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THE THESIS

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STATE SUPPORT FOR INNOVATIVE PROJECTS FOR THE DEVELOPMENT OF SOCIAL INFRASTRUCTURE OF TERRITORIES

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Global trends in the spread of the concept of a socially-oriented economy by the leading countries of the world form the need to find new tools to ensure the proper quality of life of the country's population, as well as mechanisms that can contribute to the growth of competitiveness and cohesion of society. The importance of innovative processes in the regions in this context is realized through the promotion of the development of creativity and intellectual potential of the population, which can ultimately influence the formation of social potential. Another important consequence of the development of innovative processes that take place in the fields of science, engineering and technology is the improvement of the structure of social space. Thus, the formation of an innovative environment in the social sector of the country becomes an extremely important task in ensuring the development of the social infrastructure of the territories. The key drivers that have a significant impact on the results and development of the social sphere in general and social infrastructure in particular are innovative processes that should be inherent in all participants and structures of the state, society and business at all stages of economic development. Awareness of the prospects and high level of efficiency of the innovative way of development of social infrastructure, actively supported in society, in all state and business structures, ensure the growth of not only scientific, technological and economic, but, no less important, labor and human potential. The purpose of the study is to substantiate and develop theoretical foundations, methodological provisions and applied recommendations for the state support of innovative projects for the development of social infrastructure of territories. The achievement of this goal necessitated the formulation and solution of a set of relevant tasks. The set goal and objectives of the study are achieved using a system of general scientific and special methods. The object of the research is the

process of state support for innovative projects for the development of social infrastructure of territories. The subject of the research is a set of theoretical, methodological and applied foundations for the formation and implementation of mechanisms of state support for innovative projects for the development of social infrastructure of territories. In the first section of the dissertation, social innovations are considered as an integral part of the innovative development of social infrastructure, the task of which is to organize social processes in a new way through new forms of organization, lifestyle or regulation. In addition, based on the study of the literature, it is established that social infrastructure can be considered as a set ofmaterial and material base of the social complex of territories (structures of the social sphere necessary for the organization of society) as well as public and quasi-public spaces, the purpose of which is to maintain an appropriate level of social connection through the provision of quality social services. It is established that sustainable development is an integral characteristic of social infrastructure, which is designed to ensure the social sustainability of infrastructure projects, and public-private partnership as an effective mechanism for ensuring innovative development of territories. The second section proposes a methodical approach to assessing the level of development of the social infrastructure of territories, the uniqueness of which lies in the presence of a wide range of stakeholders (state and local authorities, the business community and the public) who can use the results of the the purpose of assessing the proportionality of regional development and avoiding imbalances in the development of certain spheres of social infrastructure; to carry out a comparative assessment of the level of development of territories and the effectiveness of investment in the implementation of public-private partnership projects; for the adoption of strategic decisionson social policy. The main idea of the proposed methodical approach is the formation of an analytical profile of the level of development of social infrastructure in different regions of China in order to form targeted State support for innovative projects in the relevant spheres of social infrastructure, which will contribute to the efficiency of the use of public funds and reduce the level of regional disproportion in

the overall development of the social infrastructure of the State . The methodical approach provides for the step-by-step implementation of three methodological blocks, each of which is based on a certain calculation toolkit. The first block – the integral basis – involves the use of an integral indicator of the level of development of social infrastructure based on taxonomic analysis. The second block – clustering of regions – provides for the implementation of the procedure for dividing regions into groups (clusters) according to common socio-infrastructural characteristics. The third block – factor-analytical – is based on the use of factor analysis tools to determine a group of factors that influence the innovative development of the social infrastructure of territories. 1The formation of interaction of key stakeholders to ensure the efficiency of innovation processes of the social sector is substantiated on the basis of the model of four-level interaction, where the key stakeholders are the state, private partner, investors (sponsors), special agencies, innovation clusters and the final consumer (population of the country). Each level of interaction has its own characteristics and corresponding impact on the efficiency of innovation processes, which can only be achieved if the relevant requirements and criteria are met. The third section proposes mechanisms for the formation of interaction of key stakeholders through a certain degree of involvement of relevant stakeholders who are actively involved in the process of planning, development and implementation of social policy, which can be implemented through the use of a map of responsibility of institutions in the formation of policy for the development of social infrastructure of territories. Organizational-economic mechanisms for managing innovation activities of development are proposed social infrastructure of territories, which is the transformation of the influence of the external environment as the main source of innovative changes within the framework of the functioning of the innovation cluster, which at the same time acts as a source of resources that the social infrastructure as an open system uses at the entrance of its activities to ensure the expected result. The methodological basis of state regulation in the spheres of social infrastructure is the forms of public-private partnership as a universal toolkit, and the relevant principles, the observance of which should be a

prerequisite for making regulatory decisions on the implementation of innovative changes.

Keywords: socio-economic development, territory, state, community, management, mechanism, sustainable development, social infrastructure, clustering, public-private partnership, state support, innovations, innovative development.

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Сюй Вейдун Державна підтримка інноваційних проектів з розвитку соціальної інфраструктури територій – Рукопис.

Дисертація на здобуття наукового ступеня доктора філософії (PhD) за спеціальністю 073 − Менеджмент. − Сумський національний аграрний університет, м. Суми, 2023 р.

Сьогоднішні світові тенденції поширення концепції соціально-орієнтованої економіки провідними країнами світу формують необхідність пошуку нового інструментарію забезпечення належної якості життя населення країни, а також механізмів, здатних сприяти зростанню конкурентоспроможності та згуртованості суспільства. Значення інноваційних процесів в регіонах в цьому контексті реалізується через сприяння розвитку творчості та інтелектуального потенціалу населення, які здатні у кінцевому рахунку впливати на формування соціального потенціалу. Іншим важливим наслідком розвитку інноваційних процесів, які відбуваються у сферах науки, техніки і технологій, є поліпшення структури соціального простору. Отже, формування інноваційного середовища у соціальному секторі країни стає вкрай важливим завданням у забезпеченні розвитку соціальної інфраструктури територій. Ключовими драйверами, які мають істотний вплив на результати і розвиток соціальної сфери в цілому та соціальної інфраструктури зокрема, є інноваційні процеси, які мають бути властиві всім учасникам і структурам держави, суспільства і бізнесу на всіх етапах економічного розвитку. Усвідомлення перспективності і високого рівня ефективності інноваційного шляху розвитку соціальної інфраструктури, активно підтримувані в суспільстві, у всіх державних і бізнес-структурах, забезпечують зростання не тільки наукового, технологічного й економічного, але, що не менш важливо, – трудового і людського потенціалу. Мета дослідження полягає в обґрунтуванні та розробці теоретичних засад, методичних положень та прикладних рекомендацій щодо державної підтримки інноваційних проєктів розвитку соціальної інфраструктури територій. Досягнення цієї мети обумовило необхідність постановки та вирішення комплексу відповідних завдань. Поставлена мета і завдання дослідження досягається використанням системи загальнонаукових і

спеціальних методів. Об’єктом дослідження є процес державної підтримки інноваційних проєктів розвитку соціальної інфраструктури територій. Предмет дослідження складає множина теоретичних, методичних і прикладних засад формування та впровадження механізмів державної підтримки інноваційних проєктів розвитку соціальної інфраструктури територій. У першому розділі дисертаційної роботи розглянуто соціальні інновації як невід’ємну складову інноваційного розвитку соціальної інфраструктури, завданням якої є організація соціальних процесів новим способом через нові форми організації, спосіб життя або регулювання. Крім того на основі вивчення літератури встановлено, що соціальну інфраструктуру можна розглядати як сукупність матеріально-речової бази соціального комплексу територій (споруд соціальної сфери необхідної для організації життя суспільства) а також суспільних та квазігромадських просторів, метою яких є підтримка належного рівня соціального зв'язоку шляхом надання якісних соціальних послуг. Встанволено, що сталий розвиток є невід’ємною характеристикою соціальної інфраструктури, що покликана забезпечити соціальну сталість інфраструктурних проєктів, а державно-приватне партнерство як дієвий механізм забезпечення інноваційного розвитку територій. У другому розділі запропоновано методичний підхід до оцінювання рівня розвитку соціальної інфраструктури територій, унікальність якого полягає у наявності широкого спектру зацікавлених осіб (органів державної та місцевої влади, бізнес-спільноти та громадськості), які можуть використовувати його результати з метою оцінювання пропорціональності регіонального розвитку та уникнення диспропорцій у розвитку окремих сфер соціальної інфраструктури; для здійснення порівняльної оцінки рівня розвитку територій та ефективності інвестування в ході реалізації проєктів державно-приватного партнерства; для ухвалення стратегічних рішень державної соціальної політики. Головною ідеєю запропонованого методичного підходу є формування аналітичного профілю рівня розвитку соціальної інфраструктури в різних регіонах Китаю з метою формування цільової державної підтримки інноваційних проектів за відповідними сферами соціальної інфраструктури, що сприятиме ефективності використання державних коштів та зниженню рівня регіональної диспропорції у

загальному розвитку соціальної інфраструктури держави. Методичний підхід передбачає поетапну реалізацію трьох методичних блоків, кожен з яких базується на певному розрахунковому інструментарії. Перший блок – інтегральний базис – передбачає застосування інтегрального показника рівня розвитку соціальної інфраструктури на основі таксономічного аналізу. Другий блок – кластеризація регіонів – передбачає здійснення процедури розподілу регіонів на групи (кластери) за спільними соціально-інфраструктурними характеристиками. Третій блок – факторно-аналітичний - базується на застосуванні інструментарію факторного аналізу для визначення групи факторів, які здійснюють вплив на інноваційний розвиток соціальної інфраструктури територій. Обґрунтовано формування взаємодії ключових стейкхолдерів для забезпечення ефективності інноваційних процесів соціального сектору на основі моделі чотирьох рівневої взаємодії, де ключовими стейкхолдерами виступають держава, приватний партнер, інвестори (спонсори), спеціальні агенції, інноваційні кластери та кінцевий споживач (населення країни). Кожен рівень взаємодії має свої особливості та відповідний вплив на ефективність інноваційних процесів, яка може бути досягнута тільки за умови виконання відповідних вимог та критеріїв. У третьому розділі запропоновано механізми формування взаємодії ключових стейкхолдерів через визначену ступінь залучення відповідних зацікавлених сторін, які активно беруть участь у процесі планування, розробки та впровадження соціальної політики, що може бути реалізовано через застосування карти відповідальності інституцій у формуванні політики розвитку соціальної інфраструктури територій. Запропоновано організаційно-економічний механізмів управління інноваційною діяльністю розвитку соціальної інфраструктури територій, який представляє собою перетворення впливу зовнішнього середовища як основного джерела інноваційних змін в рамках функціонування інноваційного кластеру, який одночасно виступає джерелом ресурсів, які соціальна інфраструктура як відкрита система використовує на вході своєї діяльності для забезпечення очікуваного результату. Методологічним базисом державного регулювання за сферами соціальної інфраструктури є форми державно-приватного партнерства

як універсального інструментарію, та відповідні принципи, дотримання яких має бути обов'язковою умовою прийняття регуляторних рішень щодо впровадження інноваційних змін.

Ключові слова: соціально-економічний розвиток, територія, держава, громада, менеджмент, механізм, сталий розвиток, соціальна інфраструктура, кластеризація, державно-приватне партнерство, державна підтримка, інновації, інноваційний розвиток

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ANNEX 114

SECTION 1. THE PLACE AND ROLE OF ORGANIZATIONAL AND ECONOMIC MECHANISMS IN THE IMPLEMENTATION OF THE INNOVATIVE DEVELOPMENT MODEL

1.1. Conceptual apparatus, research methodology

In the era of transformational changes caused by globalization processes and changes in orientation towards a socially-oriented market economy, the development of social infrastructure is becoming the main tool for ensuring the quality of life of the population. The duality of the relationship between the quality of life of the population and the innovation and economic development of the state is manifested through synergistic interaction in terms of causal results of the formation of the country's intellectual and innovative potential. According to A. Degtiar [1], today's investments in the development of social infrastructure (education, medical care, information and communication facilities and communications, transport links, cultural environment and other areas), thanks to which the country's population is able to receive the necessary material and social benefits, become a springboard for the socio-economic well-being of the state in the future.

Taking into account the topics of research work, which consists in revealing the essence and features of state support for innovative projects for the development of social infrastructure of territories, we will focus on the study of key concepts of work. Accordingly, the basic framework of our research will be considered the following concepts: "social infrastructure", "innovations and innovative projects" and "state support" in terms of social infrastructure development.

Quantitative bibliometric analysis of publications in the Scopus scientometric database on social infrastructure in terms of innovative development and state support for the period from 2002 to 2022. demonstrated the growing interest of scientists to this topic (Figure 1.1).

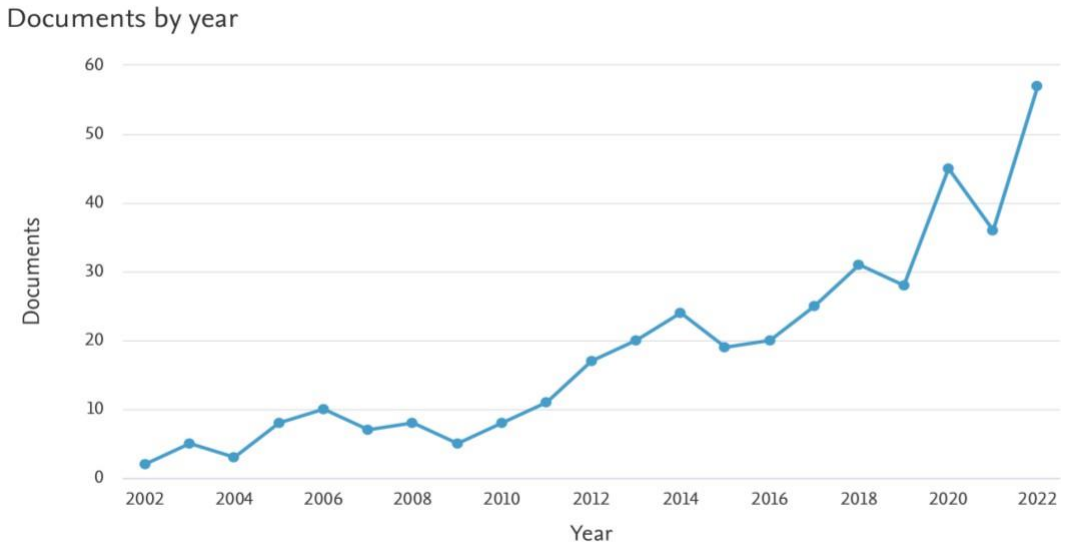


Fig.1.1. Publication activity on the topic "social infrastructure" *in the aspect of innovative development and state support*

Thus, in 2022, the number of publications in the title, abstract or keywords of which the phrase "social infrastructure" occurs reached 58 works. The search methodology assumed the use of advanced search tools with the combination of two sample arrays: the first array – the main one – asked the query for the keywords "social infrastructure"; The second array – additional – was searched by keywords "innovation", "innovative development", "state support" and others (Table 1.1). It should be noted that the main array reflects the object orientation, and an additional array is aimed at the subject-subject field of study.

Table 1.1.

Formation of a search array of bibliometric analysis of the thematic field of research work

Arrays	Search query
The main one is object-oriented	Search query keywords: social infrastructure (TITLE-ABS-KEY(*social AND infrastructure)
Additional – subject-subject-oriented	Search query keywords: innovations, innovative development, innovative projects, territorial development, social innovations, state support, government, public-private partnership TITLE-ABS-KEY (innovations) OR TITLE-ABS- KEY (innovative AND projects) AND TITLE-ABS KEY (development AND of AND territories) OR TITLE-ABS-
	KEY (social AND innovations) AND TITLE-ABS- KEY (state AND support) OR TITLE-ABS- KEY (government) OR TITLE-ABS- KEY (innovative AND development) OR TITLE-ABS-KEY (public-private AND partnership)))

The advanced search found 534 documents that met the criteria of the query. Structural analysis of the sample showed that the largest share of publications (28.5%) relates to the field of social sciences. Also, important areas of application of the categorical apparatus of social infrastructure are business, management, economics and environmental protection (Figure 1.2).

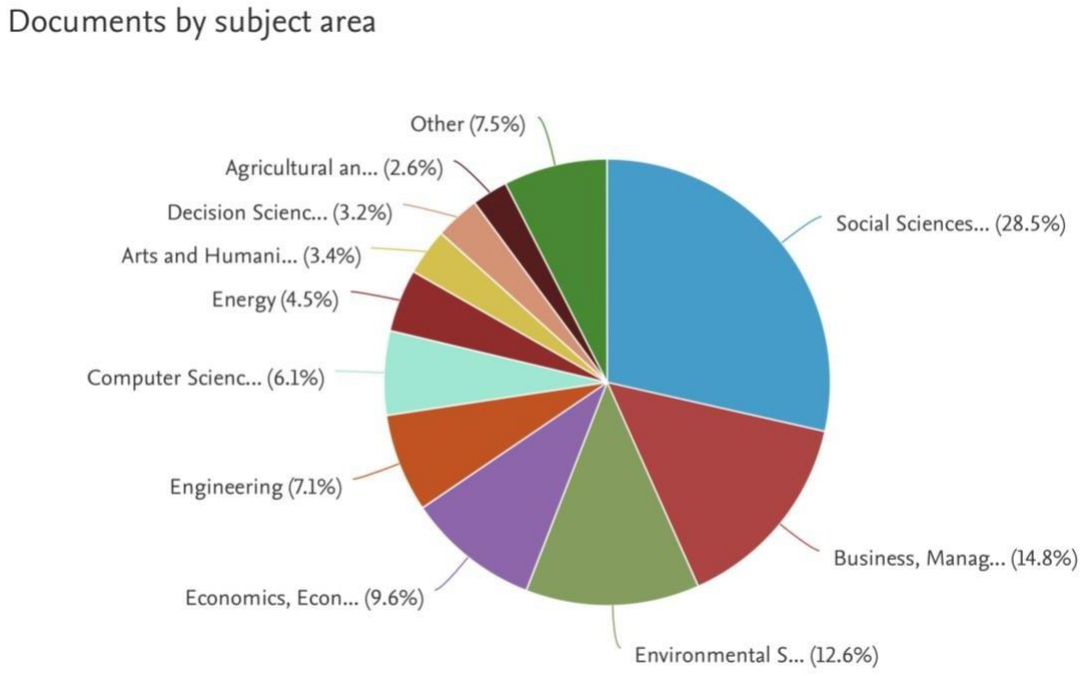


Fig.1.2. **Analysis of publications on the topic "social infrastructure"** *in the aspect of innovative development and state support* **by subject areas in the Scopus database for 2002–2022.**

1.2. Evolution of the organizational and economic mechanism of state stimulation of innovation activity in Ukraine and China.

The geographical distribution of publications postulates an uneven distribution of interest in the topic. Among the countries with the most contributions to the field of study are the United States of America and the United Kingdom, which have the highest number of publications. In third place is China, which testifies to the great interest of scientists in the topic of social infrastructure. Against 36 publications

belonging to scientists from China, Ukrainian scientists were the authors of only 5 articles (Figure 1.3).

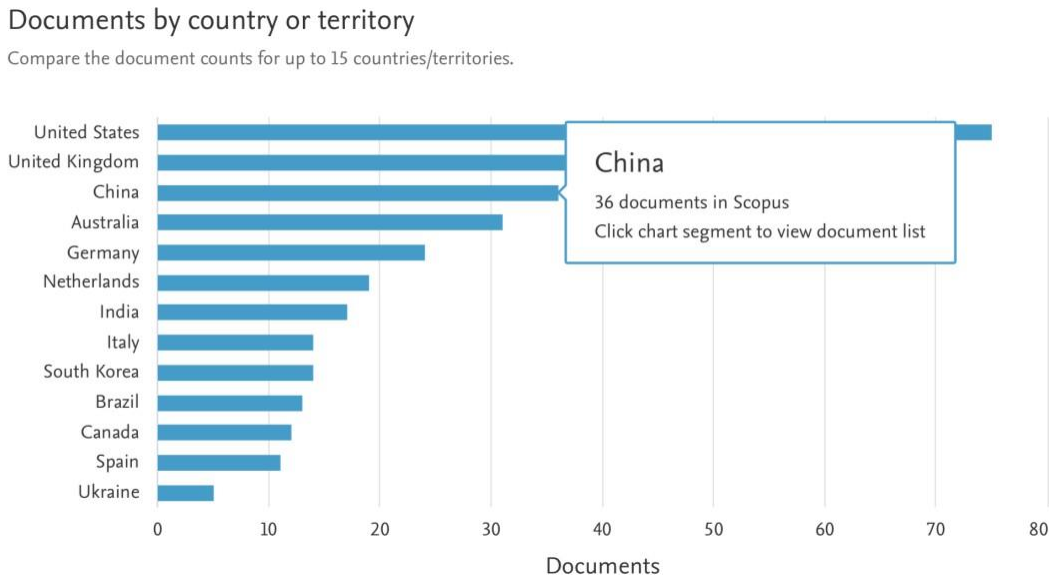


Fig.1.3. **Geographical distribution of publications on the topic "social infrastructure"** *in the aspect of innovative development and state support in* **the Scopus database for 2002–2022.**

But this trend is not surprising if we investigate the sources of research funding, the results of which were published works of scientists (Figure 1.4). Among the 15 organizations listed as sponsors for scientific projects, the National Natural Science Foundation of China is in the first place. Funding from this organization is noted in 11 studies. Also, organizations such as the European Commission, the National Science Foundation and the Bundesministerium für Bildung und Forschung made a significant contribution to sponsorship research on social infrastructure.

VOSviewer software was used to conduct cluster bibliographic analysis. It is a software tool for creating and visualizing bibliometric networks specializing in the graphical representation of bibliometric maps.

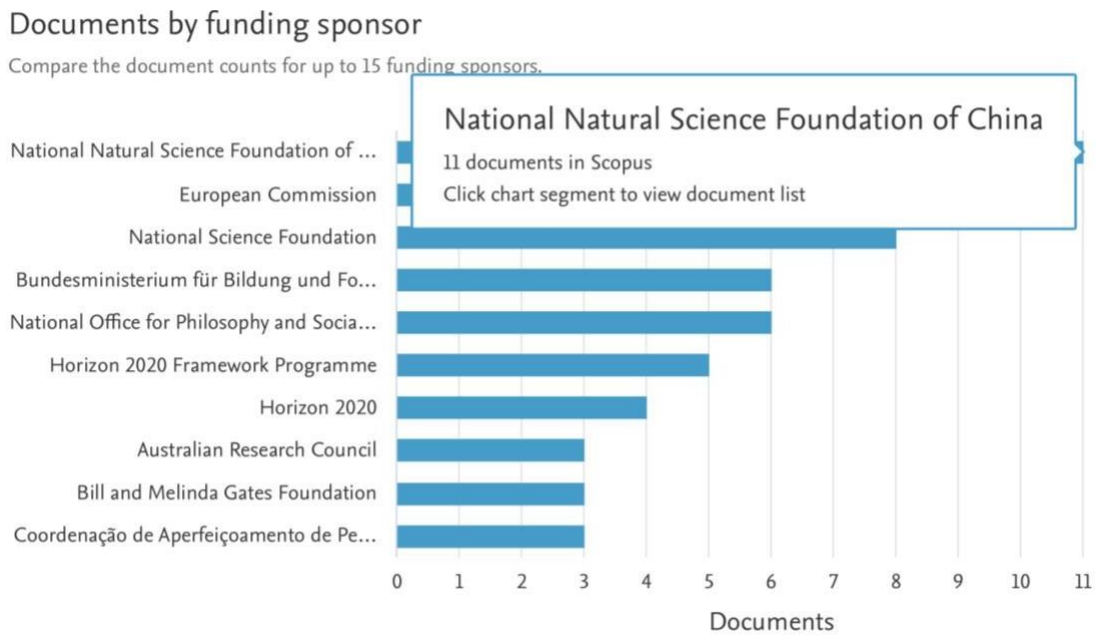


Fig.1.4. **Distribution of publications by sources of sponsorship and financial support in the Scopus database for 2002–2022.**

It provides different ways to display networks and allows you to examine the map closely using zoom, scroll, and search functions. Also, when dealing with a large number of elements, the cluster screen can provide a clear overview of the structure Network. Thus, VOSviewer was used to obtain bibliometric maps that help analyze the connections between topics [2]. The cluster display is used for better structural interpretation of the network. On the map, each unit is represented as a node. This can be a journal, category, author, article, or keyword. The distance between nodes shows their relationship. If two nodes are displayed close to each other, you can interpret it like this, that they are closely related. The links between nodes are direct shared citation, and the strength of links is proportional to the frequency of shared citation. Nodes connected to each other by stronger ties can be grouped into one cluster, and each cluster is assigned one color. It can be interpreted that the units in the cluster have high homogeneity, while the units in different clusters are heterogeneous [28].

