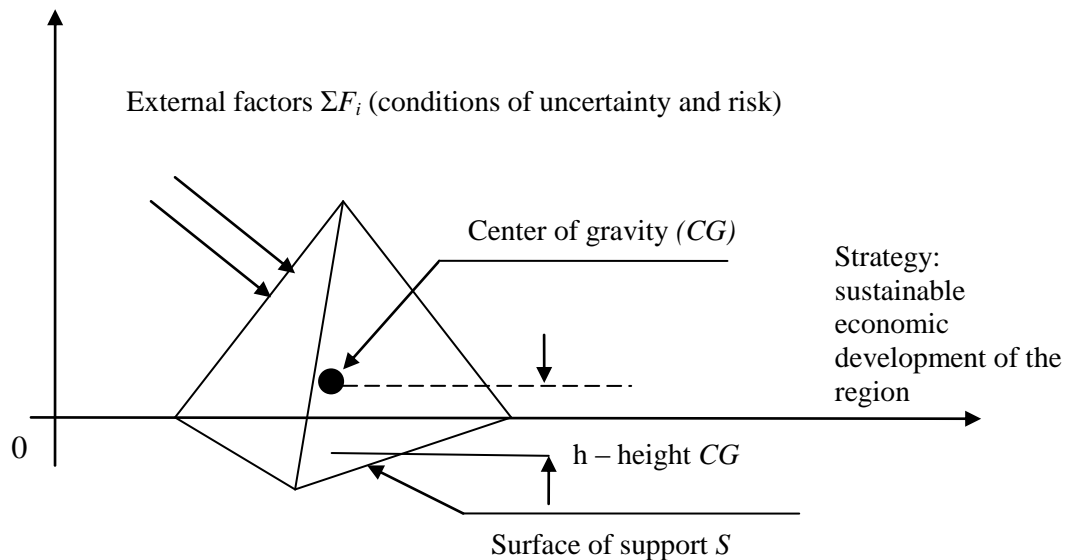


Figure 6. Simulation model of sustainable economic development of the region, the principle of "pyramid"

The author's scientific toolkit allows to carry out public-private monitoring of the effectiveness of innovations in the implementation of Smart projects.

5. Conclusion

The development of information technologies requires the development of an effective system of management of urban space. The authors on the basis of simulation modeling of sustainable development of the economy justified a new approach to evaluating the effectiveness of Smart projects, developed algorithms to assess the effectiveness of implementation projects with the use of nanotechnologies, adopted by innovative solutions. It is concluded that the authoring tools used to evaluate the effectiveness of management decisions in the framework of the implementation of the concept of "Smart City".

The expected positive consequences: an industrial revolution in IT-Technology, an increase in the efficiency of urban infrastructure, the involvement of cities in the standardization process, the development of a single set of performance indicators for Smart projects, the optimization of data collection on the necessary technologies for a particular city, and the introduction of intelligent and ecological systems.

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