1.3. Institutional, organizational and economic prerequisites for the development of social infrastructure of territories.

The combined array of input data from the Scopus and WoS databases was exported to the program and a cluster map was built based on keyword sharing. Accordingly, 11 clusters of 108 elements were formed, which have 488 links and distribute aspects of mentioning the concept of "social infrastructure" among the relevant groups. The clusters with the most significant contributions are centered around the following keywords: innovation, social innovation, infrastructure, sustainability, and sustainable development. The map of clusters by matching keywords on "social infrastructure" is shown in Fig. 1.5. and in Table 1.2. The cluster that has the largest number of ties (red cluster) is represented by the works of scientists who consider social infrastructure in the context of innovation. The most characteristic keywords of this cluster are innovation, innovation economy, digital transformation, digitalization, ecosystem, human capital, public-private partnership. Consequently, most authors, in the study of social infrastructure, emphasize the importance of innovation for the development of social infrastructure [3,4,5,6,7]. For example, Marti, L. [8] considers innovations in social infrastructure as an opportunity to overcome differences between different spheres of socio-economic activity of the state. Using the example of the study of the global innovation index of the European Union countries, the study shows that European governments should commit themselves to promoting economic policies that strengthen wealth, employment and research, as well as increase funding aimed at investing in social Infrastructure.

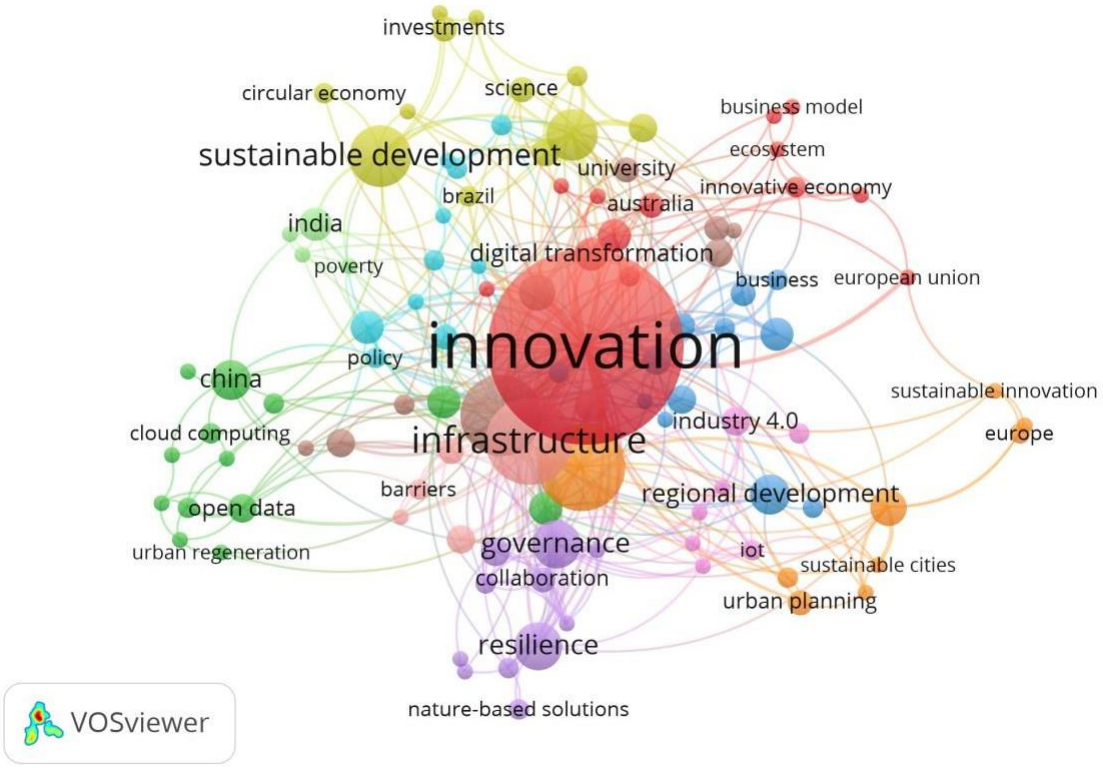


Fig.1.5 **Cluster map by keyword comparison on aspects of social infrastructure**

The core of the cluster "innovation" is the concept of "social innovations". The work of McCoyd, J. L. emphasizes the importance of social innovation in crises and emergencies. Using the example of a study on the adaptation of social services in their work during the Covid-19 pandemic, the authors show the importance of social innovations in adapting to new emergency needs of the population caused by crisis factors [9]. This context is also important for Ukraine today, given the heavy burden on social services and social infrastructure in general due to the war and its consequences for the population.

According to Biggs, R. and others [12] , there are three groups of important factors that contribute to the development and dissemination of social innovations: 1) innovation incentives; 2) sources of new ideas and approaches; 3) innovative diffusion, as a result of which new ideas and approaches are adopted and implemented.

Table 1.2

Characteristics of clusters of bibliometric analysis of social infrastructure

Cluster	Keywords	Cluster characteristics
Cluster 1 «Innovations»	Innovation, social innovation, ecosystem, digitalization, technology transfer, digital transformation, human capital, innovation economy, social capital, education, business model, etc.	Most of the authors, in the study of social infrastructure, emphasize the importance of innovation for the development of social infrastructure
Cluster 2 «Infrastructure»	Social services, digital economy, smart city, big data, social media, urban relocation, cooperation, open data, regional development, entrepreneurship, etc.	Cluster of articles that reveal the peculiarities of social infrastructure through the provision of social services, urban approach and technologies of smart cities, taking into account the peculiarities of regional development and the digital economy
Cluster 3 «Sustainable development»	Corporate social responsibility, rural development, civil society, agriculture, climate change, regions, tourism, sustainability, urban sustainability, sustainable innovation, green economy, etc.	The publications of this cluster are devoted to the aspect of sustainable development within the framework of social infrastructure formation. Most authors explore sustainability as a criterion of modern social infrastructure. The main emphasis is made on the development of rural infrastructure and tourism.
Cluster 4 "Cooperation"	Government, collaboration, transformation, public-private partnership, cooperation, sustainable solutions, social work, industry 4.0., civic engagement	This cluster of works is united on the principle of partnership interaction, which is considered as an effective tool in the development of social infrastructure. Public-private partnership in this context is the main factor of development and driver of success

The presented groups of factors, according to the authors, are not necessarily implemented in this fixed sequence, they can exert their influence simultaneously in several directions between different components, which depends on the rethinking of perspectives, stakeholders and institutional support. Stoustrup, S. goes further, and considers social innovations as mechanisms of change, which functions at the micro and meso levels, with the evolution of public initiatives that arise from the continuous interaction between them and public institutions into social innovation [11]. The author introduces the concept of radical social innovations, which, unlike traditional

(gradual) social innovations, appear locally after gradual innovation processes of institutional changes and processes teaching. Accordingly, the success of local radical social innovations lies in the successful development of interconnections and synergies with other local and regional actions and frameworks.

Therefore, taking into account the context of the above thoughts, we will consider *social innovations in our research as an integral part of the innovative development of social infrastructure, the task of which is to organize social processes in a new way through new forms of organization, lifestyle or regulation*.

The next by the number of intellectual connections is cluster 2 "infrastructure", which reveals the features of social infrastructure through the provision of social services, urban approach and smart city technologies, taking into account the peculiarities of regional development and digital economy. The core of this cluster is the concepts of "social infrastructure", "social services" and "regional development".

The most modern, from the point of view of the prevalence of use, is the concept of "social infrastructure". Considering this category, we can distinguish four ways to use the concept of social infrastructure (Fig.1.6.). The starting point for understanding each concept is the primary cause of the emergence of social infrastructure as such.

The first approach to understanding social infrastructure has to do with the argument that man is infrastructure. For example, Simone, A. argues that in the absence of formal physical infrastructure, relationships between people and ways to maintain them can be understood as the formation of a kind of infrastructure [13]. Writing in the context of Johannesburg in the early 2000s, working with infrastructure provided Simone with a living vocabulary, to describe how life functions in most suburbs of the city, and how opportunities for agreement and cooperation are possible in informal and complex spaces. Since the 2000s, thanks to the work "People as infrastructure: Intersecting fragments in Johannesburg", the concept of "people as infrastructure" has been widespread, denoting social infrastructure as a potential for collective life [14]. It is an approach to social infrastructure that is based on the understanding that social energy and effort can function as infrastructure without infrastructure support.

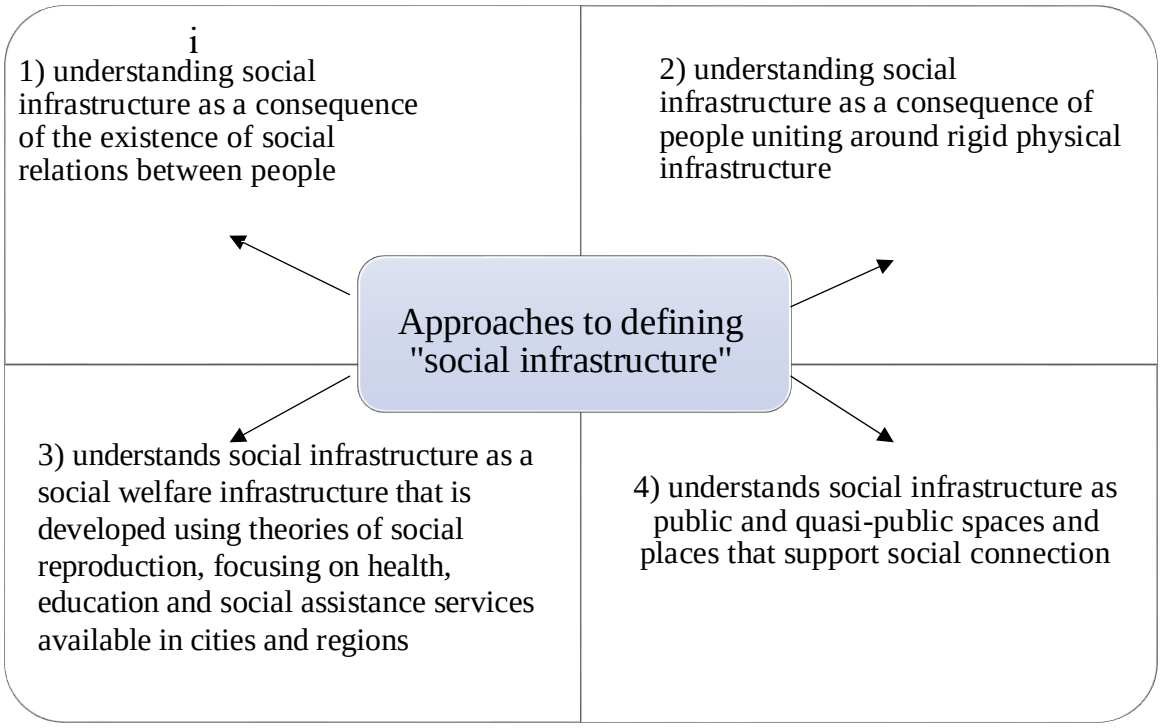


Fig.1.6. **Approaches to understanding social infrastructure**

The second approach to defining social infrastructure is closely related to the first. It focuses on sociality, that is, uniting people around conventional rigid physical infrastructures such as water, sanitation, and energy. Here, the concept of social infrastructure refers to complex social systems in an underfunded and undersupported urban environment [15]. Central to this concept is understanding how social, cultural and political factors can distort access to infrastructure. For example, research by some authors focuses on unequal relations between caste, class, religion, race and gender, as well as the consequences of distribution and access to basic services in cities [16,17]. Thus, this definition of social infrastructure defines not so much the infrastructure of social relations as the social relations of power and politics, which are tied to infrastructures.

The third approach understands social infrastructure as social welfare infrastructure that is developed through theories of social reproduction, focuses on health, education and social assistance services available in cities and regions. This

definition of social infrastructure is intended to draw attention to interconnected combination of objects, places, space, programs, projects, services and networks that support and improve the standard of living and quality of life in the community [18]. According to this approach, social infrastructure is understood as one that includes social spaces such as hospitals, schools, nursing homes, mental health services, and other spaces that perform a wide range of specific functions, but are understood as the collective provision of care for the population of an inclusive category. A positive feature of this interpretation is the definition of the place and role of not only the network of infrastructure elements, but also a set of social programs and projects that equally, in modern conditions, provide the main goal of social development.

Finally, the fourth approach focuses on social life infrastructure and understands social infrastructure as public and quasi-public spaces and places that support social connectivity. The starting point of this approach is the work of sociologist Eric Klinenberg, who, studying heat mortality rates in Chicago in 1995, found that the decisive factor in whether vulnerable groups live is the ability to access public and quasi-public spaces. On In his opinion, such spaces constitute social infrastructure and recognized, and as a result, social infrastructure is essential for the development of vital, inclusive urban areas [19].

With the spread of management practices and the need for a more substantive attitude to the category of social infrastructure, many authors began to consider social infrastructure at different levels: country, region and city. Theoretical studies of these categories can be divided into two links. The first link includes scientists who see the identity of these concepts, delimiting them only by the territorial affiliation of infrastructure elements [20,21]. Representatives of the second link endow the social infrastructure of a country, region or city with special distinctive characteristics. So, for example, according to Gnaneshwari R. social infrastructure of the country is considered as aof fixed assets that are necessary for human development [22]. Cothe civilian infrastructure of the regions, according to the Lithuanian scientist Atkociuniene V. should allow "to form sustainable communities through further

development of three-dimensional and inclusive civic activities, allocation of resources, strengthening the competence and trust of individuals and community groups, allowing them to take effective actions and play leadership roles" [23]. Also common is the definition provided by the British Property Foundation, which defines the social infrastructure of the region as "an integral part of building resilient communities, which provides most of the tools to support the community, providing it with services and facilities that meet the needs of residents, promote social interaction and improve the overall quality of life within the community" [24].

An integral part of social infrastructure is a social service, through which social assistance measures are implemented in kind or in cash, which helps households and individuals cope with various forms of vulnerability. Bricocoli, M. proposes to consider social infrastructure as a space of social services, which is actually a long-term physical asset in the social sectors that provide goods and services. In his opinion, despite strong institutional features and functional purpose, social services can provide appropriate inclusion and form social ties [10]. This view is even more relevant in light of the development of public-private partnerships, which characterize the current provision of social protection services, which calls into question not only traditional planning strategies and tools used to design social spaces services, but also ways to provide them to the public.

So, taking into account the context of the above thoughts, we will consider *the social infrastructure in our research as a set of material base of the social complex of territories (social facilities necessary for the organization of society), as well as public and quasi-public spaces, the purpose of which is to maintain an adequate level of social connection by providing quality social services*.

The next cluster of publications (Cluster 3 – "sustainable development") is devoted to the aspect of sustainable development within the framework of social infrastructure formation. Most authors explore sustainability as a criterion of modern social infrastructure. The main emphasis is made on the development of rural

infrastructure and tourism. The core of this cluster is such concepts as "social responsibility" and "sustainable development".

From focusing on the biophysical and economic considerations of the built environment Sierra, L. proposes to pay attention to social sustainability and social responsibility when evaluating investments in infrastructure projects. The team of authors proposes a method for assessing the contribution of infrastructure projects to social sustainability. This method takes into account the interaction of infrastructure with the environment in view of the potential for short-term and long-term social improvement [25].

The peculiarities of social responsibility management of large infrastructure projects are comprehensively covered in the works of Chinese scientists. For example, Zeng, S. in collaboration with other scientists propose the concept of social responsibility of large infrastructure projects, which covers three dimensions: the dynamics of the project life cycle; heterogeneity of stakeholders and interactivity of social responsibility [26]. They note that since large infrastructure projects occupy very important strategic positions in China's national economy and social development, their social responsibility and sustainability is crucial for the sustainable development of the country as a whole. Wang, Z. and others emphasize that social sustainability was not sufficiently taken into account when designing and managing social infrastructure. In their study, they present a two-level categorical classification of social impacts on social infrastructure and a monetization approach for transferring social consequences to social costs [27].

The bibliometric analysis of cluster 3 shows us that the study of social infrastructure in the context of social responsibility integrates three main areas of sustainability – environmental, economic and social. The study of the environmental aspect is related to the study of environmental problems, which consist of natural components, as well as the stress imposed on urban areas to adapt to climate change (for example, the work of Wang, H. and Pei, Z. [29]). In any case, the papers bringing together environmental, economic and social sustainability strands focus on topics such

as the application of green infrastructure in sustainable cities (e.g. the work of Cengiz, C. and Boz, A. [30]), or outlining the role and significance of sustainable infrastructure in urban areas (e.g. the work of Wang, J. and Banzhaf, E., [31]).

According to Fischer, J.M. and Amekudzi, A. at the present stage, sustainable development is becoming a more important goal in planning and policy development in the field of social infrastructure, and the quality of life is considered by the authors as an important measure for understanding, characterizing and effectively applying in the search and development of appropriate infrastructure solutions for sustainable development. They explain the importance of the quality of life parameter in decision-making on the development of social infrastructure in the context of sustainable development on the example of the use of strategically developed or rebuilt infrastructure of regional importance while preserving or improving the natural environment. Based on a theoretical review and study of examples of infrastructure development, the authors propose a new paradigm that considers infrastructure development as part of a socio-technical system. This paradigm encourages strategic infrastructure development and policies that expand choice and achieve numerous sustainable development goals [32].

Therefore, taking into account the context of the above thoughts, we will consider *social responsibility and sustainable development as an integral characteristic of social infrastructure designed to ensure the social sustainability of infrastructure projects.*

Finally, the fourth cluster of publications (Cluster 4 – "cooperation") is devoted to the aspect of partnership in the approach to managing social infrastructure development. Cooperation in this context is considered as an effective tool in the development of social infrastructure, and public-private partnership is the main factor of development and driver of success.

Public-private partnership is an institutional and organizational alliance between governments, regional governments and businesses, based on joint financing of projects. Lember, V. and others believe that public-private partnerships can stimulate

important changes in the management and delivery of public services by using it as a tool to implement market deregulation. Public-private partnership opens up opportunities for the market and citizens to participate in the development of public policy in social sectors of the economy that were previously considered state monopolies (transport, medical, energy and other sectors), involving private market operators, and sometimes groups of citizens to meet public needs [33]. At the same time, governments can use public-private partnerships as a new governance mechanism in developing the strategic capacities of various social and market agents in order to increase the legitimacy of government. Therefore, according to the authors of the study, public-private partnership changes not only the relationship and power structure between government and the market, but also between government and citizens.

Ma, L. and colleagues believe that social infrastructure has become an important element for measuring national economic development and social benefits, which are usually financed in the form of public grants, private investment and public-private partnerships. In their research, they conduct scientometric analysis to systematically select literature and structure the body of knowledge about public-private partnership publications and social infrastructure. The results of the analysis conducted by the authors show that public-private partnership, as before, has valuable potential for creating social infrastructure. They identify six main research topics, namely: "financial and economic viability, risk management, performance management, contract and relationship management, management and regulation, as well as favorable and inhibitive factors" in the field of public-private partnerships [34]. In terms of practical application, they identify major gaps between developed and developing countries and outline the areas and future challenges of public-private partnerships in three main areas: hospitals, schools, and housing.

Therefore, taking into account the context of the above thoughts, we will consider *public-private partnership as an effective mechanism for ensuring innovative development of territories*.

Thus, our bibliometric analysis of publications in the Scopus and WoS scientometric databases on social infrastructure in terms of innovative development and state support allowed us to draw the following conclusions:

1) for the period from 2002 to 2022. there is a significant increase in the interest of scientists in this topic;

2) geographical distribution of publications postulates an uneven distribution of interest in the topic. Among the countries with the most contributions to the field of study are the United States of America and the United Kingdom, which have the highest number of publications. In third place is China, which testifies to the great interest of scientists in the topic of social infrastructure;

3) cluster map by keyword comparison on aspects of social infrastructure is represented by 4 main groups, which are named by the dominant keywords by the number of links: Cluster 1 "innovation", Cluster 2 "infrastructure", Cluster 3 "sustainable development", Cluster 4 "cooperation".

The analysis of publications of each cluster allowed to form a categorical research apparatus, taking into account the context and opinions of different authors on various aspects of the manifestation of social infrastructure as an economic category, namely (Figure 1.7):

consider *social innovations as an integral part of the innovative development of social infrastructure, the task of which is to organize social processes in a new way through new forms of organization, lifestyle or regulation*;

consider *social infrastructure as a set of material and material base of the social complex of territories (social facilities necessary for the organization of society), as well as public and quasi-public spaces, the purpose of which is to maintain an adequate level of social connection by providing quality social services*;

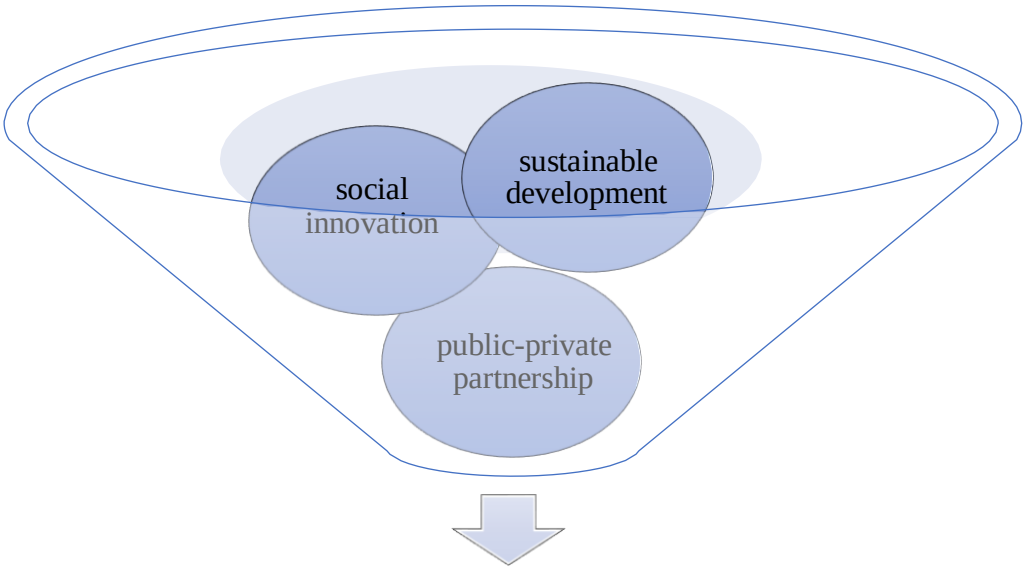


Fig.1.7. **The main substantive aspects of the category "social infrastructure"**

consider social *responsibility and sustainable development as an integral characteristic of social infrastructure designed to ensure the social sustainability of infrastructure projects*;

to consider *public-private partnership as an effective mechanism for ensuring innovative development of territories.*

SECTION 2. RESEARCH OF THE LEVEL OF INNOVATIVE DEVELOPMENT OF SOCIAL INFRASTRUCTURE IN UKRAINE AND CHINA

2.1.Research of the state of innovation processes in the social sector of Ukraine

Today's global trends in the spread of the concept of socially-oriented economy by the leading countries of the world form the need to find new tools to ensure an adequate quality of life of the country's population, as well as mechanisms that can contribute to the growth of competitiveness and cohesion of society. According to L. Fedulova, the introduction of such mechanisms involves strengthening the strategic role of the state, primarily in determining priorities and directions for the development of the social sector of the economy [1]. The importance of innovation processes in this context is realized through the promotion of the development of creativity and intellectual potential of the population, which can ultimately influence the formation of social potential. Another important consequence of the development of innovation processes that occur in the fields of science, technology and technology is the improvement of the structure of social space. Consequently, the formation of an innovative environment in the social sector of the country becomes an extremely important task in ensuring the development of social infrastructure of the territories. The key drivers that have a significant impact on the results and development of the social sphere in general and social infrastructure in particular are innovative processes that should be inherent in all participants and structures of the state, society and business at all stages of economic development. Awareness of the prospects and high level of efficiency of the innovative way of social infrastructure development, actively supported in society, in all state and business structures, ensure the growth of not only scientific, technological and economic, but, last but not least, labor and human potential.

In Ukraine, the development of innovation processes in the social sector is

complicated today not only by the consequences of years of systemic crisis and lack of proper attention of state authorities, but also by the unprecedented invasion of the Russian Federation, which has been causing a devastating effect on social infrastructure for more than a year. Thus, according to the Ministry of Infrastructure of Ukraine [2], the amount of direct losses of Ukraine's infrastructure from the war amounted to $ 143.8 billion. The analytical report provided by the think tank at the Kyiv School of Economics together with the Office of the President of Ukraine, the Ministry of Economy, the Ministry for Reintegration of the Temporarily Occupied Territories, the Ministry of Infrastructure of Ukraine, the Ministry for Communities and Territories Development of Ukraine within the framework of the project "Russia will pay" provides full information on direct losses of infrastructure from destruction as a result of Russia's military aggression against Ukraine (Table 2.1.). The largest share of direct losses are the destruction of residential buildings (37.3%). Educational institutions have also suffered significant losses, with total damage as of February 2023 reaching $8.9 billion. Infrastructure losses related to culture, tourism and sports amounted to $ 2.2 billion, and losses to health care institutions - $ 1.8 billion. The digital infrastructure has not been left without destruction, in the development and renewal of which, in Ukraine over the past pre-war years, significant progress has taken place. The most affected are the regions of Ukraine in which hostilities were directly conducted: Donetsk, Kharkiv, Luhansk, Mykolaiv, Zaporizhzhia, Kyiv and Chernihiv regions. Among the cities that suffered the most during the war, Mariinka, Mariupol, Irpin, Kharkiv, Chernihiv, Severodonetsk, Lysychansk, Vuhledar, Sumy, Rubizhne, Izyum, Mykolaiv, Bakhmut, Volnovakha [3].

Compared to the beginning of June 2022, there was a significant increase in the number of destroyed and damaged infrastructure: from 121 thousand. up to 153 thousand rubles. The number of residential buildings affected by the war increased from 777 to 1216 healthcare facilities [3].

Table 2.1.

General estimate of direct losses of infrastructure from Russia's military aggression in

monetary terms as of February 2023

Type of property	Estimate of direct losses, $ billion	Share of direct losses by property type, % of total amount
Residential buildings	53,6	37,3%
Infrastructure	36,2	25,2%
Assets of enterprises, industry	11,3	7,9%
Education	8,9	6,2%
Agro-industrial complex and land resources	8,7	5,6%
Energy	8,1	3,1%
Forest fund	4,5	2,2%
Vehicles	3,1	1,8%
Trade	2,6	1,0%
HOUSING	1,4	1,5%
Culture, tourism, sports	2,2	1,2%
Health	1,8	0,4%
Administrative buildings	0,5	0,4%
Digital infrastructure	0,6	0,4%
Social sphere	0,2	0,1%
Financial sector	0,04	0,01%
Together	143,8	100%

Source: [3]

Damage to healthcare facilities accounts for about 1.2% of the total cost of losses in Ukraine.

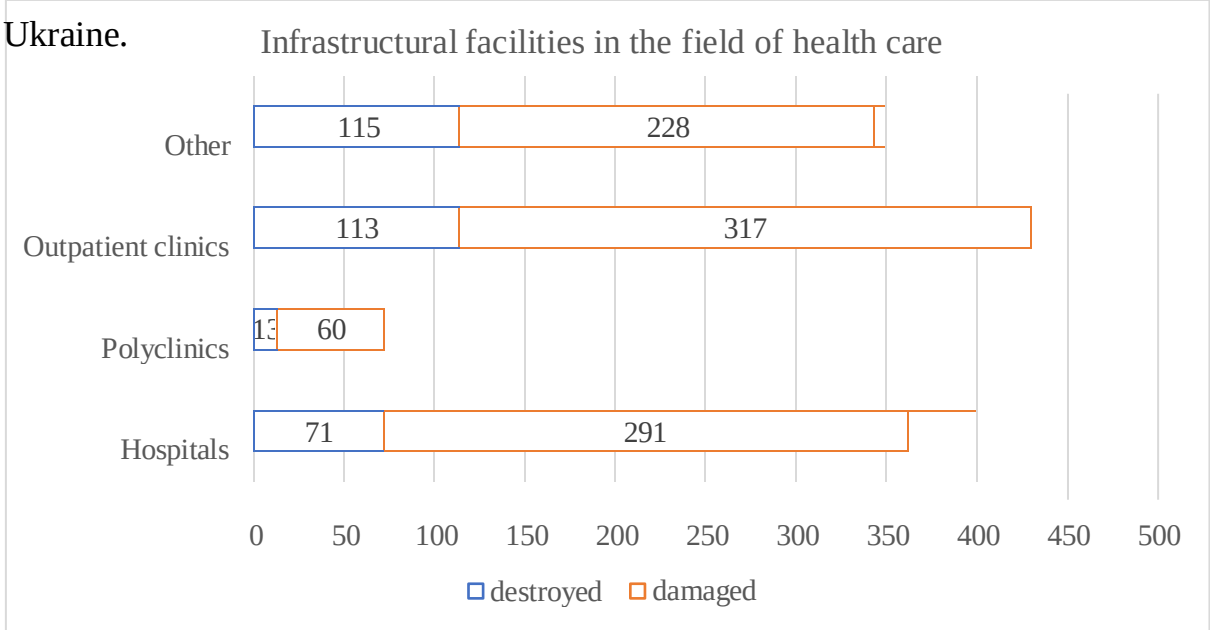


Fig.2.1. **Destroyed or damaged infrastructural facilities in the field of health care**

Source: based on [3]

Direct documented losses from the destruction of educational institutions amount to $8.94 billion. In total, as a result of hostilities, at least 915 educational infrastructure facilities have already been destroyed and 2165 damaged (Figure 2.2).

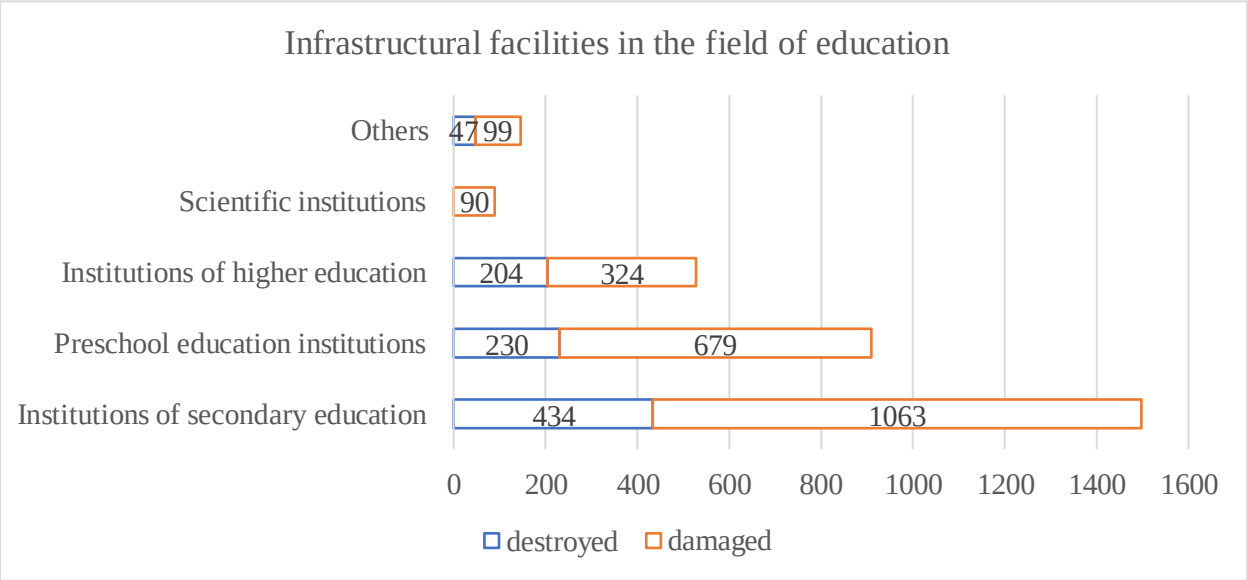


Fig.2.2. **Destroyed or damaged infrastructural facilities in the field of education**

Source: based on [3]

The scientific infrastructure also suffered losses, according to preliminary estimates, 117 objects of movable and immovable property of 34 institutes and other institutions of the National Academy of Sciences of Ukraine were destroyed, damaged and seized for the needs of the Armed Forces of Ukraine. The preliminary total estimate of losses, only for scientific institutions of the National Academy of Sciences of Ukraine, is $ 7.8 million.

As a result of large-scale hostilities in different regions of Ukraine, social facilities were damaged, in particular, destroyed or damaged social protection institutions, geriatric institutions, sanatoriums, children's camps and orphanages, boarding schools, institutions for working with the homeless (Figure 2.3.). During the year of a full-scale war, direct losses to the infrastructure of social services provided by the state amount to $ 0.2 billion.

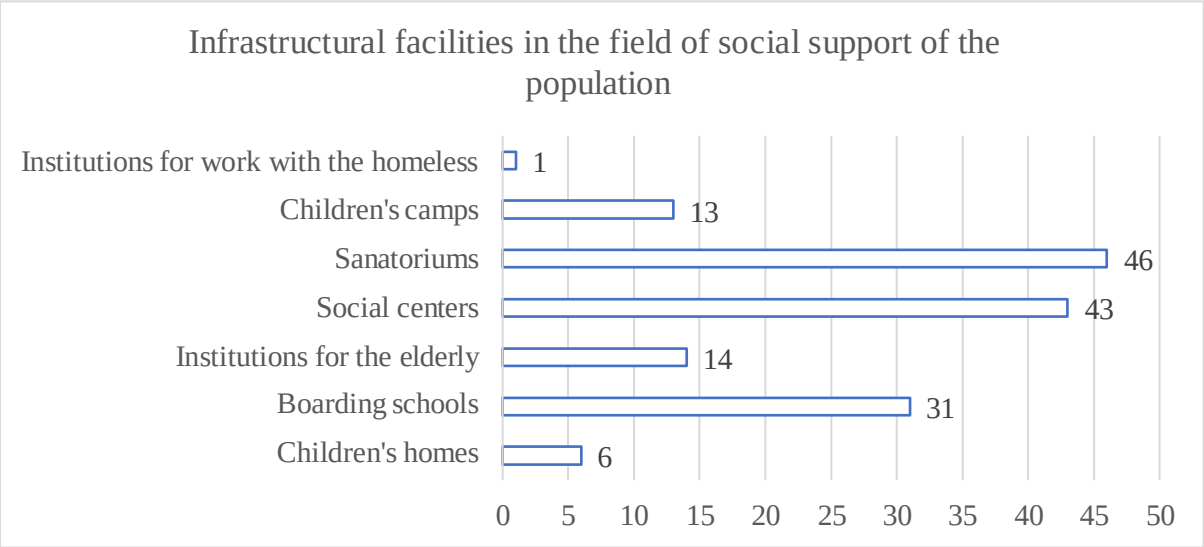


Fig.2.3. **Destroyed infrastructural facilities in the field of social support of the population**

Source: based on [3]

Since the beginning of Russia's military aggression, according to documented losses, 348 religious sites, 703 houses of culture/palaces of culture, 82 museums and 8 sports stadiums have been damaged in Ukraine.

Consequently, all the above-mentioned damage to social infrastructure will undoubtedly complicate the development of innovation processes in the social sector of Ukraine. Moreover, it should also be borne in mind that on a market basis this sphere cannot be restored and developed; We need direct support at the expense of budget funds, foreign sponsorship at the state, regional and municipal levels.

The analysis of socio-demographic characteristics of Ukrainian households for 2022, conducted by the State Statistics Service of Ukraine, showed that the average level of satisfaction of the population with their housing conditions is 58.8%, with the level of satisfaction in rural areas is lower and 47.9% in 2022, which shows a tendency to reduce satisfaction compared to 2021 (48.1%). The distribution of households according to the degree of satisfaction with their housing conditions in 2022 is shown in Fig. 2.4.

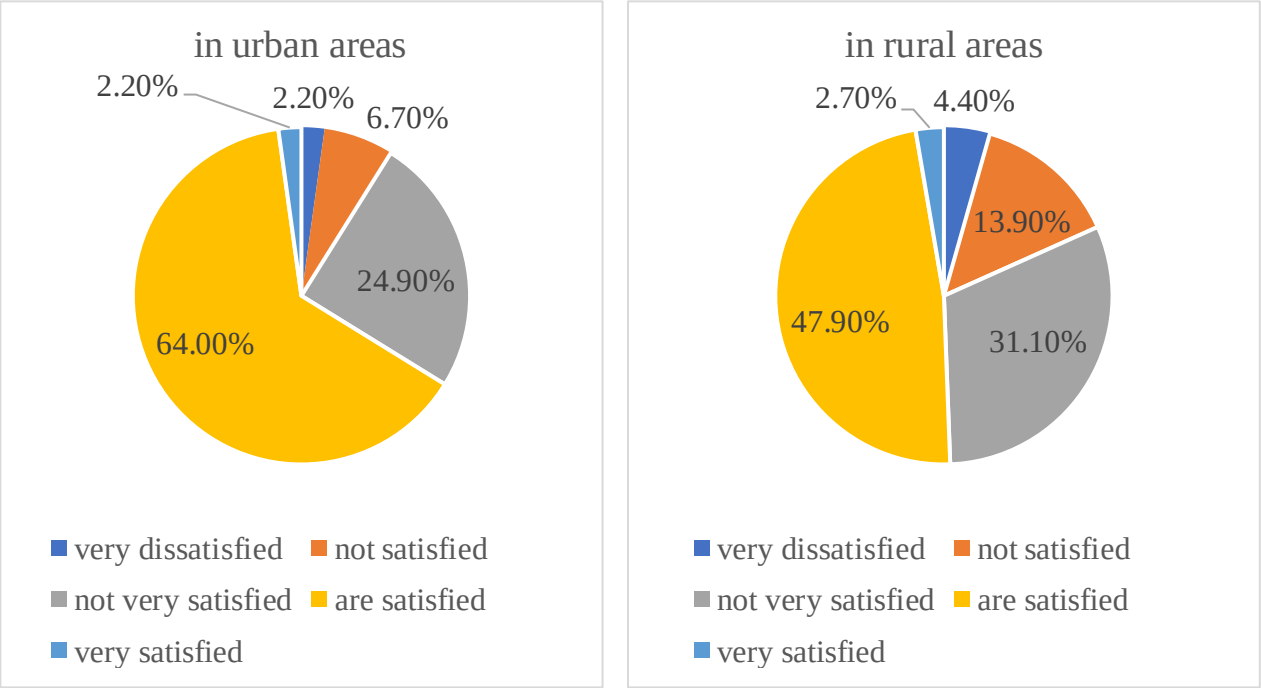


Fig.2.4. **Distribution of households according to the degree of satisfaction with their living conditions**

Source: based on [4]

Housing conditions are unsatisfactory for almost 11% of the urban population and 21% of the rural population. This indicator indicates the existence of infrastructural territorial discrimination and indicates a significant lag in the development of social infrastructure in rural areas.

The share of households with convenient access to public transport (at a distance of no more than 500 m) in 2022 was 78.3%. The trend of infrastructural territorial discrimination is also observed in this direction of social infrastructure development (Figure 2.5). Compared to households in large cities, rural population is provided with convenient access to public transport worse by 39.1%.

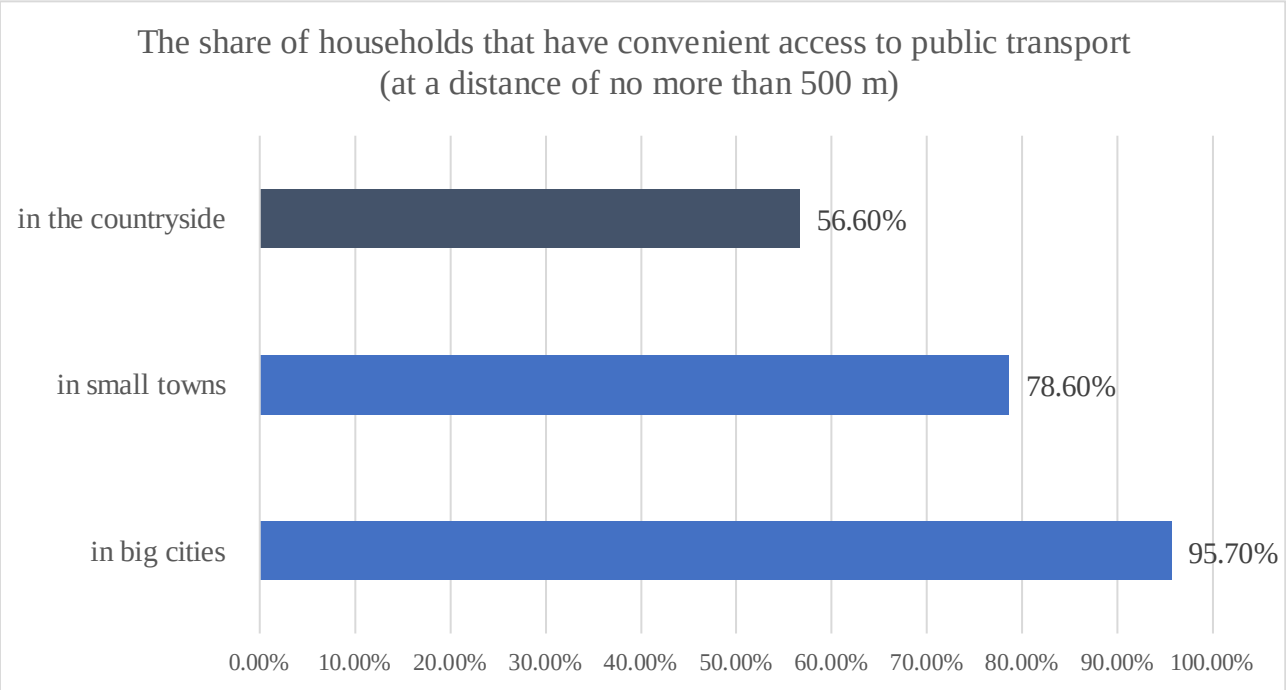


Fig.2.5. **Distribution of households by availability of convenient access to public transport in 2022**

Source: based on [4]

The next indicator that should be analyzed to understand the development of social infrastructure is the indicator of coverage of children in preschool educational institutions. This indicator is calculated as the ratio of the number of pupils of preschool educational institutions to the total number of children aged 1-6 years (without children studying in the first grades of general secondary education institutions) multiplied by 100. The dynamics of this indicator for the period from 2010 to 2021. indicates insufficient coverage of preschool children in preschool educational institutions, which is primarily a consequence of the insufficient level of development of social infrastructure. The pace of development showed that in urban and rural areas over 10 years progress was achieved only at the level of an increase of 7%. For rural areas, the situation is more critical, since only 40% of children are covered by preschool educational institutions (Figure 2.6).

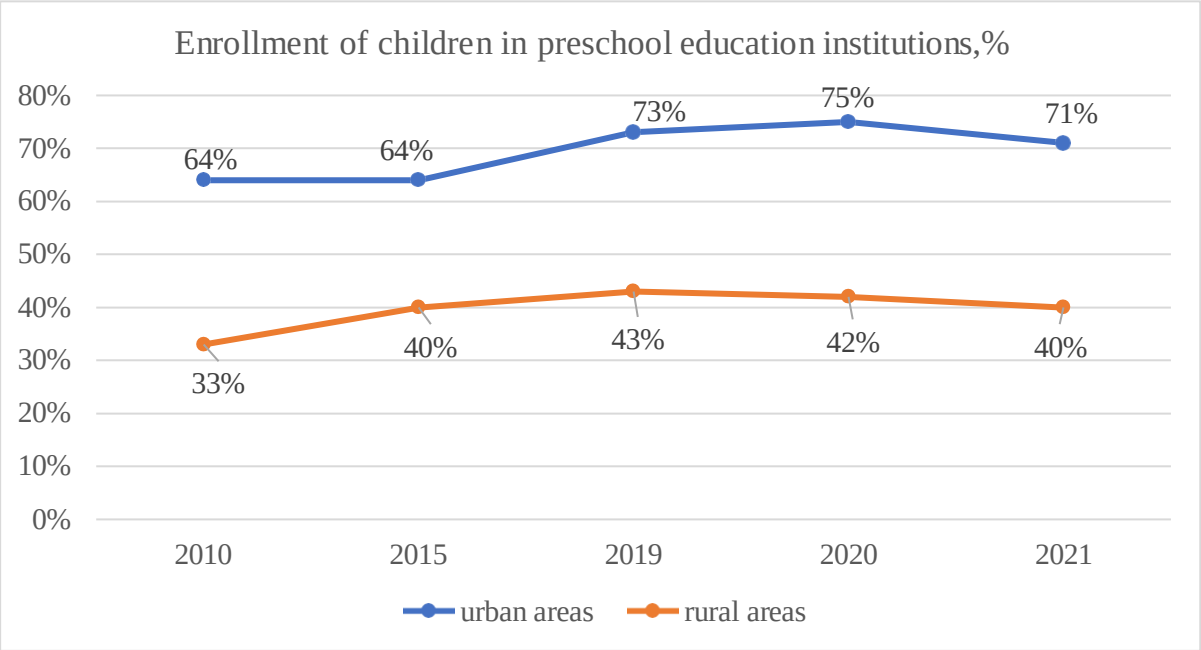


Fig.2.6. **Dynamics of development of the indicator "Coverage of children in preschool educational institutions" 2010-2021.**

Source: based on [5]

Among the changes that have taken place in the social infrastructure in terms of general secondary education institutions, it should be noted the reorganization of ordinary schools into hub institutions or branches. The purpose of creating pivotal educational institutions is to form a single educational space to ensure the closest equal conditions for obtaining complete general secondary education for all children living in community territory, as well as rational and effective use of human, infrastructure, logistical, financial and other available resources. The creation of pivotal educational institutions began in Ukraine from 2013-2014 academic year 2016-2017 academic year is characterized by the active creation of pivotal educational institutions. Thus, at the end of the 2016-2017 academic year (April 2017) there were 178 units. The greatest positive dynamics of the establishment of pivotal institutions according to the recorded data can be traced in the period from January 31, 2017 to November 1, 2017, when the network grew by 272 hubs (by 152.8%) and by 389 branches (by 76.1%). As of June 1, 2022, a total of 1241 hub institutions and 1794 branches operate, in particular, from October 2021 to June 2022, the network of hub institutions and branches decreased by 0.1% [6].

The creation of hub institutions with branches as part of the reform of the New Ukrainian School is one of the successful methods of optimizing the network of general secondary education institutions in territorial communities to ensure equal conditions for obtaining complete general secondary education and the effective use of available human, financial, infrastructure, logistical and other resources.

The structure of expenditures of the state budget expenditures on various components of the social infrastructure of Ukraine is also indicative (Fig. 2.7.).

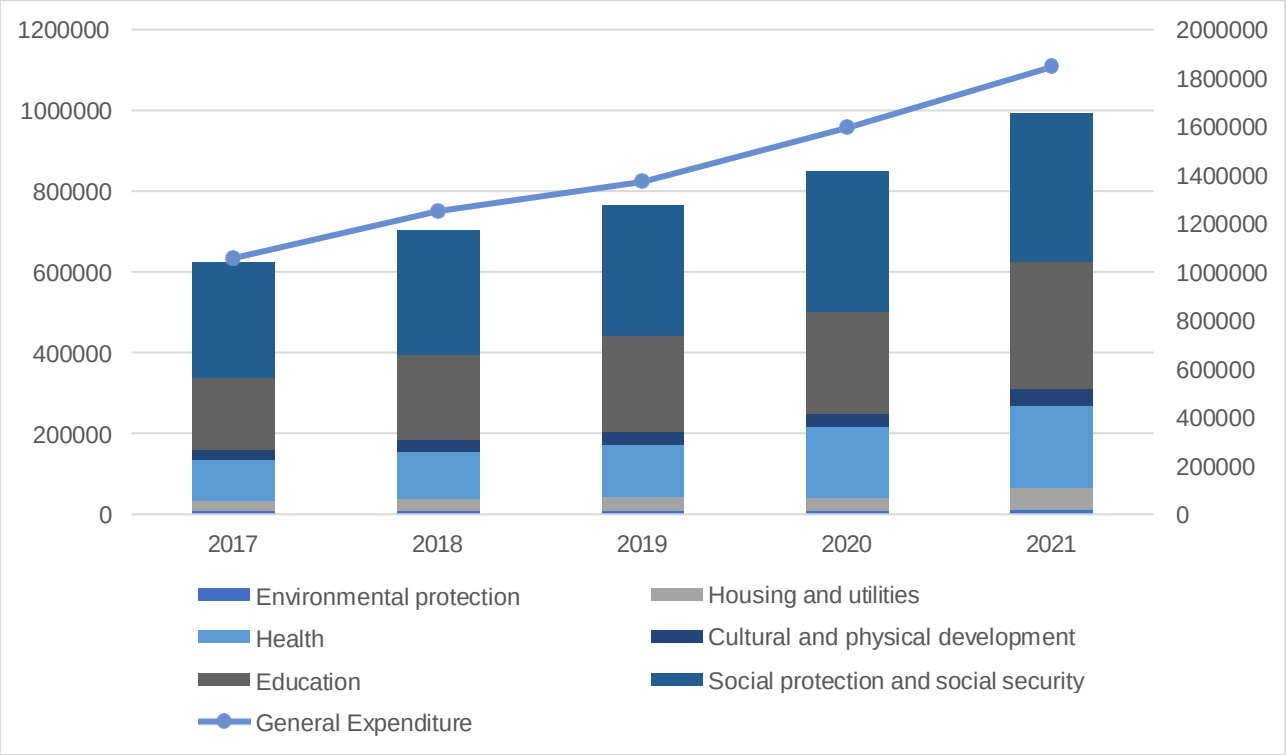


Fig.2.7. **Analysis of the dynamics of the structure of state budget expenditures on various components of the social infrastructure of Ukraine, mln. UAH.**

Source: based on [7]

According to Figure 2.7., social protection and social security have the largest share in the structure of state budget expenditures. Increase in healthcare expenditures in 2020- 2021 due to the positive changes that the healthcare system has undergone during the pandemic. In particular, the increase in expenditures was primarily caused by the need to purchase additional artificial lung ventilation equipment, construction of cryogenic gas distributionstations to expand the number of points with access to oxygen, expansion of networks of diagnostic centers with the possibility of PCR

testing, creation of training centers for training mobile teams working with patients with COVID.

In addition, in 2021 there was a significant increase in spending in the field of spiritual and physical development. At the same time, it should be noted the low level of expenditures in the field of environmental protection, which is undoubtedly a negative trend in the context of the implementation of the Green Deal directives. This trend indicates that taking into account generally accepted world priorities that were adopted at the legislative level as a whole formally met the requirements of environmental conservation, harmonious development of science, technology, ecology and economics. Due to the limited financial capabilities of Ukraine and the military invasion of Russia, the simultaneous provision of all areas of activity leads to the dispersion of investment resources, and, as a result, achieving the planned indicators for each direction of social infrastructure development becomes a difficult task to achieve. In this context, the validity of the course of economic development of the state in the direction of ensuring the welfare and livelihoods of people on an innovative basis is becoming increasingly significant and relevant.

In our opinion, the most appropriate indicator for assessing the state of innovation processes in the social sector of Ukraine from the point of view of information analytics is the use of data from the world rating Global Innovation Index. This index tracks the latest global innovation trends and annually evaluates the effectiveness of the innovation ecosystem of economies around the world, highlighting the strengths and weaknesses of innovation and individual gaps in innovation indicators.

The index includes about 80 indicators on the following indicators: "Institutions", "Human Capital and Research", "Infrastructure", "Market Complexity", "Business Conditions", "Development of Technology and Knowledge Economy", "Creative Results". According to the Global Innovation Index 2022 [8], Ukraine in 2022 ranked 57th among 223 countries whose economic and innovation profiles are analyzed annually. Compared to 2021 before the war, Ukraine's position

fell by 8 points, which is primarily due to military aggression by the Russian Federation. The comparative analysis of Ukraine is carried out within the framework of the Lower middle-income group, to which it belongs according to this rating. For a more informative understanding of Ukraine's positions, a radar of the main indicators was built in comparison with indicators for the group, Europe and indicators of the countries included in the Top-10 (Figure 2.8).

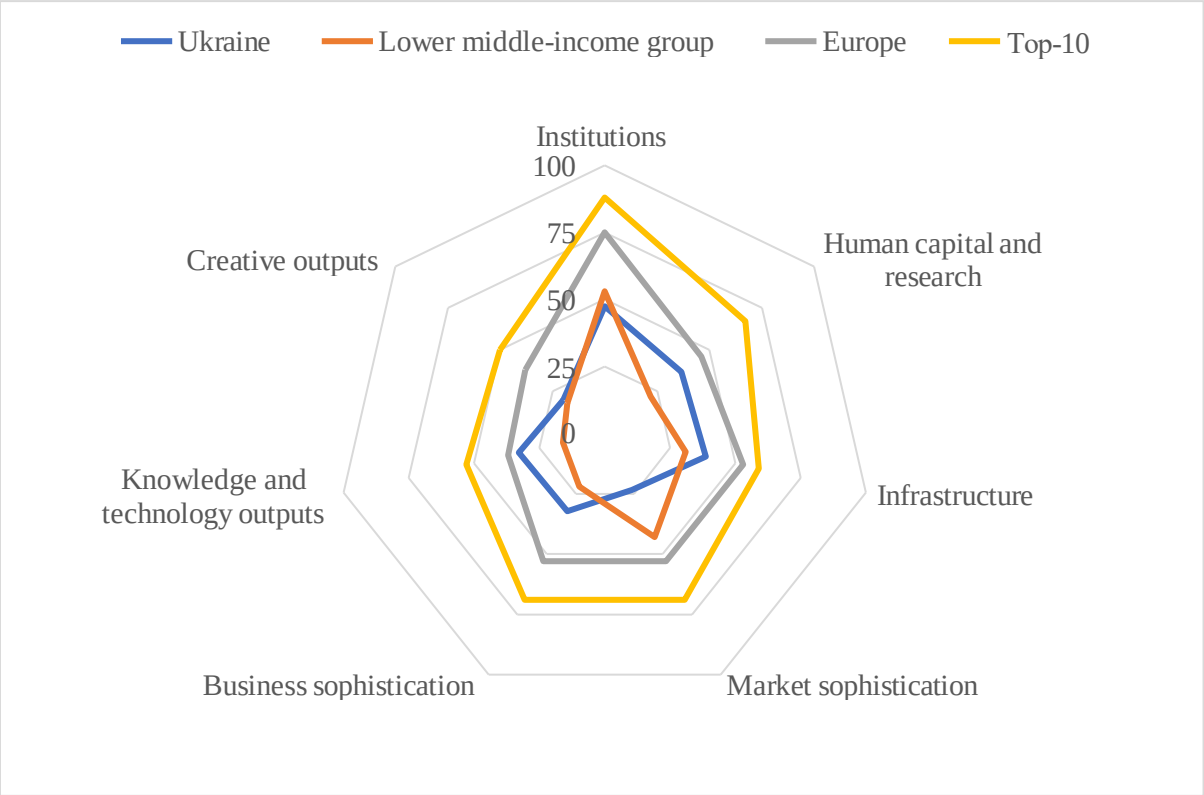


Fig.2.8. **Radar of Ukraine's positions in the Global Innovation Index-2022 rating according to the main indicators**

Source: based on [8]

Interpreting the results of the diagram, it can be stated that Ukraine in its qualification group exceeds the average values for the indicators "Human Capital and Research", "Infrastructure", "Business Conditions", "Development of Technologies and Knowledge Economy". At the same time, according to the indicator "Market complexity", Ukraine has a significant lag. But as part of our research, we focus on the Infrastructure indicator. Therefore, we analyze it in more detail. In Fig.2.9. presents the general dynamics of Ukraine's rating positions in the Global Innovation Index, as well as the dynamics of the indicator «Infrastructure» over the past 10 years.

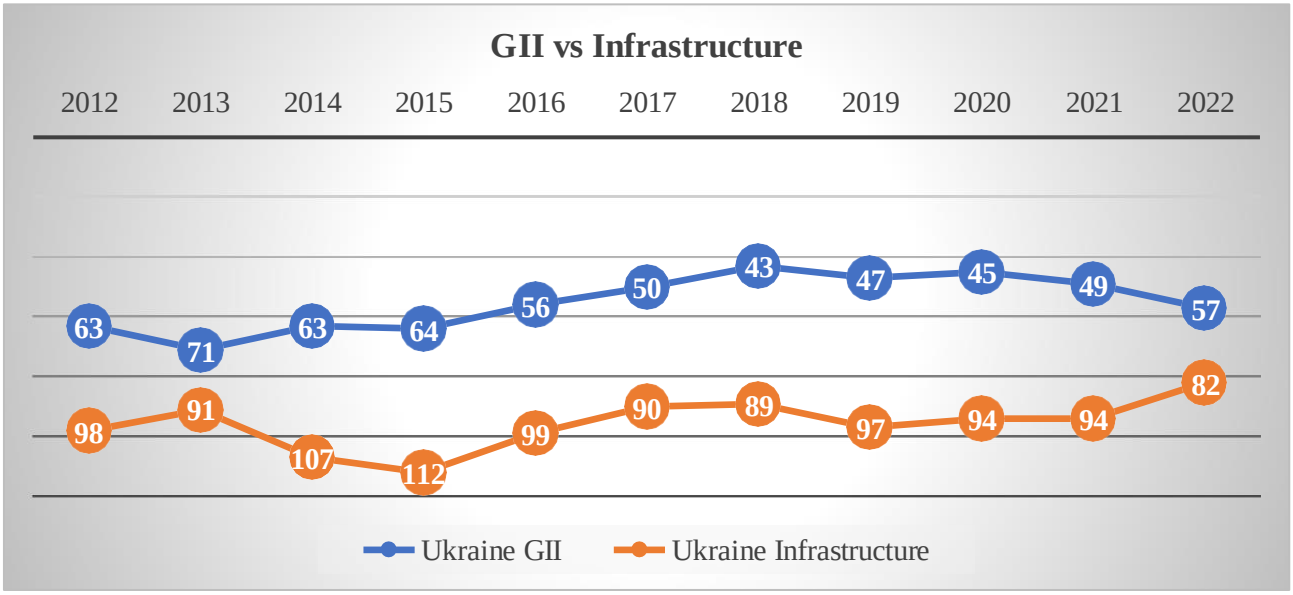


Fig.2.9. Dynamics of the overall rating position and the indicator "Infrastructure" in the Global Innovation Index

Source: constructed according to [8,9,10,11,12,13,14,15,16,17,18]

Compared to the position of 2012, Ukraine's overall position in the Global Innovation Index has risen by 6 points, and according to the development of the Infrastructure indicator by 16 points. This means that the positive contribution of infrastructure development to the formation of the overall innovation rating is significant. The development of this indicator took place in waves, in 2014-2015 there were peak declines in rating positions on this indicator. This trend is primarily related to the economic and political crisis that arose due to the annexation of Crimea and parts of Donetsk and Luhansk regions by the Russian Federation. The next decline in rating positions occurred in 2019-2020. due to the instability caused by the effects of the Covid-19 pandemic. In 2022, the rating position on the indicator "Infrastructure" was on the 82nd place, which is 12 positions more than in 2021. At the same time, taking into account the current circumstances (destruction of Ukrainian infrastructure by the aggressor country), it is possible to predict a decline in positions on this indicator in the coming years.Today, for Ukraine, the main factors that necessitate the development of social infrastructure are the following:

1) wartime conditions that require the state to fully support the population,

especially its vulnerable strata;

2) transformation processes in socio-economic life associated with strategic renewal of the social sphere in the context of post-war reconstruction. This, in turn, leads to a change in the requirements for the products of all industries that meet the social needs of the population: the aggravation of many social problems, which requires the development of new approaches to their solution; acute lack of resources for the development of the social sphere, which leads to the need to find new, cheaper ways to solve social problems; openness of Ukrainian society and approximation to the standards of the European Union; implementation of the experience of using innovative social technologies by partner countries;

3) strengthening the social orientation of business through the development of corporate social responsibility and the concept of moral society;

4) understanding of the need to create an open information society based on the use of new information technologies.

The influence of these factors necessitates the introduction of new concepts, methods and technologies for providing services in the social sphere. The main goal of innovation in the social sphere should be to solve the social problems of modern society.

In Fig.2.10. The main directions of development of innovation processes in the social sphere are given.

Currently, the distinctive features of socialization and innovative development of social infrastructure are:

- innovative development of the material sector of the economy: introduction of new technologies in the healthcare industry, transport infrastructure, education, sports and cultural spheres;
- digitalization of social services, development of new convenient applications with the most socialized interface (taking into account the special needs of vulnerable groups of the population);
- development of infrastructure of territorial communities, taking into account

the needs of the social sector, aimed at eliminating discrimination between urban and rural population;

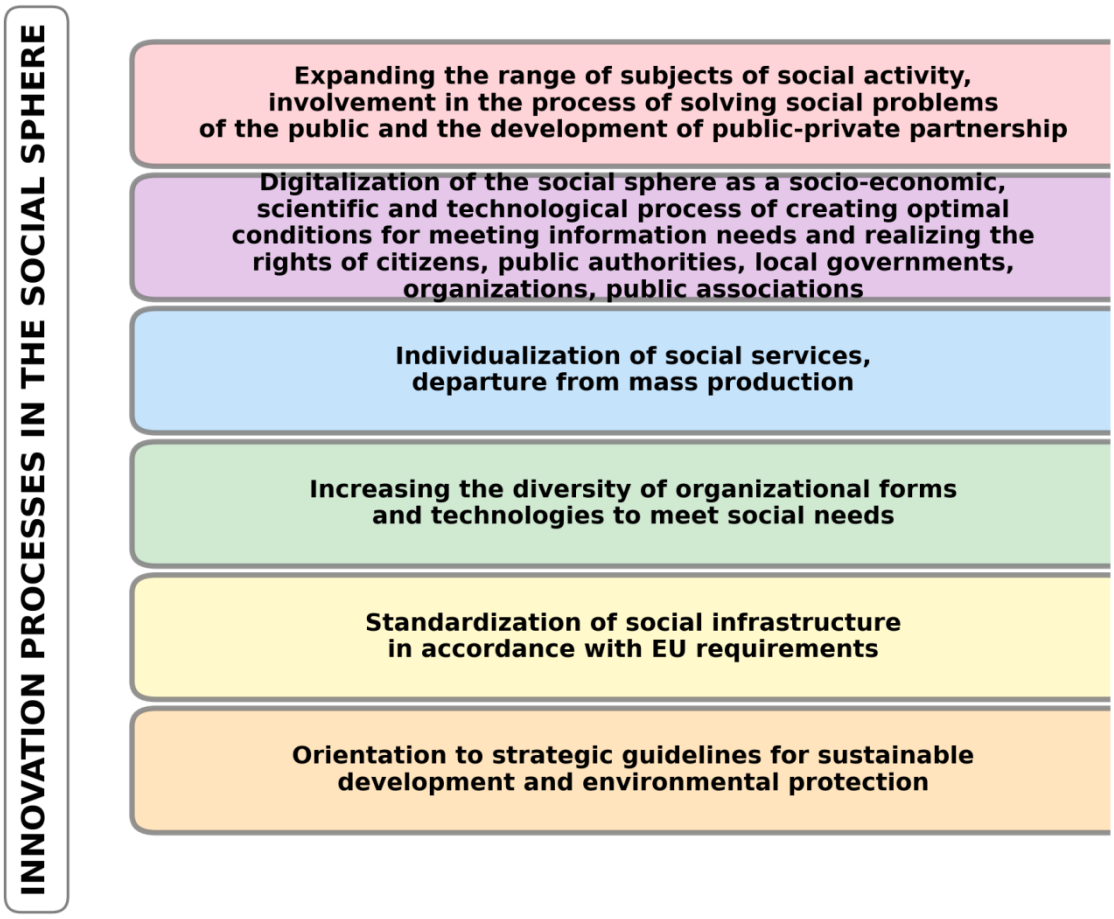


Fig.2.10. **Actualized directions of development of innovation processes in the social sphere**

Source: author's vision

- overcoming consumer psychological positions in the minds of Ukrainians and focusing on the formation of an active and healthy lifestyle;
- promoting the development of socio-ecological-urban approach to the development of infrastructure of cities and regions;
- the most effective use of financial support for the sphere of social services;
- selective selection of innovative projects according to the criteria of socio-economic efficiency.

The most urgent role of social innovations is in healthcare, where there is a very unfavorable situation. Over the past 20 years, mortality in Ukraine has exceeded the birth rate, and due to the military aggression of the Russian Federation, in general,

the number of Ukrainian population is declining even faster. Killed on the battlefield, civilian casualties, forced migration of Ukrainians abroad – all these indicators significantly reduce the number of Ukrainians, and hence the human capital of the state. In this regard, the main task of the state is to preserve the health of the population and improve the level and quality of life. Under these circumstances, the issue of development of social and innovative activities and creation of mechanisms for supporting social innovations is actualized.

In accordance with this, the main source for the development of solving the socio- economic needs of the population through the development of social infrastructure through the implementation of social innovations can be: firstly, budget funds – the advantage of this form is the absence of the need for return, but their value is minimal, so these funds go mainly only to those social projects that are fixed in the expenditure part of the relevant budget, and for new social projects it is necessary to look for alternative methods of financing; secondly, external and internal loans, government loans, financing of social innovations through international sponsorship; Thirdly, indirect financing is the creation of conditions for financing social innovations through the mechanism of public-private partnership.

An example of financing social innovations through international sponsorship is the Ukrainian Social Investment Fund, created to support the least socially protected segments of the population, as well as initiatives of territorial communities and public organizations. The task of the fund is the effective use of international assistance funds for the needs of the social sphere with an emphasis on the development of social infrastructure. Within the framework of Ukrainian-German financial cooperation The Ukrainian Social Investment Fund is the executor of a large-scale project "Promoting Social Infrastructure Development". From 2008 to 2020, 7 grants totaling EUR 61.55 million were allocated for the implementation of the Project in different regions of Ukraine, two of which are currently in the initial stage of implementation and five projects have been successfully completed. The main objectives of the project are to upgrade and improve social infrastructure and strengthen local communities [19].

Table 2.2.

Characteristics of social cooperation projects with Germany, the EU and the KFW Development Bank together with the Ukrainian Social Investment Fund, which are under implementation

Project name	Purpose	Grant size and donor	Implementation period
Project "Provision of social services in the community"	Providing support to the amalgamated territorial communities of Odesa and Ternopil regions to strengthen their capacity to provide residents with quality social services, increase access to social and communal infrastructure of the community, improve service coverage of vulnerable groups of the population (elderly, disabled, families in difficult life circumstances)	2,85 mln. USD United States Japan Social Development Foundation (JSDF) through the International Bank for Reconstruction and Development	2018-2022
USIF VI Social Infrastructure Development Assistance Project	Creation of housing for internally displaced persons (IDPs), improvement of infrastructure of social facilities (schools and preschool educational institutions) in communities that accept IDPs.	9 mln. euro The German government through KfW	2018-2022
Project "Promotion of social infrastructure development – improvement of primary rural medicine	Improving the conditions for the provision of primary healthcare through energy-efficient renovation of premises and supply of medical equipment	14,45 mln. euro The German government through KfW	2019-2023

Source: based on [19]

In Table 2.2. A description of the projects that are currently at the implementation stage is presented. Adaptation of social development in the context of European integration into the system of social mechanisms for the implementation of innovation processes requires Ukraine to review the effectiveness of organizational and economic mechanisms for managing innovation activity with a focus on the use of public-private partnership tools as a means of optimizing innovation processes and intensifying innovation activity at all levels. In our opinion, such a mechanism, firstly, provides formation of a system of interaction between key stakeholders to ensure the effectiveness of innovation processes in the social sector, secondly, a well-founded system of scientific support for innovations, taking into account the logic and specifics of the implementation of not only its own innovation, but also the

peculiarities of perception, evaluation, mutual adaptation of elements of the social system, specific subjects to new conditions of life, as well as expertly monitors possible prospects and consequences of implementation specific innovation. Thirdly, the introduction of innovative social technologies should be implemented through the use of a set of techniques and methods aimed at studying, actualizing and optimizing innovation, as a result of which innovations are created and materialized, causing qualitative changes in various spheres of life, focused on rational and sustainable material, natural, economic and social resources.

Effective implementation of innovative social technologies is possible subject to the introduction of a model of social public-private partnership – a specific form of public relations that are closely interconnected with the implementation of power functions and functions of key stakeholders. The modern market economy involves the rejection of the centralized solution of a number of social issues and their transfer to the level of certain territories - regions, industries, enterprises, mainly, on the basis of negotiations between representatives of employers and employees with the participation of state representatives as intermediaries and guarantors of compliance with the law. State support for innovative projects for the development of social infrastructure of territories should be focused on the development of a system of social partnership together with representatives of trade unions, entrepreneurs, the government and other government structures, and public-private partnership in this context should be considered not only a means of political and economic stabilization, but also a mechanism of evolutionary changes in society.

2.2. Study of the state of innovation processes in the social sector of China

The analysis of the state of innovation processes in China's social sector should also begin with a study of the country's position in the Global Innovation Index. China, ranked 34th in 2012, joined the innovation leaders in 2016 and since then, consistently strengthening its position, has been one step away from the top ten in 11th place in 2022 [8]. Among upper-middle-income economies, China ranks 8th overall in the Innovation Performance Subindex, and its performance level is comparable to that of

high-income economies such as the Netherlands and Germany, but with lower contributions to innovation. As can be seen in Fig.2.11. China in its group of countries (upper-middle-income countries) has indicators that are far above the group average for all indicators.

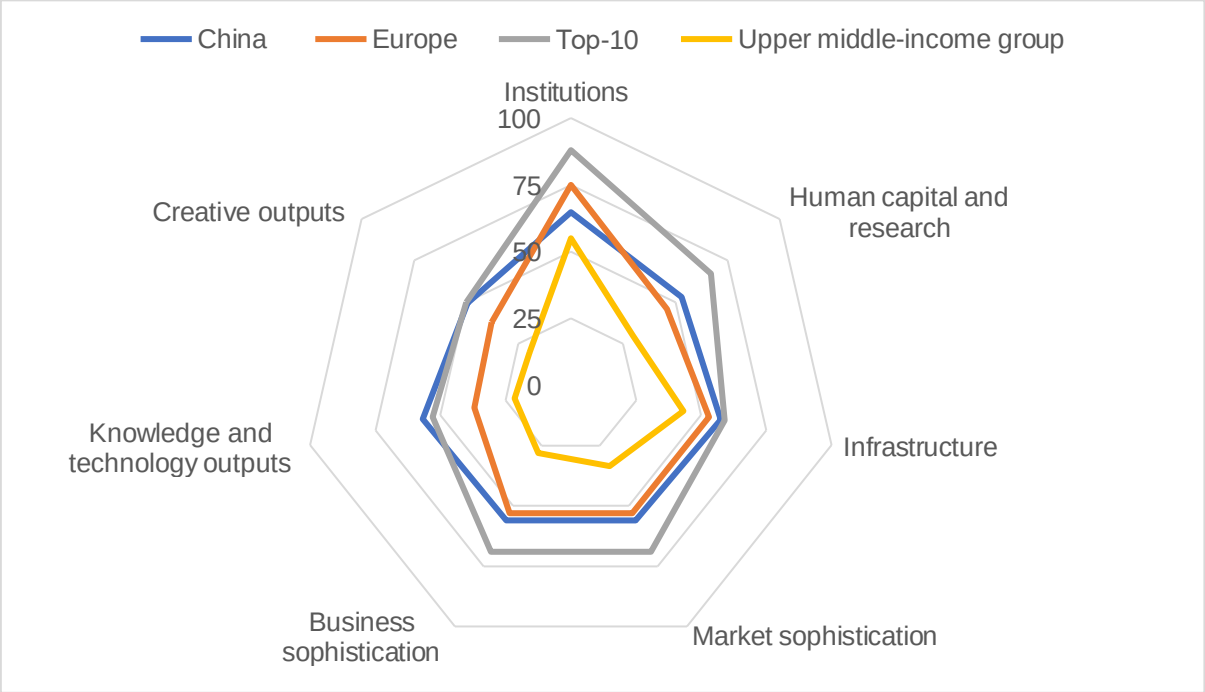


Fig.2.11. **Radar of China's positions in the Global Innovation Index-2022 rating by main indicators**

Source: based on [8]

According to such indicators as "Creative outputs" and "Infrastructure", China's positions are as close as possible to those of the TOP-10 countries. Besides, China's large-scale presence in the 100 largest scientific and technological clusters – geographical areas around the world with the highest density of inventors and scientific authors – is indicative. In 2022, China equaled the United States in the number of best science and technology clusters, this indicator reached the level of 21 clusters.

It is interesting to compare the score of indicators that form the Global Innovation Index between China and Ukraine. Despite the fact that these countries are in different groups, according to some indicators, Ukraine's lagging behind is not critical (Figure 2.12).

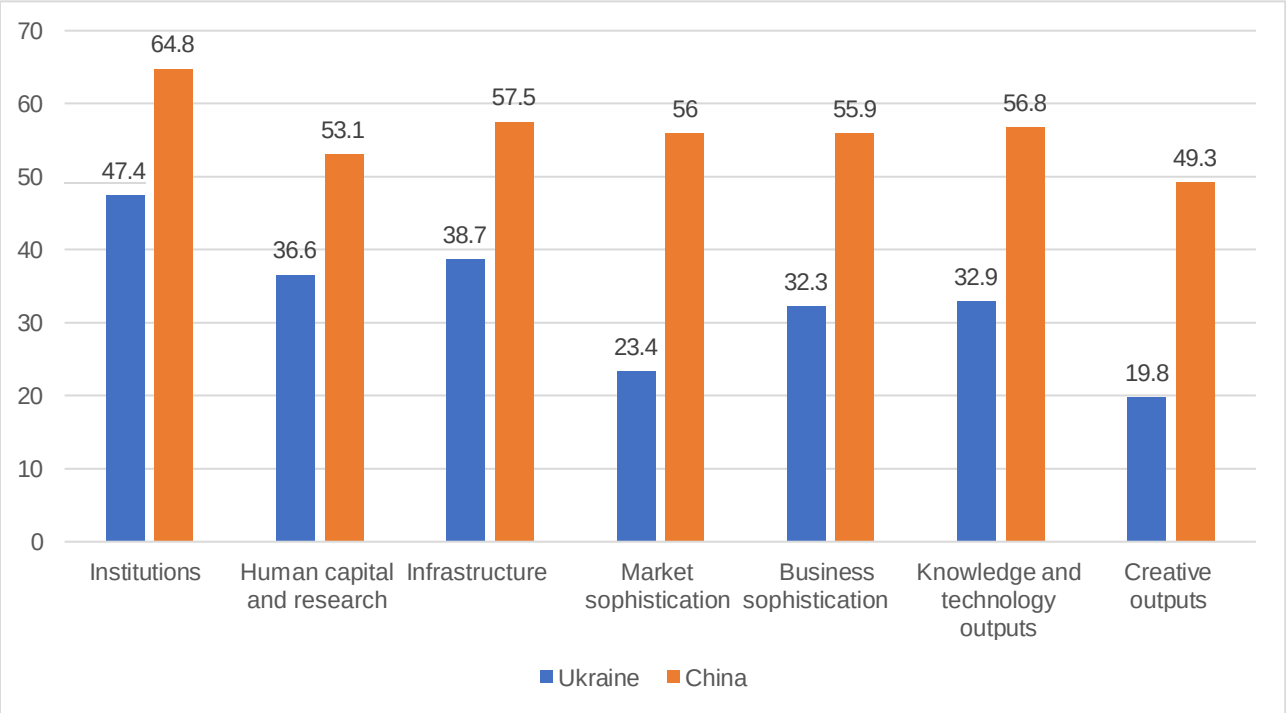


Fig.2.12. **Comparison of the score of key indicators of the Global Innovation Index-2022 between China and Ukraine**

Source: based on [8]

For example, according to the indicators "Institutions", "Human capital and research" and "Infrastructure", the gap between China and Ukraine is the smallest. As part of our study, we will focus on a deeper comparative analysis of the indicator "Infrastructure" (Table 2.3).

Analyzing the results of the presented table 2.3. The following conclusions can be drawn:

- compared to 2020, according to the general indicator "Infrastructure", both China and Ukraine have risen in the ranking by 11 and 12 positions, respectively;

- the most successful subindicator for both Ukraine and China was the indicator "Information and communication technologies" (+19 positions for Ukraine and +25 positions for China).

Table 2.3.

Comparative analysis of the rating positions of China and Ukraine by the indicator "Infrastructure" in the context of subindicators

	Ukraine	China	Ukraine	China	Ukraine	China	Ukraine	China
	2020	2020	2021	2021	2022	2022	ranks changing 2022/2020	ranks changing 2022/2020
Infrastructure	**94**	**36**	**94**	**24**	**82**	**25**	**+12**	**+11**
Information and communication technologies (ICTs)	82	45	69	34	63	20	**+19**	**+25**
ICT access	65	71	69	71	66	61	-1	+10
ICT use	89	53	91	52	62	39	+27	+14
Government's online service	93	34	72	12	72	12	+21	+22
E-participation	74	29	46	9	46	9	+28	+20
General infrastructure	95	6	124	5	111	13	**-16**	**-7**
Electricity output, GWh/mn pop.	58	45	58	40	60	35	-2	+10
Logistics performance	65	26	65	26	65	25	0	+1
Gross capital formation, % GDP	102	6	125	4	125	3	-3	+3
Ecological sustainability	99	54	106	59	86	54	**+13**	0
GDP/unit of energy use	117	94	120	97	116	104	+1	-10
Environmental performance	57	98	57	98	43	115	+14	-17
ISO 14001 environmental certificates/bn PPP$ GDP	68	19	82	17	78	15	-10	+4

Source: author's calculations according to [8,9,10]

- It should be noted that in China, information and communication technologies have only become more used, *and* have become more accessible. At the same time, for Ukraine, access to information and communication technologies has decreased. Both countries have made significant progress in implementing government

online services and electronic participation. This means that in the analyzed countries there has been an increase in the promotion of civic engagement and accessible governance through information and communication technologies. This growth points to the rapid expansion of e-participation as a tool to engage and strengthen cooperation between governments and citizens and improves access to information and public services, which states implement policies aimed at expanding equal opportunities in access to information and communication technologies for both individual citizens and society as a whole;

- both Ukraine and China have certain problems with *the "General infrastructure" subindicator (*-16 positions for Ukraine and -7 positions for China). For Ukraine, the downgrade on this sub-indicator was mainly due to a decrease in the efficiency of electricity production for the population (shelling of energy infrastructure by the Russian Federation negatively affected this indicator). In addition, there was a decrease in gross capital accumulation in Ukraine. Downgrade According to these indicators, Ukraine is a consequence of destructive external factors. Only in terms of logistics efficiency, Ukraine managed to maintain its position at the level of 2020. For China, the most progressive indicator on the subindicator *"General infrastructure*" was the indicator of efficiency of electricity production per capita, and no progress has been made in terms of logistics efficiency and gross capital accumulation;

- compared to the subindicator "*Ecological sustainability*" Ukraine in the dynamics of its development for the period from 2020 to 2022. ahead of China (+13 positions in the ranking for Ukraine). It should be noted, of course, that in fact China's position is higher in 2022, but unlike Ukraine, progress on this subindex has not been achieved. Negative shifts in rating positions in terms of GDP per unit of energy consumption. The ratio of gross domestic product (GDP) to use energy indicates energy efficiency. To obtain comparable and consistent estimates of real GDP by country in relation to the physical contribution to GDP, i.e. energy consumption units, GDP is converted into 2017 international dollars using purchasing power parity rates.

Differences in this ratio over time and by country reflect structural changes in the economy, changes in sectoral energy efficiency and differences in fuel balances. For China, the growth in energy

consumption is closely linked to growth in modern industrial sectors, motorized transport and urban areas, but energy use also reflects climatic, geographical and economic factors (such as relative energy prices) [20,21]. So, for China, solving the problem of energy efficiency remains urgent. Besides, China has even more significant negative indicators in rating positions for Environmental performance. This indicator characterizes climate change, environmental hygiene and ecosystem viability. As with most countries with high rates of industrialization and urbanization, China faces more pollution and an increasing burden on ecosystem viability, indicating the need to pay more attention to the range of requirements for sustainable development, prioritizing important issues such as air and water quality, biodiversity and climate change;

- as for Ukraine, it has a negative rating downgrade according to ISO 14001 environmental certificates / bn PPP$ GDP, which reflects the effectiveness of the country's environmental management system. This standard is designed primarily to reduce the impact of enterprises on the environment. In the world market, more and more organizations and enterprises are implementing the ISO 14001 system with subsequent environmental certification in order to be recognized in the market of products and services, have access to credit for the implementation of business development measures, and gain favor from environmentally conscious consumers [23]. According to the experience of the EU countries, this practice contributes to the development of the economic component, since bringing national requirements to the international level opens up opportunities for exporting products and services, increasing the scientific and technical base, attracting partnership developments in the field of information technology, as well as participating in research, technical and design projects, which are aimed, among other things, at the implementation of resource-saving technologies and raising public awareness of environmental component [23] . In Ukraine, the situation is somewhat different, despite the fact that

ISO 14001 was adopted in 1997 [24]. It has not yet been widely used among manufacturers, which, on the one hand, is due to the lack of a conscious approach to greening production, and on the other hand, to a lack of understanding of the general

requirements of this standard, which often requires the involvement of specialized specialists to receive advisory services. The strategic task for Ukraine is the development of an environmental management system, as it opens up new opportunities for manufacturing enterprises, in particular for exporting products to the world market of goods and services, investing in the implementation of innovative projects, and ultimately on the economic component of the country;

- unlike Ukraine, China has made progress in implementing an environmental management system (+4 positions in the ranking compared to 2020). Since 2016, China has been actively implementing an environmental standardization strategy with an emphasis on an innovative, coordinated, green development path. Together with other countries of the world, China strengthens cooperation in the field of standardization, promotes the expansion of exchange of experience and mutual learning, and improves international standardization systems. With the great support of the Chinese government, more than 210,000 organizations have passed ISO14001 certification and received ISO14001 certification [25, 27].

Thus, the analysis of the positions of China and Ukraine on the indicator "Infrastructure" in the Global Innovation Index-2022 has formed an idea of the progress achieved and problem areas of innovative infrastructure development of countries in general and social in particular.

At the same time, despite the fact that the Global Innovation Index is quite informative in determining the country's position on certain indicators in comparison with other countries, this index reflects global trends that are the result of internal processes, which actualizes the need to study the innovative development of social infrastructure not only at the macro level, but also at the level of internal processes of the country. In this context, attention should be paid to the trends and dynamics of formation real GDP in China, the main growth factor of which in 2022 was investment

(Figure 2.13), which was facilitated by public sector spending on infrastructure [26]. Half of the investment in infrastructure was directed to transport and public facilities. Increasing the level of utilization of industrial capacity supports investment in business at a high level, but investment in real estate has suspended due to defaults of construction companies and falling sales. Analysis of the structure of China's investments (Figure 2.14) showed that it is necessary to spend more on "soft" (education, healthcare, social protection) and "hard" investments (environmental facilities, renewable energy sources, urban transport systems, etc.). Social protection of the population should grow, but public revenues are low, which requires reform of the pension system, health care system and public revenue system.

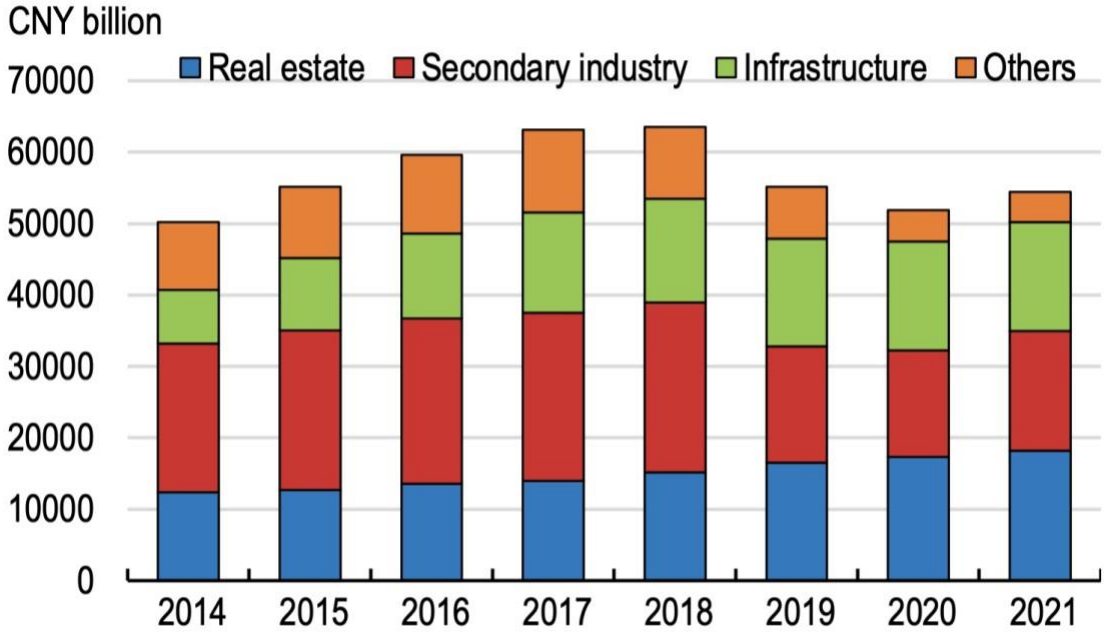


Fig.2.13. **The share of infrastructure and real estate investment has increased, while industry's shrank**

Source: [28]

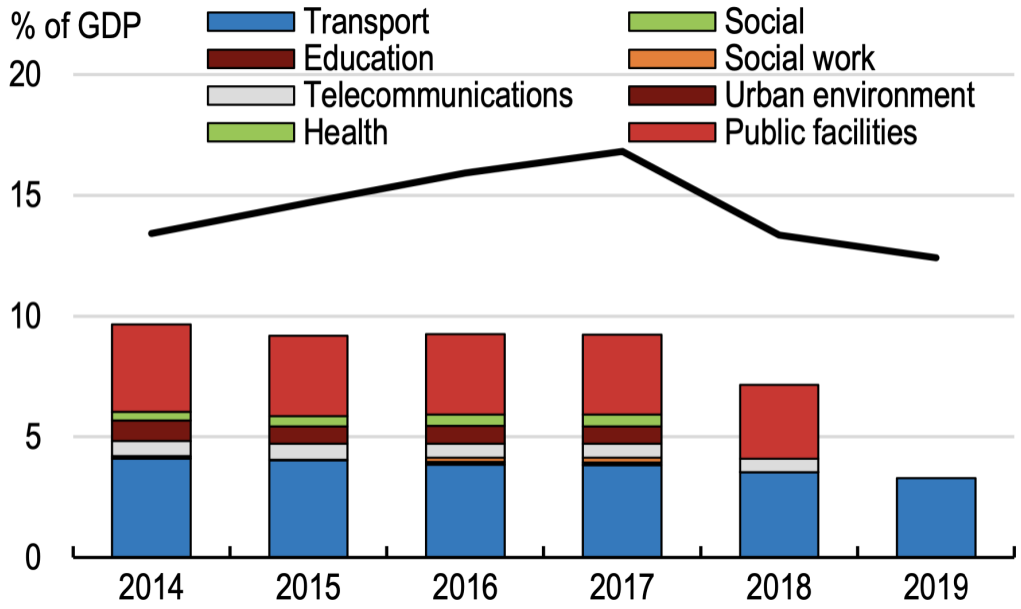


Fig.2.14. **Infrastructure investment exceeded a quarter of the total and goes mainly to transport and public facilities**

Source: [28]

First of all, this need arises from the fact that the Chinese have a high life expectancy compared to the level of income in the country, but retire early. Different pension schemes offer different benefits, while contribution rates are a high burden for the poor. COVID-19 has exposed weaknesses in China's healthcare system. The emergence of the health crisis was the result of insufficient funding and staffing of disease control centers, as well as an insufficient level of development of the mechanism of the infectious disease awareness system. Therefore, to achieve inclusive and sustainable growth, modernization of social security and fiscal revenues is necessary.

General features of the health care system, such as insufficient funding, uneven geographical distribution of resources, especially high-quality ones, a high share of out-of-pocket health spending, limited availability of intensive care units, the level of effectiveness of the emergency response system, and other factors influenced the outcome of the COVID-19 outbreak.

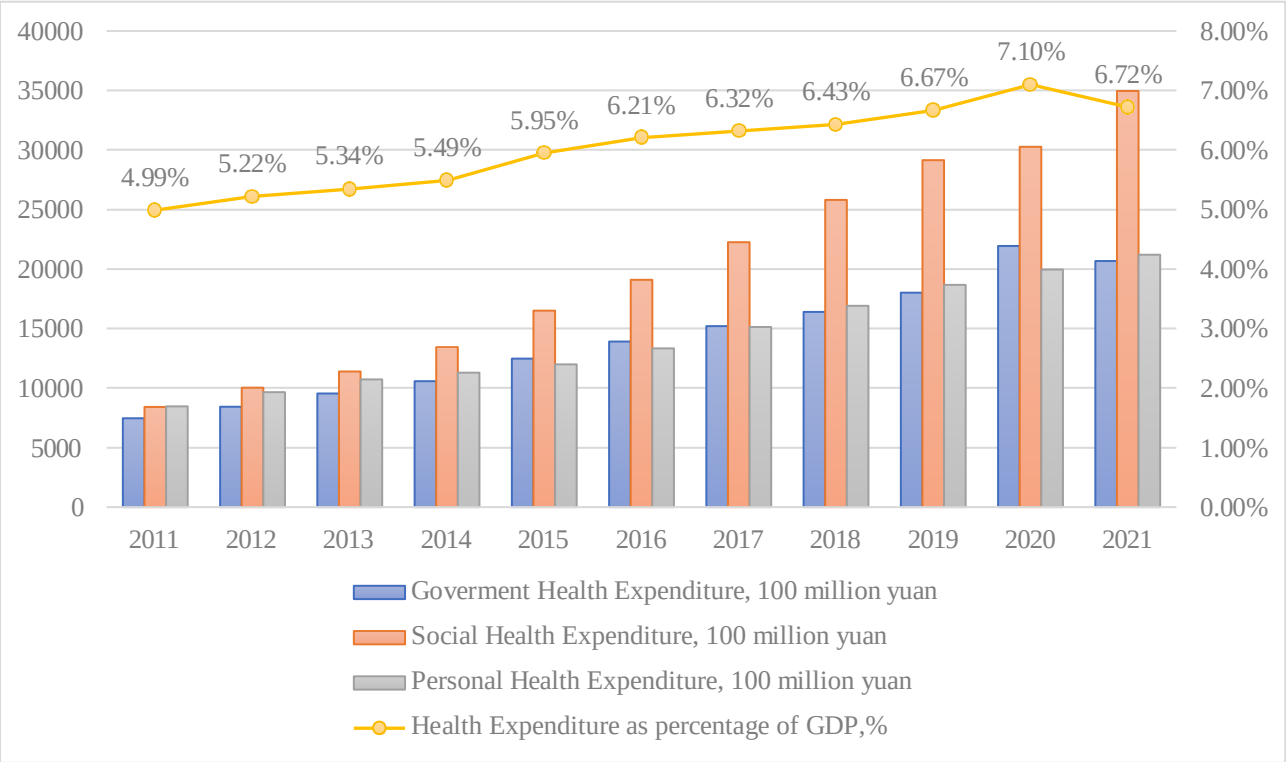


Fig.2.15. **The structure of healthcare expenditures in the dynamics for the period 2011-2021**

Source: based on information from the website of the State Statistics Service of Katai [29]

For example, according to official data from the Chinese Statistics Service, personal expenditures of the population in the health sector continue to grow despite the increase in social spending in the field of health care (Fig. 2.15). In 2021, personal expenditures of the population exceeded the level of public spending. Of course, 2021 showed better preparedness of the country to deal with the effects of the pandemic. These features will also determine the system's ability to make growth more inclusive and sustainable. The level of health insurance coverage is high - over 95%, but the level of reimbursement of expenses is relatively low, especially outside the place of registration of households. In general, the development of the health care sector in China, as well as Ukraine, has problems of a discriminatory nature in servicing the rural population. Regional discrimination also applies to China's social insurance system, which is currently highly segmented by worker categories and regions. Provincial unification of pension administration will help avoid deficits in regions with ageing populations and surpluses in regions with young populations, and the

transfer of social insurance between regions should be unhindered and not provide for fines for receiving services outside the registered place of residence.

The next indicator to analyze to understand China's social infrastructure development is the average number of education enrolled per 100,000 population by education levels and regionally. The analysis of statistical data showed that over the past 10 years there has been a gradual increase in the average number of preschool and higher education covered by 100 thousand. populace. The tendency of recovery of growth after a sharp drop in the period from 2012 to 2015. observed for primary and junior secondary education. But the average number of covered by upper secondary education per 100 thousand. Compared to 2011, it decreased by almost 21%. This trend may lead in the future to uneven filling of the labor market and a shortage of specialists in certain professions.

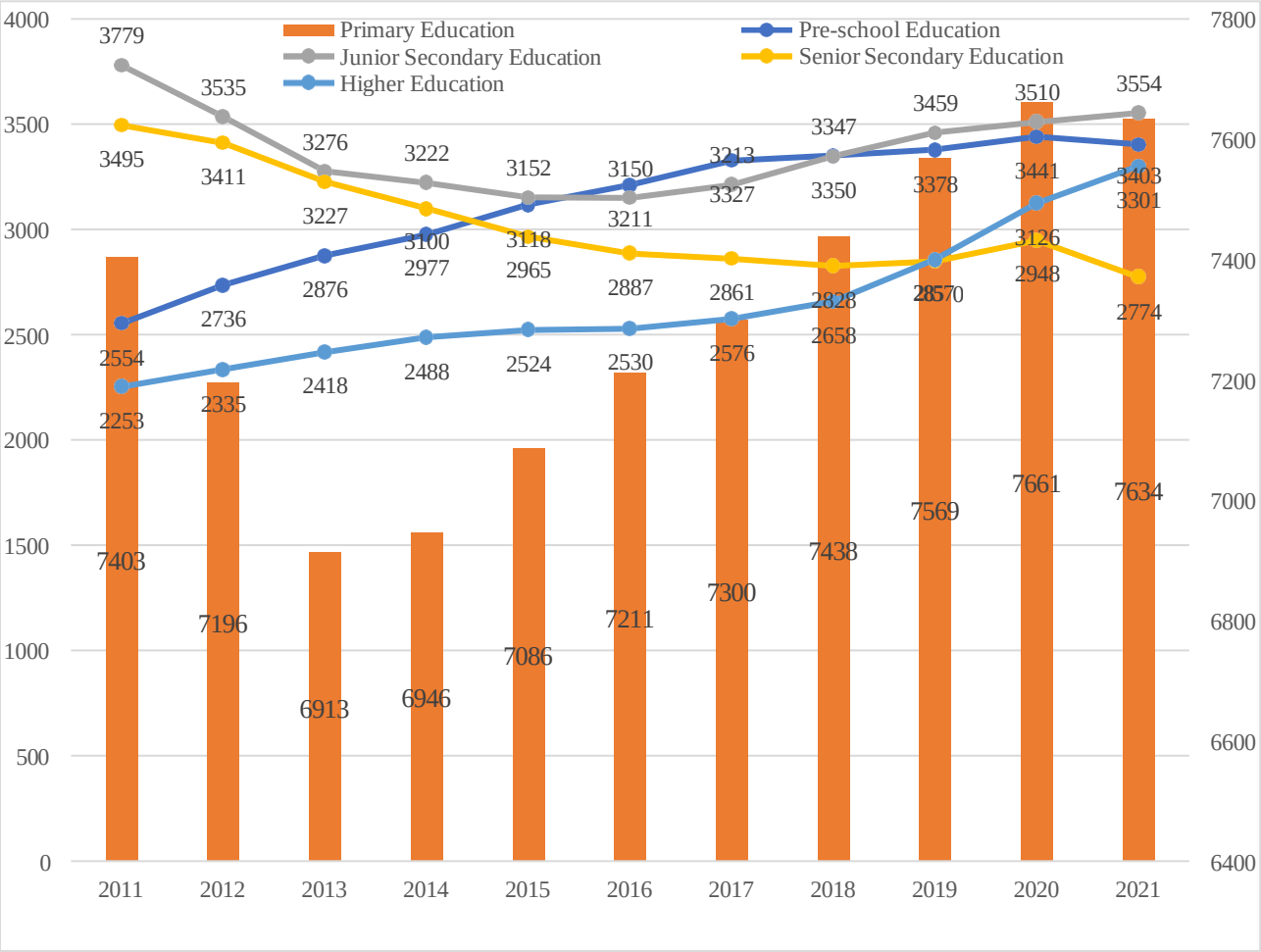


Fig.2.16. **Average Education Enrolment per 100 000 Population by Level in the dynamics for the period 2011-2021**

Source: based on information from the website of the State Statistics Service of Katai [29]

Table 2.4

Average Education Enrolment per 100 000 Population by Regions in 2021

Region	Pre-school Education	Primary Education	Junior Secondary Education	Senior Secondary Education	Higher Education
Bejing	2589	4735	1597	1024	5313
Tianjin	2278	5421	2458	1953	5153
Hebei	3310	9169	4139	3429	2926
Shanxi	2893	6671	3131	2880	3112
Inner Mongolia	2514	5861	2770	2454	2351
Liaoning	2049	4638	2335	2062	3742
Jiilin	1749	4798	2506	2423	4550
Heilongjiang	1541	3700	2632	2367	3448
Shanghai	2251	3588	2000	1139	3691
Jiangsu	2979	6909	3113	2233	3531
Zhejianng	3105	5928	2572	2162	2632
Anhui	3506	7678	3765	3138	3089
Fujian	4020	8481	3668	2583	3023
Jiangxi	3581	8758	4789	3712	4001
Shandong	3830	7435	3818	2622	3429
Henan	4018	10179	4820	3578	3424
Hubei	3108	6670	3085	2413	3914
Hunan	3542	7977	3874	3161	3487
Guangdong	3964	8547	3400	2306	2922
Guangxi	4533	10280	4580	3792	3432
Huinan	3871	8596	3876	3112	2839
Chongqing	3101	6329	3528	3129	3605
Sichuan	3127	6558	3343	2760	2925
Guizhou	4291	10273	4665	3533	2593
Yunnan	3748	8158	3886	3318	2871
Tibet	4274	9989	3964	2976	1634
Shaanxi	3473	7494	3046	2395	4279
Gansu	3879	8097	3538	2868	2999
Qinghai	3845	8730	3747	3719	1613
Ningxia	3626	8373	3980	3380	2749
Xinjiang	4305	11328	4312	2906	2526

- maximum value

- maximum value

An analysis of the average number of education enrollments per 100,000 population by region in 2021 showed that the Bejing region has the highest level of

higher education enrollment, while having the lowest rates for enrollment in junior secondary education and upper secondary education (Table 2.4.). Qinghai has the lowest higher education enrollment, almost 4 times lower than the Bejing region. Guangxi region has the highest preschool and upper secondary education coverage, while Heilongjiang region has undercoverage for preschool. The Xinjiang region has the highest rate for the enrollment of junior secondary education. Thus, in general, in China there is a certain uneven coverage among different levels of education.

Thus, the study of the state of innovation processes in the social sector of China based on the country's position in the Global Innovation Index and analysis of statistical indicators of social infrastructure is considered appropriate to offer a matrix of identified bottlenecks and appropriate recommendations for overcoming them (Table 2.5).

It should be noted that the innovative development of China's social infrastructure over the past few years is primarily due to the COVID-19 pandemic, which has caused a new wave of innovation throughout the economy. Medicine is a major area where the government has pledged to invest more in research and development, but this time the innovations are more inclusive as they meet the demand of hundreds of millions of people. Another area that has undergone further innovative development in China is digital services for the population. But not all digital services have benefited from the COVID-19 outbreak. The share of the shared economy, which accounted for 3.2% of GDP in 2019 and has developed dynamically in recent years, is likely to decline due to growing wariness about the physical sharing of housing, cars, household appliances and other facilities.

The main source of innovative development of social infrastructure in China today are concession projects. According to the World Bank, China annually needs to invest 130 billion dollars in the development of social infrastructure. USD USA, and the total amount of state expenditures on the social sphere is 200 billion. USD USA for the year, which is 40% of state budget revenues [30].

Table 2.5

Matrix for increasing the level of inclusion of China's social infrastructure by the main structural elements

Strengthening inclusiveness	
Bottlenecks	Recommendations
Health	
1. COVID-19 has highlighted the shortcomings of low health reimbursement rates, which has led many people to the poverty line. 2. Disease control centers are underfunded and losing staff. 3. The system of direct reporting of infectious diseases to the central government, but it can be blocked at the local level. 4. Lack of a transparent and effective mechanism for global data exchange.	1. Distribute high-quality healthcare resources more evenly to reduce incentives to move to metropolitan areas. 2. To increase the number of qualified medical personnel in rural areas through more effective rotation of quality personnel. 3. Ensure that local centers for disease control are adequately funded and staffed so they can help avoid future health crises. 4. Improve the mechanism of the infectious disease reporting and information exchange system and ensure its smooth functioning. 5. Increase transparency and data sharing with global healthcare experts and organizations
Education	
1. Uneven distribution of qualified teaching staff between regions. 2. Uneven education coverage of the population at different levels of education. 3. Uneven filling of the labor market and shortage of specialists in certain professions	1. To increase the number of qualified teaching staff in rural areas through more effective rotation of quality personnel. 2. To expand the network of preschool educational institutions and coverage of children with education in rural areas. 3. Distribute high-quality education resources more evenly to reduce incentives to move to metropolitan areas.
Public services and public transport	
1. People's access to public services is still largely related to their residence permit or place of household registration. 2. Currently, only city workers are covered by unemployment insurance. 3. China has a high life expectancy for its income level and a low retirement age 4. Lack of an adequate suburban transport network	1. Extend unemployment insurance to the entire workforce and unify administration at the national level. 2. Ensure the sustainability of the pension system by linking retirement age to life expectancy. 3. Create suburban rail networks for better integration of rural areas near cities. 4. Expand and improve rural roads to integrate such areas into commercial networks and provide an opportunity to get to work in cities.
Environmental sustainability of cities and regions	
1. Pollution causes great damage to human life 2. Constant growth of energy consumption against the background of lack of sufficient energy efficiency 3. Increasing the burden on ecosystem viability	1. Accelerate China's energy transition through green investment. 2. Encourage producers of electricity from renewable sources by allowing them to sell electricity they produce through the grid. 3. Increase investment in sewage treatment plants and environmental infrastructure, in particular in urban water purification and environmentally friendly rural sanitation facilities.

Such expenditures prompted the PRC authorities in 2004 to amend the Constitution regarding the nationalization of land and allowed the use of concessions in the implementation of large-scale infrastructure development projects, mainly in the construction of roads and highways, bridges, educational institutions, etc. This made it possible to attract private investment and launch large-scale projects. Thus, according to the concession project for UAH 300 billion. USD USA built 16 thousand. Km. a new high-speed railway, which should also contribute to an increase in employment in construction. On the construction of the branch Shanghai-Beijing attracted 100 thousand tons. workers, the project is planned to build 42 high-speed branches [32].

In China, concession projects were developed in the construction of water utilities and power plants, highways, new subway lines and light metro, the creation of high-speed bus lines connecting residential areas of cities with industrial and commercial centers. Examples of such concession projects are: construction of the LaibinB Power Plant in Guangchi province – foreign investors participated in the concession on a tender basis; construction of water treatment plants in Chengdu, Shenyang and Beijing. In 2005, a public expert-analytical department "China Center for Public-Private Partnerships" was established in Beijing, which is engaged in analytical research and control over concession projects in the field of utilities [31]. In a relatively short time, when establishing mutually beneficial relations between the state, private partners and the public through the use of various forms of public-private partnership, including concessions, significant positive results were obtained in the social sphere of China. Thus, the study of the state of innovation processes in the social sector of China showed that for China the solution to the problem of energy efficiency remains relevant, as for most countries with high rates of industrialization and urbanization, China faces the problem of greater pollution and an increase in the burden on the viability of ecosystems, which indicates the need to pay more attention to the range of requirements for sustainable development with priority given to such important issues, like air and water quality, biodiversity and climate change. In

addition, innovative development of social infrastructure requires increasing the level of its inclusion, especially in the fields of education, health care and public services.

2.3. Methodical approach to assessing the level of innovative development of social infrastructure of territories

Current trends in innovative economic development – focus on sustainable development and digitalization – actualize the formation and application of management systems that should be aimed at assessing and monitoring the level of development of the social infrastructure of the territories. The current system of indicators for the development of social infrastructure of a certain territory does not fully hide all of the innovation and social environment. The existing approaches in the world are mostly focused on taking into account the classical areas of social infrastructure, such as education, healthcare, culture and sports, and transport infrastructure. Some authors also refer to social infrastructure as the level of security and the existence of equal opportunities for the population [27, 33]. Other scientists, when analyzing the level of development of social infrastructure, focus on providing an environmental complex, especially with regard to the socio-urban direction of development of cities and territories, conceptualizing sustainability as the main vector. The work of scientists such as Sierra, L.A., Pellicer, E. and Yepes, V. [34] is focused on measuring the social sustainability of infrastructure projects, which essentially proves the need for an integrated approach to assessing the level of development of social infrastructure of territories. Another aspect of measuring the level of development of social infrastructure is offered by Ukrainian scientists: Boichenko V.S., Shaulskaya L.V. [33, 35] based on the Human Development Index of the city, the main idea of calculating which is the realization of the possibility of carrying out a comprehensive assessment of the level of human development of territorial entities, taking into account the existing demographic volume of the human component and the current possibilities of realizing the potential of human development in the conditions of the existing social infrastructure of the city.

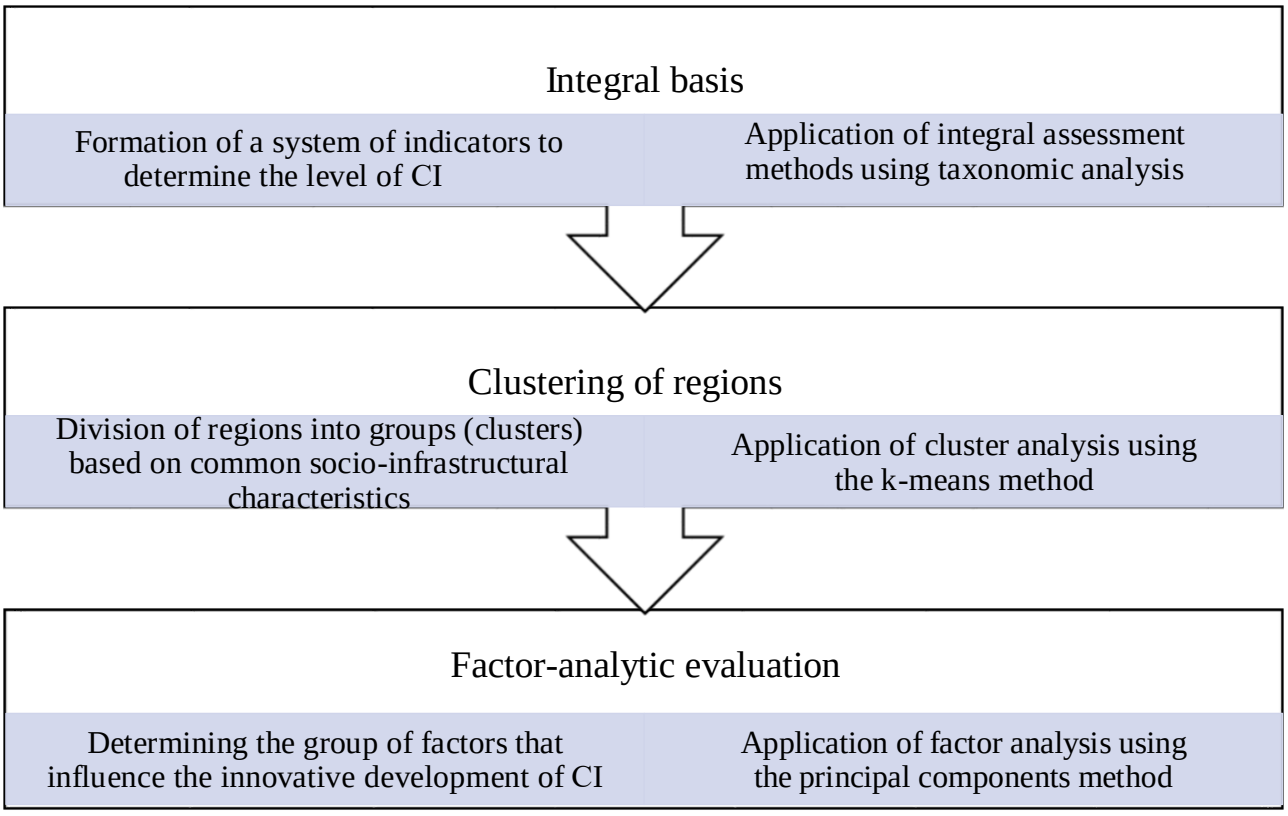
Another aspect that actualizes the need to develop a methodological approach

to assessing the level of innovative development of the social infrastructure of territories is the disproportionality of development. As you know, social infrastructure can be considered at different levels, depending on the scale of measurement of the analyzed territories. For example, there is the concept of social infrastructure of a country, region and city. The division of territories into certain administrative-territorial units, as a rule, leads to differentiated development results. In this context, we mean the existence of potential disproportions in the development of various administrative-territorial units. It becomes logical to assume that, for example, different regions will have different levels of social infrastructure development. Our study of the state of innovation processes in the social sector of China has confirmed the hypothesis that there is a disproportion in the development of different regions of China, which, in turn, necessitates the development of a methodological approach to determining the level of development of the social infrastructure of the region. *The main idea of this methodology is to form an analytical profile of the level of development of social infrastructure in different regions of China in order to form targeted state support for innovative projects in the relevant areas of social infrastructure, which will contribute to the efficiency of using public funds and reduce the level of regional disproportion in the overall development of social infrastructure of the state*.

This technique involves the phased implementation of three methodological blocks, each of which is based on a specific calculation toolkit (Fig.2.17). The first block – the integral basis – involves the use of an integral indicator of the level of development of social infrastructure based on taxonomic analysis. The second block – clustering of regions – provides for the implementation of the procedure for dividing regions into groups (clusters) according to common socio-infrastructural characteristics. The third block - factor-analytical - is based on the use of factor analysis tools to determine a group of factors t hat influence the innovative development of the social infrastructure of the territories.

Rice. 2.17. Step-by-step design of the methodology for assessing the level of innovative development of the social infrastructure of territories

The formation of a system of indicators for determining the level of development of social infrastructure was carried out on the basis of a generalization of existing approaches to structuring the spheres of activity and constituent elements. In accordance with this, we propose to assess the social infrastructure of the territory (region) according to the following groups of indicators (Fig.2.18).



As part of our research, we suggest using an 8-indicator scorecard. In contrast to the existing areas of assessment, in addition to the classical areas of social infrastructure, such as education, healthcare, transport and the cultural and sports sector, we propose to take into account indicators of employment, environmental protection, investment in the relevant areas of social infrastructure and social security. Such an approach will allow a more comprehensive approach to assessing the level of development of social infrastructure and will provide an opportunity to take into account the innovative component in shaping the development of social

infrastructure.

Thus, the first indicator "Employment" reflects the level of development of social infrastructure in terms of employment of the region's population. It characterizes its structural specification with a focus on the ratio of employment of urban and rural population. The choice of this indicator for calculating the level of development of social infrastructure is explained by the fact that it describes the labor market, characterizes the existing conditions for implementation in the field of labor and the level of welfare of the population of the region.

The second indicator "Environment" reflects the level of development of social infrastructure in terms of living conditions of the population related to ensuring proper environmental living conditions (clean air, water). For China, taking into account this indicator is extremely important, which is confirmed by the analysis of its position in the Global Innovation Index (paragraph 2.2). Especially important is the indicator of investment in environmental projects, which determines the involvement of the state in solving environmental pollution problems.

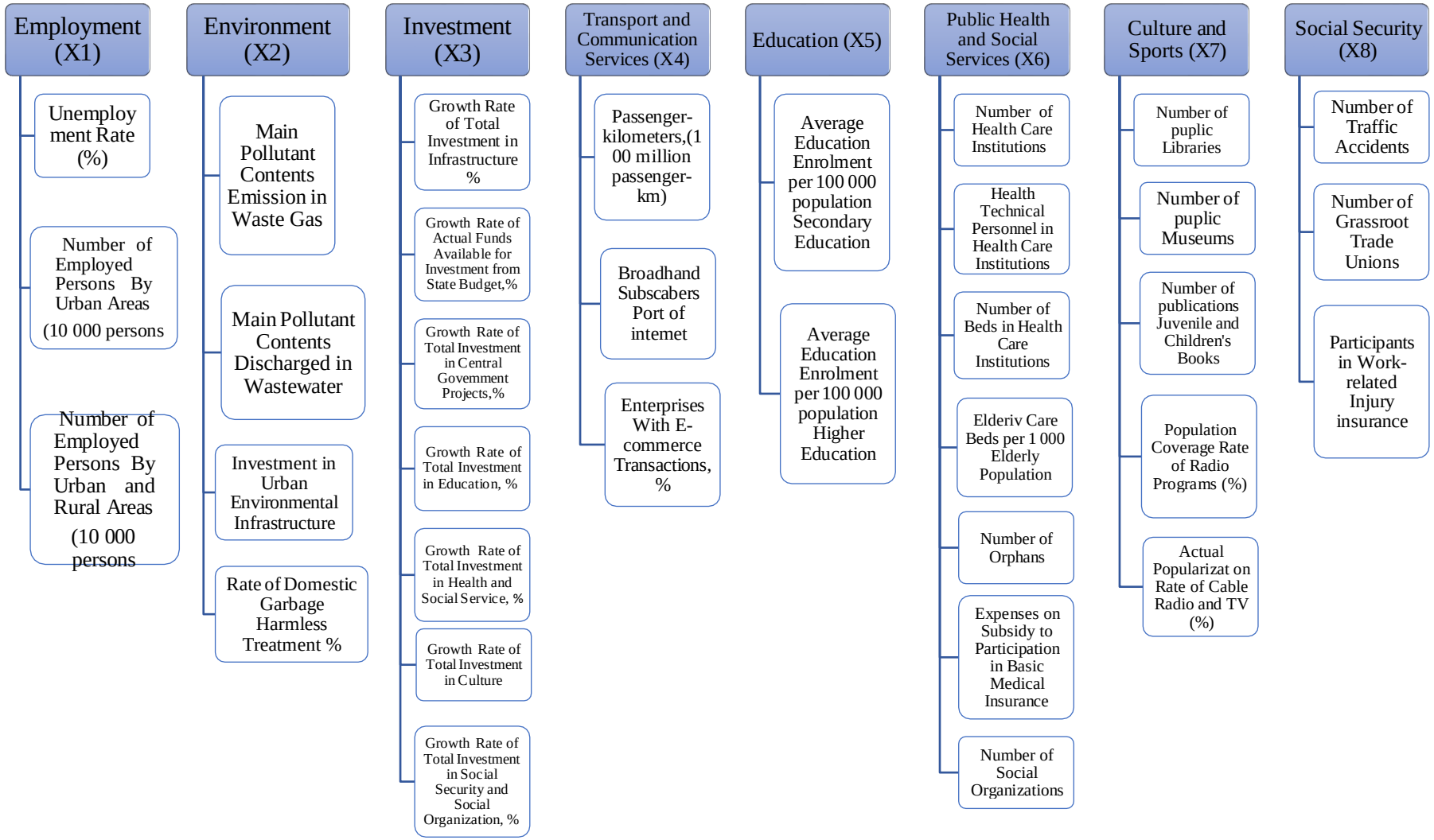


Fig. 2.18 **System of indicators for assessing the level of development of social infrastructure of the territory**

The third indicator "Investment" consists of indicators such as the index of total investment in infrastructure, the growth rate of actual funds available for investment from the state budget, the growth rate of investment in public projects, the growth rate of investment in education, healthcare, culture and sports, as well as the growth rate of total investment in social security and social organizations. This indicator in its essence provides an opportunity to assess the financial support of social infrastructure.

The fourth indicator "Transport and Communication Services" characterizes the mobility opportunities of the population, and indicators such as the availability of broadband subscriber Internet and the percentage of enterprises that carry out e-commerce transactions form the basis for evaluating digitalization processes.

The fifth indicator "Education" characterizes the possibilities of accumulating intellectual resources and educational potential within the region.

The sixth indicator "Public Health and Social Services" describes current and existing opportunities to ensure a long and healthy life of the population. Among the indicators are the following: number of health care facilities, provision of medical and technical personnel of health care institutions, number of beds in health care facilities, provision of beds for the elderly, number of orphans, subsidy costs for participation in basic health insurance, number of social organizations.

The seventh indicator "Culture and Sports" characterizes the possibilities of cultural development and ensuring a healthy lifestyle of the population. Among the indicators are the number of public libraries, the number of public museums, the number of publications of youth and children's literature, the level of coverage of the population with radio programs, the level of coverage of the population in terms of cable radio and television.

And finally, the eighth indicator "Social Security" characterizes the level of social tension and basic protection of the population, as well as the openness and accessibility of human development of the region for all segments of the population.

Thus, we have formed a system of indicators for assessing the level of development of the social infrastructure of the territories, which consists of 8 indicators, taking into account 34 partial indicators.

The information base for the formation of a scorecard was the data system of the State Statistics Service of China. According to the database, the study covered 31 regions of China. A fragment of input data for assessing the level of development of social infrastructure in China is shown in Table 2.6., and the general information table of input data is presented in Annex A.

Table 2.6

Fragment of input data for assessing the level of development of social infrastructure in China

	Employment *(X1)*			...	Social Security *(X8)*		
Region	Unemployment Rate (%)	Number of Employed Persons By Urban Areas	Number of Employed Persons By Urban and Rural Areas		Number of Traffic Accidents	Number of Grassroot Trade Unions	Participants in Work-related Injury insurance
	x1.1	*x1.2.*	*x1.3*	...	*x8.1*	*x8.2*	*x8.3*
Bejing	3,2	1013	145		5363	3,4	1307,2
Tianjin	3,7	534	107		7548	1,6	408,4
Hebei	3,1	2133	1510		4268	12,5	1084,7
Shanxi	2,3	1014	701		9213	5,3	640,1
Inner Mongolia	3,8	790	428		3576	5,2	338,2
Liaoning	4,3	1483	707		4876	5,7	807,9
Jiilin	3,3	718	510		11026	2,8	392,4
...				...			
Ningxia	4,1	225	120		1588	1,2	143,8
Xinjiang	2	774	586	...	5372	3,6	456,1

It should be noted that to compile a matrix of indicators, the elements of which are indicators $\tilde{O}_{ij}$ () and at the same time, *and = 1....m, and j = 1....n, where* m = *31 (number of regions of China), and n* = 34 (number of indicators by groups of indicators) was carried out using the standardization procedure. This procedure was applied in order to bring the input data to a single measurement system according to the formula:

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{S_j} \quad (2.1)$$

where x_{ij} – the value of the *j-th* indicator for the i-th region of China; $\bar{x}_j$ - arithmetic mean value of the j-th indicator; S_j – standard deviation of the j-th indicator; z ij – *standardized value* of the *j-th indicator for the i-th region of China*.

In Table 2.7. a fragment of the standardized matrix of input data for determining the level of development of the social infrastructure of China's regions is given, and the general standardized matrix is reflected in Annex B.

Table 2.7

Fragment of a standardized matrix of input data to determine the level of development of social infrastructure in China's regions

	Employment *(X1)*			...	Social Security *(X8)*		
	x1.1	*x1.2.*	*x1.3*	...	*x8.1*	*x8.2*	*x8.3*
Bejing	0,197	-0,430	-1,195		-0,472	-0,839	0,462
Tianjin	0,961	-0,845	-1,255		-0,172	-1,242	-0,590
Hebei	0,044	0,541	0,967		-0,623	1,201	0,202
Shanxi	-1,177	-0,429	-0,314		0,056	-0,413	-0,319
Inner Mongolia	1,113	-0,623	-0,746		-0,718	-0,435	-0,672
Liaoning	1,877	-0,022	-0,305		-0,539	-0,323	-0,122
Jiilin	0,350	-0,686	-0,617		0,305	-0,973	-0,609
...				...			
Ningxia	1,571	-1,113	-1,234		-0,991	-1,332	-0,900
Xinjiang	-1,636	-0,637	-0,496	...	-0,471	-0,794	-0,534

The next procedure for preparing input data to break the level of development of the social infrastructure of the region is the classification of all 34 indicators, into stimulants and destimulants. Indicators that have a positive impact on the level of development of social infrastructure were attributed to stimulants (C), indicators that have a negative impact – to destimulants (D). The results of classification of indicators on the basis of positive or negative impact on the level of development of social infrastructure are shown in Table 2.8.

able 2.8

Classification of indicators on the basis of positive or negative impact on the level of development of social infrastructure in China's regions

	Indicators of the level of development of SI	S/D
1	Unemployment Rate (%)	Etc
2	Number of Employed Persons By Urban Areas(10 000 persons)	C
3	Number of Employed Persons By Urban and Rural Areas(10 000 persons)	C
4	Main Pollutant Contents Emission in Waste Gas by Region (10 000 tons)	Etc
5	Main Pollutant Contents Discharged in Wastewater (10 000 tons)	Etc
6	Investment in Urban Environmental Infrastructure (10 000 yuan)	C
7	Rate of Domestic Garbage Harmless Treatment %	C
8	Growth Rate of Total Investment in in Infrastructure %	C
9	Growth Rate of Actual Funds Available for Investment from State Budget,%	C
10	Growth Rate of Total Investment in Central Govemment Projects,%	C
11	Growth Rate of Total Investment in Education, %	C
12	Growth Rate of Total Investment in Health and Social Service, %	C
13	Growth Rate of Total Investment in Culture Sports and Entertaiment, %	C
14	Growth Rate of Total Investment in Social Security and Social Organization, %	C
15	Passenger-kilometers,(100 million passenger-km)	C
16	Broadhand Subscabers Port of intemet (10 000 ports)	C
17	Enterprises With E-commerce Transactions , %	C
18	Average Education Enrolment per 100 000 population Secondary Education	C
19	Average Education Enrolment per 100 000 population Higher Education	C
20	Number of Health Care Institutions	C
21	Health Technical Personnel in Health Care Institutions per 1000 Persons	C
22	Number of Beds in Health Care Institutions (10 000 beds)	C
23	Elderiv Care Beds per 1 000 Elderly Population (bed)	C
24	Number of Orphans	Etc
25	Expenses on Subsidy to Participation in Basic Medical Insurance	C
26	Number of Social Organizations	C
27	Number of puplic Libraries	C
28	Number of puplic Museums	C
29	Number of publications Juvenile and Children's Books	C
30	Population Coverage Rate of Radio Programs (%)	C
31	Actual Popularization Rate of Cable Radio and TV (%)	C
32	Number of Traffic Number of RegionAccidents	Etc
33	Number of Grassroot Trade Unions	C
34	Participants in Work-related Injury insurance	Etc

In accordance with the methodology for calculating the integral indicator of the level of development of the social infrastructure of the region, it is necessary to determine the reference value , $p_0\left(x_{.01}, x_{02}, ...x_{0j}, ...x_{0m}\right)$ *j=1..m..*, with which further comparison of indicators for a specific region is carried out. If the indicator xj *acts as a stimulant,* then . In the case when the $x_{0j} = \max_i x_{ij}$ indicator xj is *classified as a destimulant, then* . Thus, the conditional region is determined, $x_{0j} = \min_i x_{ij}$ which is assigned best

in terms of the analyzed indicators and the purpose of the study, the value of the parameters from standardized data.

After constructing the standard, the distances between the individual points characterizing a particular region and the point of the standard are determined. The so-called Euclidean distance is calculated using the following formula:

$$d_{0i} = \sqrt{\sum_{j=1}^{m}(x_{ij} - x_{0j})^2} \quad (2.2)$$

Using the formulas below, in the process of analysis, the level of development of social infrastructure in 31 regions of China was calculated.

$$K_i = 1 - \frac{d_{0i}}{d0} \quad (2.3); \quad d_0 = \bar{d}_0 + 2\sigma_0 \quad (2.4);$$

$$\bar{d}_0 = \frac{\sum_{i=1}^{n} d_{0i}}{n} \quad (2.5); \sigma = \sqrt{\frac{\sum_{i=1}^{n}(d_{0i} - d_0)^2}{n}} \quad (2.6),$$

where $\bar{d}_0$ is the average value of the Euclidean distance for all regions; σ is the standard deviation of multidimensional distances.

Thus, the value of the integral coefficient of the level of development of social infrastructure can take values from 0 to 1 (). It should be noted that the closer the value of the integral coefficient to 1, the higher the level of development of social infrastructure has a certain region of China. $Kñò_i \in [0.1]$

The calculation of integral coefficients of the level of development of the social infrastructure of China's regions is presented in Annex C.

The obtained values of the calculated indicators of the integral coefficient of the level of development of the social infrastructure of the regions of China are plotted on the map and presented in Fig.2.19.

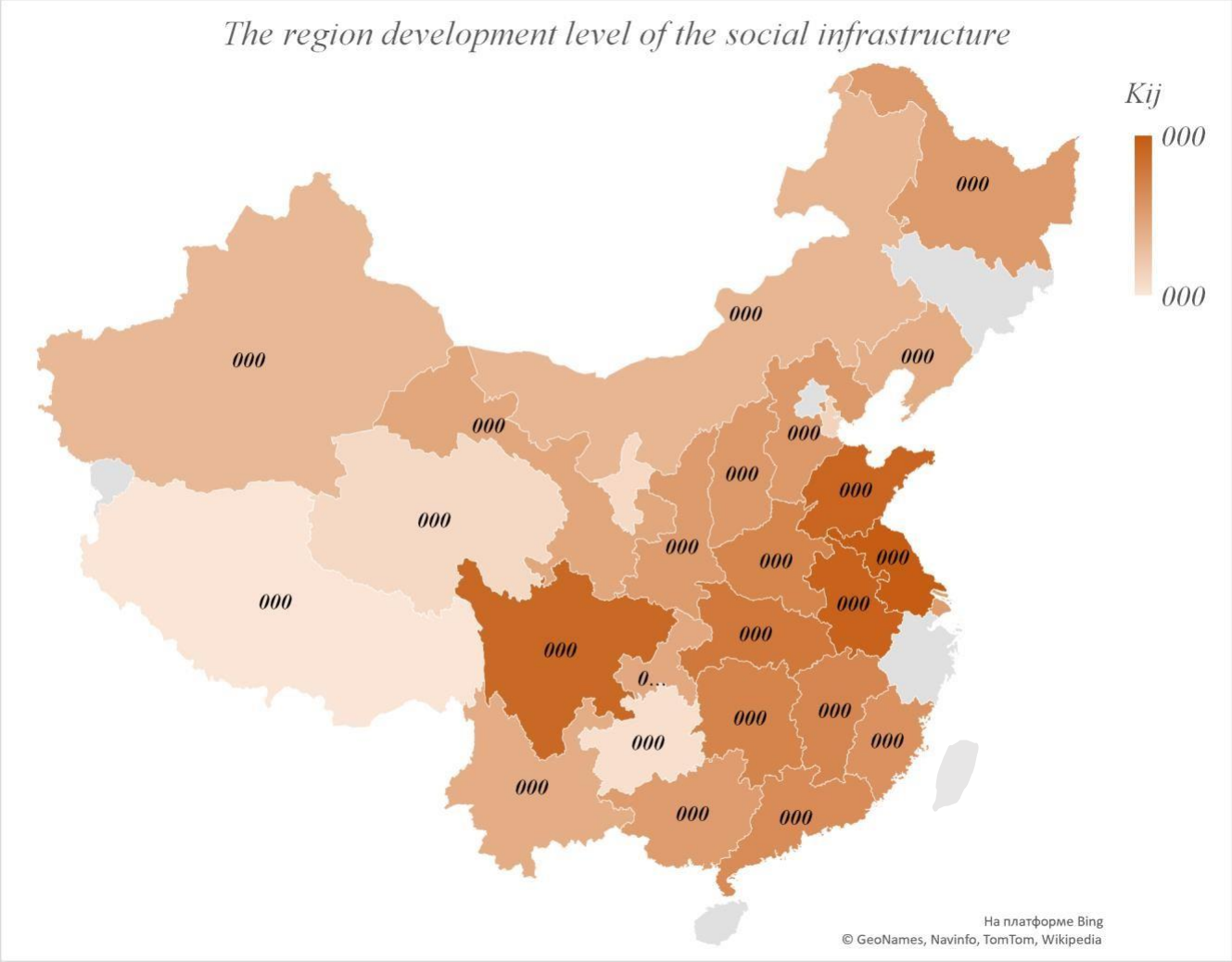


Fig.2.19 **Map of the level of development of social infrastructure of regions of China**

According to the results of calculation of integral coefficients, the most developed social infrastructure is observed in such regions of China as Zhejianng, Jiangsu, Anhui, Shandong and Sichuan. For example, the Zhejianng region has quite high scores on indicators of "Employment", "Transport and Communication Services", "Education" and "Public Health and Social Services". Despite the relatively high level of environmental pollution and a decrease in investment, this region managed to get the highest indicator of the level of development of social infrastructure among all regions of China. The Jiangsu region scores best in terms of the length of transport routes, the number of social and trade union organizations, and the percentage of coverage of radio programs. According to the calculations, the Shandong region is distinguished by high values of indicators for the indicator of the

cultural sphere and sports. And the Sichuan region has the largest expenditures on insurance medicine and the largest number of libraries.

At the same time, special attention should be paid to the regions whose level of development of social infrastructure according to the results of calculations turned out to be the lowest. These regions include Tianjin, Huinan, Qinghai, Ningxia, Guizhou and Tibet. Tibet has the lowest level of social infrastructure development. This region is characterized, on the one hand, by the lowest rates of employment, transport and communication services, the smallest number of social organizations, the lowest indicator of providing hospitals with technical staff and the number of beds in hospitals. On the other hand, the Tibet region has the lowest level of pollution and the number of road accidents. In the context of providing employment, the Ningxia region is in close positions to the Tibet region, and in some labor market indicators, such as the unemployment rate, it is even worse. The development of transport and communication services in this region is also at a low level. The most important indicators by which the Ningxia region is more developed than the Tibet region are "Social Security" and "Public Health and Social Services". The regions of Tianjin, Huinan and Qinghai have very close indicators in terms of social infrastructure development. It should be noted that despite the overall low level of social infrastructure development, according to the employment indicator, the Qinghai region has the lowest unemployment rate among all 34 regions of China. And the Huinan region has the lowest pollution rate among all 34 regions.

It is also important to analyze the indicator "Investment". In terms of growth in total infrastructure investment, the Xinjiang region has the best indicator (level of social infrastructure development K_{ij}= 0.13); the Growth Rate of Actual Funds Available for Investment from State Budge is dominated by the Shanxi region (level of development of social infrastructure K_{ij}= 0,19); the Shanghai region dominates in terms of Growth Rate of Total Investment in Central Govemment Projects and Growth Rate of Total Investment in Education (level of social infrastructure development K_{ij}= 0.19); Growth Rate of Total Investment in Health and Social

Service is led by Jiilin (level of development of social infrastructure K_{ij} = 0.16); according to the Growth Rate of Total Investment in Culture Sports and Entertaimen, the Chongqing region has the highest investment (level of social infrastructure development K_{ij} = 0.16); the Growth Rate of Total Investment in Social Security and Social Organization is dominated by Henan (level of development of social infrastructure K_{ij} = 0.25). The logical conclusions that allow us to make such observations are as follows:

1) *the level of development of a certain indicator proportionally depends on the size of the investment* (for example, the Shanghai region with the largest investments in the indicator "Education" has high indicators in this group, and the Chongqing region managed to reach the proper level in the group of indicators "Culture and Sports" due to the high level of investment in Investment in Culture Sports and Entertaimen);

2) *the level of investment in certain sectors of social infrastructure (which are characterized by separate indicators) provides a high level of social infrastructure in the region as a whole. This may indicate that the effectiveness of the state's financing strategy for certain sectors of social infrastructure is low, which leads to the awareness of the need to revise such a strategy and apply the principle of complexity and synergistic effect*;

3) a high level of investment in social security of the region can lead to an increase in the overall level of development of the social infrastructure of the region.

Thus, the calculation of integral coefficients of the level of development of the social infrastructure of China's regions allowed to quantitatively assess and qualitatively interpret the disproportion of China's regional development, which consists in the difference in development according to general indicators and individual indicators and is a consequence of the existence of uneven distribution of budget resources.

According to the proposed step-by-step design of the methodology for assessing the level of innovative development of the social infrastructure of the

territories, the next stage is the clustering of China's regions - the division of regions into groups (clusters) according to common socio-infrastructural characteristics. According to the research methodology, clustering of regions of China is proposed to be carried out using the iterative method of k-means.

The use of cluster analysis allows the delimitation of regions not by one parameter, but by a certain set of indicators, while the following task is performed: based on the data that are part of the set *X*, a set of regions *G* is formed into *m* clusters (subsets) *Q1,Q2,...,Qm* so that each region *Gj* belonged to only one subset, and regions belonging to the same cluster were similar, while regions belonging to different clusters should be heterogeneous [36].

The essence of the iterative method of cluster analysis of k-means is that the classification process begins with the definition of initial conditions – the number of clusters. At the first stage of the analysis, we select *n observations, each of which is characterized using* m *signs* X1, X2,..., X *n These observations should be classified into* $_k$ clusters. From n observations randomly select *k* regions, which are taken as references.

Each standard is assigned a serial number, which is also a region number. From (*n-k) regions, the point* Xi *with coordinates* (xi1, xi2, ..., x*im*) *is selected* and checked using the Euclidean distance to which of the standards it is as close as possible, that is, it has a minimum distance. At the next stage of the analysis, select the point *Xi+1* and repeat all procedures for it. Thus, after the implementation *(n-k)* iterations, all regions of the population will be assigned to one of the *k* clusters [37].

Table 2.9 presents the results of clustering of 31 regions of China by 34 indicators of social infrastructure.

Table 2.9

Analysis of the results of clustering of regions of China (*stage 1*)

Variables	Between SS	df	Within SS	df	F	signif.p
x1.1	2,44542	3	27,55458	27	0,79873	0,505405
x1.2	20,69553	3	9,30447	27	20,01832	0,000000
x1.3	23,71095	3	6,28905	27	33,93176	0,000000
x2.1	14,92113	3	15,07887	27	8,90586	0,000288
x2.2	23,04184	3	6,95816	27	29,80334	0,000000
x2.3	23,47319	3	6,52681	27	32,36786	0,000000
x2.4	1,81330	3	28,18670	27	0,57899	0,633845
x3.1	2,31348	3	27,68652	27	0,75204	0,530759
x3.2	1,68873	3	28,31127	27	0,53684	0,661046
x3.3	11,92510	3	18,07490	27	5,93784	0,003017
x3.4	6,29565	3	23,70435	27	2,39032	0,090724
x3.5	0,58364	3	29,41636	27	0,17857	0,909995
x3.6	12,05329	3	17,94671	27	6,04454	0,002754
x3.7	1,77247	3	28,22753	27	0,56513	0,642703
x4.1	24,97842	3	5,02158	27	44,76796	0,000000
x4.2	22,21848	3	7,78153	27	25,69757	0,000000
x4.3	10,17239	3	19,82761	27	4,61737	0,009848
x5.1	13,10881	3	16,89119	27	6,98467	0,001259
x5.2	4,68827	3	25,31173	27	1,66699	0,197571
x6.1	20,36426	3	9,63574	27	19,02069	0,000001
x6.2	15,08284	3	14,91716	27	9,09997	0,000250
x6.3	25,33336	3	4,66664	27	48,85748	0,000000
x6.4	3,53398	3	26,46602	27	1,20176	0,327948
x6.5	12,44658	3	17,55342	27	6,38162	0,002070
x6.6	12,14637	3	17,85363	27	6,12298	0,002575
x6.7	20,95529	3	9,04471	27	20,85172	0,000000
x7.1	21,62542	3	8,37458	27	23,24043	0,000000
x7.2	16,90195	3	13,09805	27	11,61375	0,000045
x7.3	11,50692	3	18,49309	27	5,60005	0,004048
x7.4	4,61974	3	25,38026	27	1,63819	0,203862
x7.5	14,22402	3	15,77598	27	8,11463	0,000519
x8.1	10,55296	3	19,44704	27	4,88386	0,007697
x8.2	25,34935	3	4,65065	27	49,05642	0,000000
x8.3	14,89572	3	15,10428	27	8,87573	0,000294

Consequently, it should be noted that 31 regions of China were divided into four clusters by 34 indicators in two iterations. The results of the carried out

clustering cannot be considered satisfactory, since according to the indicators x1.1, x2.4, x3.1, x3.2, x3.5, x3.7, x6.4 and x7.4, the value of the level of trust (p - level) is critical, which indicates that these indicators do not have a significant impact on the clustering results. Thus, in order to obtain more scientifically based results, these indicators were excluded from the clustering procedure. After their exclusion, we have the following results (Table 2.10).

Table 2.10

Analysis of the results of clustering regions of China (*stage 2*)

Variables	Between SS	df	Within SS	df	F	signif.p
x1.2	20,69553	3	9,30447	27	20,01832	0,000000
x1.3	23,71095	3	6,28905	27	33,93177	0,000000
x2.1	14,92113	3	15,07887	27	8,90586	0,000288
x2.2	23,04184	3	6,95816	27	29,80334	0,000000
x2.3	23,47319	3	6,52681	27	32,36785	0,000000
x3.3	11,92510	3	18,07490	27	5,93784	0,003017
x3.4	6,29565	3	23,70435	27	2,39032	0,090724
x3.6	12,05329	3	17,94671	27	6,04454	0,002754
x4.1	24,97842	3	5,02158	27	44,76796	0,000000
x4.2	22,21848	3	7,78152	27	25,69758	0,000000
x4.3	10,17239	3	19,82761	27	4,61737	0,009848
x5.1	13,10881	3	16,89119	27	6,98467	0,001259
x5.2	4,68827	3	25,31173	27	1,66699	0,197571
x6.1	20,36426	3	9,63574	27	19,02069	0,000001
x6.2	15,08285	3	14,91715	27	9,09997	0,000250
x6.3	25,33336	3	4,66664	27	48,85751	0,000000
x6.5	12,44658	3	17,55342	27	6,38162	0,002070
x6.6	12,14637	3	17,85363	27	6,12298	0,002575
x6.7	20,95529	3	9,04471	27	20,85172	0,000000
x7.1	21,62542	3	8,37458	27	23,24044	0,000000
x7.2	16,90195	3	13,09805	27	11,61375	0,000045
x7.3	11,50692	3	18,49309	27	5,60005	0,004048
x7.5	14,22402	3	15,77598	27	8,11463	0,000519
x8.1	10,55296	3	19,44704	27	4,88386	0,007697
x8.2	25,34935	3	4,65065	27	49,05642	0,000000
x8.3	14,89572	3	15,10428	27	8,87573	0,000294

Conducting analysis of variance allowed to check the adequacy of the results of cluster analysis and the feasibility of their practical application. According to table. In Fig.

2.10 it should be noted that the values of intergroup variance exceed the values of variances within clusters for most of the analyzed indicators. The calculated values of the F-criterion are greater than the table value of this criterion at the appropriate level of significance and corresponding degrees of freedom. The value of the level of trust (p - level) allows us to conclude that the relationship between factors found in clusters is determined by a random feature of this sample with a probability of 1%.

The average values of variables for the formed clusters, which correspond to are shown in Fig.2.20.

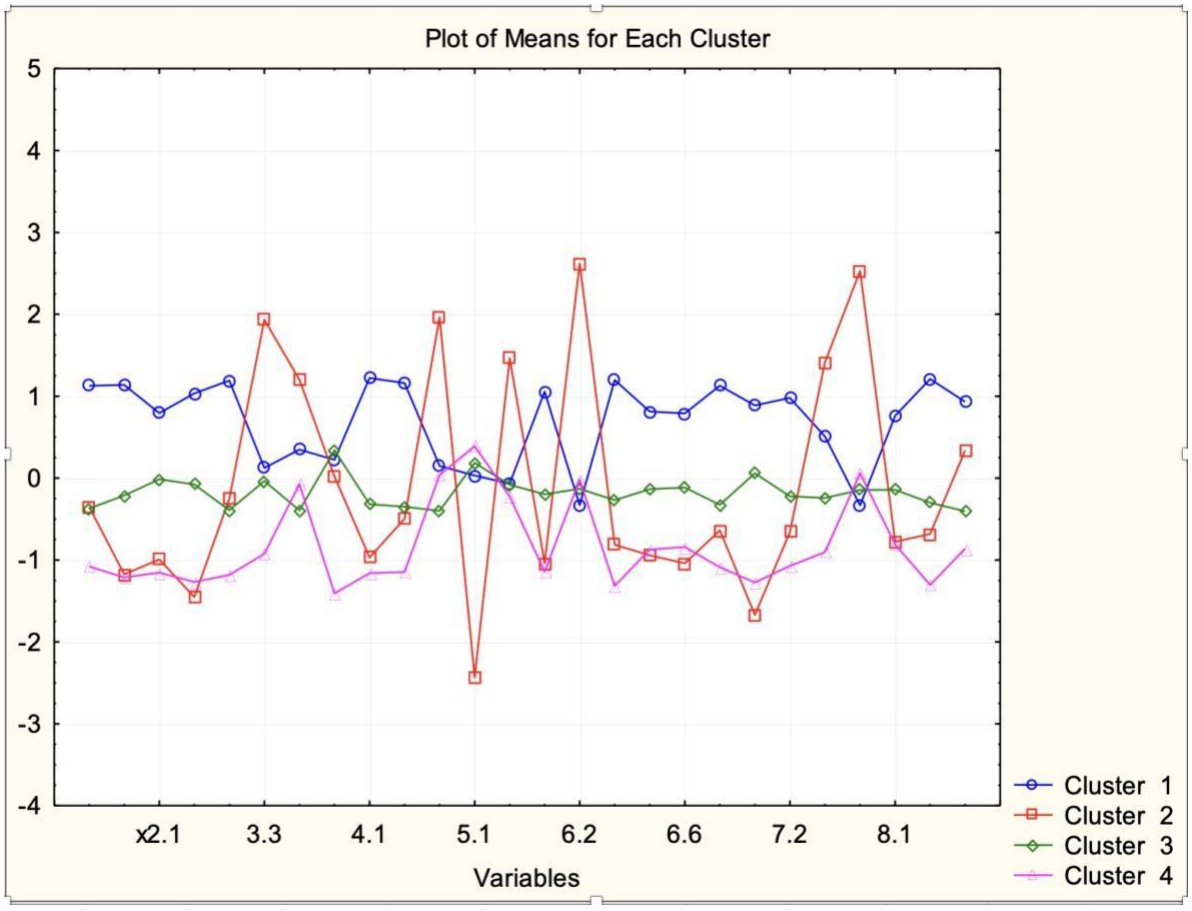


Fig.2.20 **Average values of variables for formed clusters in terms of development of social infrastructure of regions of China**

According to the analysis, the composition of the formed clusters and the number of regions of China that fell into each cluster were determined using the k-medium method. Tables 2.11, 2.12, 2.13 and 2.14 present statistical analysis of each cluster (mean, variance level, coefficients of variation) of objects (regions).

able 2.11

Cluster Statistical Analysis 1

Variables	Mean	Standard deviation	Variance	Members of Cluster Number 1	Distance
x1.2	1,127850	0,963662	0,928645	Hebei	0,767942
x1.3	1,138800	0,637424	0,406310	Jiangsu	0,617405
x2.1	0,793912	0,863487	0,745610	Zhejianng	0,826162
x2.2	1,034079	0,644314	0,415140	Anhui	0,662623
x2.3	1,191377	0,642446	0,412737	Shandong	0,726328
x3.3	0,124070	0,724893	0,525470	Henan	0,748927
x3.4	0,348578	0,828918	0,687105	Hubei	0,853118
x3.6	0,223583	0,707919	0,501149	Hunan	0,634862
x4.1	1,221763	0,505462	0,255492	Guangdong	0,946871
x4.2	1,160035	0,850517	0,723379	Sichuan	0,900877
x4.3	0,147933	0,654212	0,427993		
x5.1	0,030906	0,748964	0,560947		
x5.2	-0,066129	0,467270	0,218341		
x6.1	1,055305	0,975142	0,950903		
x6.2	-0,331707	0,506915	0,256963		
x6.3	1,197303	0,617421	0,381208		
x6.5	0,813022	1,197846	1,434834		
x6.6	0,790539	1,030809	1,062568		
x6.7	1,128356	0,904355	0,817857		
x7.1	0,887390	0,626069	0,391963		
x7.2	0,979260	1,048507	1,099367		
x7.3	0,508807	0,822738	0,676898		
x7.5	-0,333718	0,646991	0,418598		
x8.1	0,760134	1,167754	1,363649		
x8.2	1,209915	0,370594	0,137340		
x8.3	0,930380	1,261189	1,590598		

Table 2.12

Cluster Statistical Analysis 2

Variables	Mean	Standard deviation	Variance	Members of Cluster Number 2	Distance
x1.2	-0,35109	0,111618	0,012458	Bejing	0,602028
x1.3	-1,17482	0,027996	0,000784	Shanghai	0,602028
x2.1	-0,99211	0,183552	0,033691		
x2.2	-1,45268	0,035941	0,001292		
x2.3	-0,25066	0,420842	0,177108		
x3.3	1,93451	0,358192	0,128302		
x3.4	1,19971	1,437791	2,067244		
x3.6	0,01858	0,672135	0,451765		
x4.1	-0,97083	0,036036	0,001299		
x4.2	-0,49627	0,098966	0,009794		
x4.3	1,96360	2,443561	5,970992		
x5.1	-2,43427	0,118009	0,013926		
x5.2	1,46568	1,378914	1,901405		
x6.1	-1,03906	0,130338	0,016988		
x6.2	2,62117	2,459367	6,048483		
x6.3	-0,81302	0,108518	0,011776		
x6.5	-0,94183	0,018888	0,000357		
x6.6	-1,04061	0,057106	0,003261		
x6.7	-0,63911	0,145638	0,021211		
x7.1	-1,67037	0,028572	0,000816		
x7.2	-0,65845	0,194583	0,037863		
x7.3	1,41387	1,139874	1,299312		
x7.5	2,52979	0,609888	0,371964		
x8.1	-0,77684	0,430439	0,185277		
x8.2	-0,68182	0,221886	0,049233		
x8.3	0,33912	0,173687	0,030167		

It should be noted that the obtained clustering results mostly correspond to the results obtained during the calculation of the integral coefficients of the level of development of social infrastructure. The point is that cluster 1 includes regions whose integral coefficient of the level of development of social infrastructure has high values (K_{ij} >0,20). A characteristic feature of this cluster is the maximum approximation of the values of indicators to the reference ones. But according to some indicators, there is a lag behind the regions of the second cluster. For example, according to the indicator "Investment", this cluster has lower values of indicators.

Table 2.13

Cluster Statistical Analysis 3

Variables	Mean	Standard deviation	Variance	Members of Cluster Number 3	Distance
x1.2	-0,370609	0,254607	0,064825	Shanxi	0,596022
x1.3	-0,212613	0,447876	0,200593	Inner Mongolia	0,485567
x2.1	-0,013565	0,794253	0,630837	Liaoning	0,665792
x2.2	-0,078148	0,493598	0,243639	Jiilin	0,700989
x2.3	-0,392783	0,448094	0,200788	Heilongjiang	0,519317
x3.3	-0,034959	0,830711	0,690081	Fujian	0,423624
x3.4	-0,394157	0,951490	0,905333	Jiangxi	0,656858
x3.6	0,340852	0,871546	0,759593	Guangxi	0,617832
x4.1	-0,319402	0,446333	0,199213	Chongqing	0,719506
x4.2	-0,348279	0,289267	0,083675	Guizhou	0,683247
x4.3	-0,399560	0,773633	0,598508	Yunnan	0,680148
x5.1	0,186207	0,789737	0,623684	Shaanxi	0,739612
x5.2	-0,081466	0,959487	0,920615	Gansu	0,559617
x6.1	-0,197443	0,284897	0,081166	Xinjiang	0,426753
x6.2	-0,130848	0,610911	0,373212		
x6.3	-0,268963	0,301984	0,091194		
x6.5	-0,134450	0,559086	0,312577		
x6.6	-0,115289	0,791916	0,627131		
x6.7	-0,326142	0,349377	0,122064		
x7.1	0,059912	0,537031	0,288402		
x7.2	-0,222298	0,483088	0,233374		
x7.3	-0,242007	0,890005	0,792109		
x7.5	-0,144541	0,842777	0,710272		
x8.1	-0,142560	0,702931	0,494111		
x8.2	-0,300780	0,507625	0,257683		
x8.3	-0,405426	0,224050	0,050198		

The second cluster includes 2 regions of Bejing and Shanghai. These regions also have a fairly high level of social infrastructure development ($K_{ij} = 0.20$, $K_{ij} = 0.19$), but they are separated into a separate cluster due to significant differences with the region of Cluster 1 in terms of certain indicators (level of investment in state projects, provision of technical staff of health care institutions, average level of coverage of the population by school educational institutions). According to by these indicators, these regions lag far behind the regions of Cluster 1, which actualizes their allocation into a separate group.

At the same time, this cluster has the highest rates in terms of the "Investment" indicator.

Table 2.14

Cluster Statistical Analysis 4

Variables	Mean	Standard deviation	Variance	Members of Cluster Number 4	Distance
x1.2	-1,07756	0,151232	0,022871	Tianjin	0,713914
x1.3	-1,21236	0,077085	0,005942	Huinan	0,397664
x2.1	-1,15300	0,182894	0,033450	Tibet	0,447297
x2.2	-1,26827	0,115432	0,013325	Qinghai	0,356528
x2.3	-1,18270	0,078782	0,006207	Ningxia	0,584486
x3.3	-0,92406	1,030330	1,061580		
x3.4	-0,07340	0,959666	0,920959		
x3.6	-1,40898	0,881744	0,777473		
x4.1	-1,16087	0,181027	0,032771		
x4.2	-1,14638	0,208294	0,043386		
x4.3	0,03746	0,745667	0,556020		
x5.1	0,39052	0,964475	0,930212		
x5.2	-0,22591	1,539258	2,369314		
x6.1	-1,14215	0,036968	0,001367		
x6.2	-0,01868	0,652735	0,426063		
x6.3	-1,31630	0,098059	0,009616		
x6.5	-0,87286	0,379488	0,144011		
x6.6	-0,84202	0,183412	0,033640		
x6.7	-1,08787	0,137792	0,018987		
x7.1	-1,27438	0,523657	0,274216		
x7.2	-1,07271	0,181676	0,033006		
x7.3	-0,90554	0,448407	0,201069		
x7.5	0,06023	0,775096	0,600774		
x8.1	-0,81036	0,375991	0,141369		
x8.2	-1,30492	0,062196	0,003868		
x8.3	-0,86121	0,162907	0,026539		

Cluster 3, which includes the largest number of regions, is of interest. It should be noted that the integral coefficient of the level of development of the social infrastructure of the regions included in this cluster has a value of $0.13<K_{ij}>0.24$. The only exception is the Guizhou region, whose level of social infrastructure development is 0.03. This is explained by the fact that this region has the same trends as other regions, attributed to this cluster, namely: deviations from the reference values are greater than the deviations of Cluster 1, and less than the deviations of

Cluster 2, that is, for most partial indicators of social infrastructure, the regions of Cluster 3 have average indicators. As for the Guizhou region, its peculiarity is that by some indicators the region has critical values (for example, the highest unemployment rate, the highest rate of decline infunding for social services and infrastructure), which ultimately negatively affected the overall level of development of its social infrastructure.

Finally, Cluster 4 includes regions with the lowest level of social infrastructure development K_{ij}<=0.06.

Thus, a methodical approach to assessing the level of development of the social infrastructure of territories was proposed, the **uniqueness of which lies in the presence of a wide range of stakeholders** (state and local authorities, business community and the public) who can use its results to assess the proportionality of regional development and avoid disproportions in the development of certain areas of social infrastructure; to carry out a comparative assessment of the level of development of territories and the effectiveness of investment in the implementation of public-private partnership projects; to make strategic decisions of state social policy.

Conclusions to Chapter 2

The second section of the thesis is devoted to the study of the level of innovative development of social infrastructure in Ukraine and China. The main scientific and practical results are as follows:

1. The study of the state of innovation processes in the social sector of Ukraine made it possible to allocate actualized directions of social infrastructure development in the context of modern challenges and innovative orientation, namely: expanding the range of subjects of social activity, digitalization of the social sphere, individualization of social services, increasing the diversity of organizational forms and technologies to meet social needs, focusing on strategic guidelines for sustainable development and preservation of the environment, standardization of social infrastructure in accordance with EU requirements.

2. Adaptation of social development in the context of European integration into the system of social mechanisms for the implementation of innovation processes requires Ukraine to review the effectiveness of organizational and economic mechanisms for managing innovation activity with a focus on the use of public-private partnership tools as a means of optimizing innovation processes and intensifying innovation activity at all levels. In our opinion, such a mechanism, firstly, provides formation of a system of interaction between key stakeholders to ensure the effectiveness of innovation processes in the social sector, secondly, a well-founded system of scientific support for innovations, taking into account the logic and specifics of the implementation of not only its own innovation, but also the peculiarities of perception, evaluation, mutual adaptation of elements of the social system, specific subjects to new conditions of life, as well as expertly monitors possible prospects and consequences of implementation specific innovation. Thirdly, the introduction of innovative social technologies should be implemented through the use of a set of techniques and methods aimed at studying, actualizing and optimizing innovation, as a result of which innovations are created and materialized, causing qualitative changes in various spheres of life, focused on rational and sustainable material, natural, economic and social resources.

3. A comparative analysis of the positions of China and Ukraine according to the indicator "Infrastructure" in the Global Innovation Index-2022 formed an idea of the progress achieved and problem areas of innovative infrastructure development of countries in general and social in particular. Thus, both countries have made significant progress in implementing government online services and e-participation, as a tool to engage and strengthen cooperation between governments and citizens, which improves access to information and public services. Compared to the subindicator "*Ecological sustainability*", Ukraine in the dynamics of its development for the period from 2020 to 2022. ahead of China, for which the solution to the problem of energy efficiency remains relevant. Besides, China has even more significant negative indicators in the rating positions for Environmental performance.

This indicator characterizes climate change, environmental hygiene and ecosystem viability. As with most countries, with high rates of industrialization and urbanization, China faces the problem of greater pollution and increasing burden on ecosystem viability, indicating the need to pay more attention to the range of requirements for sustainable development. At the same time, unlike Ukraine, China has made progress in implementing an environmental management system. Together with other countries of the world, China strengthens cooperation in the field of standardization, promotes the expansion of exchange of experience and mutual learning, and improves international standardization systems.

4. The conducted study of the state of innovation processes in the social sector of China based on the country's position in the Global Innovation Index and analysis of statistical indicators of social infrastructure allowed us to offer a matrix of recommendations for increasing the level of inclusion of China's social infrastructure in the following structural elements: healthcare, education, public services and public transport, environmental sustainability of cities and regions.

5. A methodical approach to assessing the level of development of social infrastructure of territories has been proposed, the **uniqueness of which lies in the presence of a wide range of stakeholders** (state and local authorities, business community and the public) who can use its results to assess the proportionality of regional development and avoid imbalances in the development of certain spheres of social infrastructure; to carry out a comparative assessment of the level of development of territories and the effectiveness of investment in the implementation of public-private partnership projects; to make strategic decisions of state social policy.

6. The main idea of the proposed methodological approach is the formation of an analytical profile of the level of development of social infrastructure in different regions of China in order to form targeted state support for innovative projects in the relevant areas of social infrastructure, which will contribute to the efficiency of using public funds and reduce the level of regional disproportion in the

overall development of social infrastructure of the state. The methodical approach involves the phased implementation of three methodological blocks, each of which is based on a specific calculation toolkit. The first block – the integral basis – involves the use of an integral indicator of the level of development of social infrastructure based on taxonomic analysis. The second block – clustering of regions – provides for the implementation of the procedure for dividing regions into groups (clusters) according to common social and infrastructural characteristics. The third block - factor-analytical - is based on the use of factor analysis tools to determine a group of factors that influence the innovative development of the social infrastructure of the territories.

SECTION 3. SUBSTANTIATION OF THE MAIN DIRECTIONS OF IMPROVEMENT OF ORGANIZATIONAL AND ECONOMIC MECHANISMS OF MANAGEMENT OF INNOVATION ACTIVITY OF DEVELOPMENT OF SOCIAL INFRASTRUCTURE OF TERRITORIES

3.1. Formation of interaction of key stakeholders to ensure the effectiveness of innovation processes in the social sector

Given the growing need for investment and limited government budgets, many governments are increasingly turning to the private sector to attract material resources and expertise to create social infrastructure. The most common tool in world practice in this context is the use of public-private partnership. At the same time, despite the growing tendency among governments of many countries to consider public-private partnership as a model of procurement and financing of infrastructure projects in the social sphere, one of the aspects that has not yet been given sufficient attention is the issue of forming interaction between key stakeholders to ensure the effectiveness of innovation processes in the social sector. Public-private partnership usually involves the conclusion of long-term contracts related to large-scale infrastructure projects, which is due, firstly, to the presence of a certain circle of stakeholders and entities between which economic and communication relationships are formed, poor management of which can have a very negative impact on the quality of social services and, as a result, lead to dissatisfaction of the end user.

Thus, the formation of interaction between key stakeholders should be considered as a necessity - especially in the case of public-private partnership projects that are related to the social sphere, and therefore to the loyalty and satisfaction of the end user - the population of the country. Before proceeding to the formation of recommendations for the formation of interaction between key stakeholders to ensure the effectiveness of innovation processes in the social sector, let us consider in detail the structural composition of such interaction, and therefore, determine

of such interaction, and therefore, determine who are the key stakeholders in this context (Figure 3.1.).

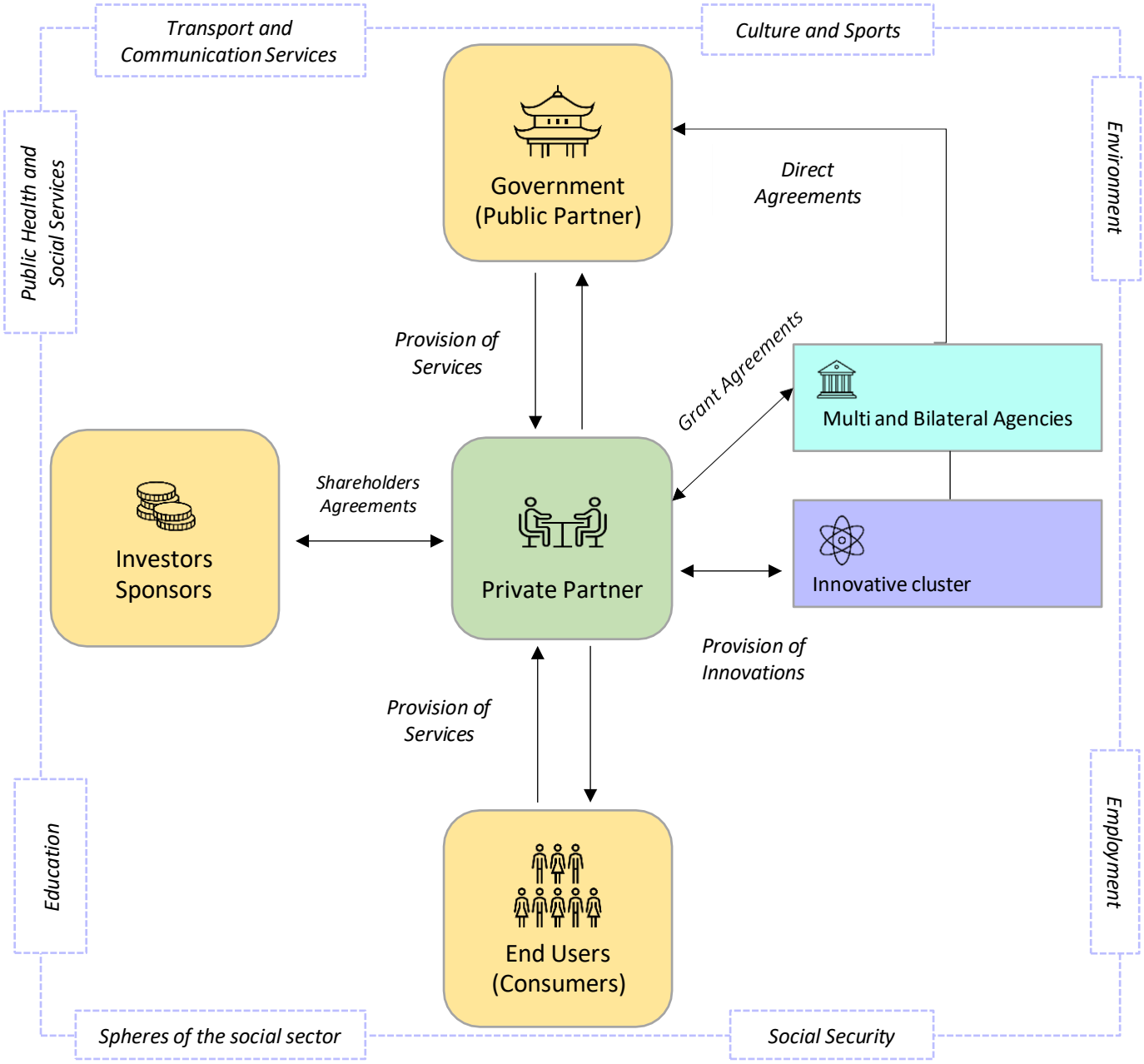


Fig.3.1. **Formation of interaction of key stakeholders to ensure the effectiveness of innovation processes** [proposed by the author based on 2]

The first level of interaction is realized through the relationship between *the state and the private partner*. Strategic directions of social development of society and their implementation are implemented in the form of national policies and

regulations that define the goals of social development at the national or regional levels. In this context, harmonizing the development of innovation in the field of social infrastructure development and investment policy with these norms, goals and processes will significantly contribute to achieving the goals of inclusive and sustainable development of social infrastructure. Thus, the first level of interaction is designed to help government officials become familiar with what will be a favorable environment for innovation in the social sector through public-private partnership projects. For example, harmonization of current legislation with the Paris Agreement and other climate change regulations can become the basis for attracting investment in low- carbon and climate-resilient social infrastructure [2].

Moreover, the existence of a clear understanding of the internal administrative structure that performs the function of control and coordination function in planning social policy and social development of the country is important for the transition from abstract state concepts and desired intentions to private investment. It should be noted that in this context, a transparent state policy to clarify special requirements for innovation processes in the social sector (focus on inclusiveness, sustainability, gender equality, etc.) form effective relationships between the state and a private partner. The structure of organizational and economic mechanisms for managing innovation activities for the development of social infrastructure of territories may differ in different countries, both from the point of view of the authorities responsible for the development and implementation of social policy, and from the point of view of interaction between them. The policy-making process is also governed by existing institutional capacity and coordination mechanism at national and subnational levels. In this respect, some countries adopt a centralized governance strategy, while other countries favor more decentralized governance with significant initiatives undertaken at the subnational or national level.

The institutional capacity of the state in implementing the goals of innovative social development can be assessed vertically (at the national and subnational levels of government) and horizontally (between ministries and sectors). Usually, the

supreme body controls the national social policy and gives advice on its implementation. Traditionally, most countries apply a top-down process of implementing social policies (for example, China, France, Germany). In this case, the central government sets a national target, which is then passed down to the administrations of the provinces, regions and territories. However, there are examples where subnational or state social policy initiatives become the main drivers of change, which is happening in the case of the United States of America.

Table 3.1.

Map of the responsibility of institutions in shaping the policy of development of social infrastructure of territories (example)

	Institutions				
	Ministry of the Environment	Ministry of Education	Ministry of Health	**...**	Innovation cluster
Type of institution	Government	**...**	**...**	**...**	**...**
Normative document	Sustainable Development Goals Law	**...**	**...**	**...**	**...**
Jurisdiction	National level	**...**	**...**	**...**	**...**
Responsibilities	Formation of a national strategy for sustainable development	**...**	**...**	**...**	**...**
Contact person	**...**	**...**	**...**	**...**	**...**

Horizontal coordination between institutions is another important feature of any credible institutional structure. Establishing horizontal coordination requires an effective division of responsibilities and effective interaction between ministries. This creates the need to develop specific procedures and mechanisms to involve independent advisory bodies and relevant stakeholders. At this stage, the second level of interaction is formed – the interaction between *the state and relevant specialized*

agencies and clusters.

The result of the formation of such interaction is a certain degree of involvement of relevant stakeholders who are actively involved in the process of planning, developing and implementing social policy. It is also necessary to identify independent institutions that monitor and advise on this process. In Table 3.1. An example of formation of such interaction in the form of a map of responsibility is presented.

For effective interaction between the state and a private partner, the need for a monitoring body to manage public-private partnership contracts should be understood. To exercise such supervision, it is necessary:

1) having a properly trained contract management team, including members who have experience in monitoring social infrastructure and qualitatively assessing economic risks, while being able to effectively interact with external resources (such as innovation cluster and independent agencies) when necessary.

2) availability of a structured plan for monitoring the construction and life cycle of PPP projects, including adaptation measures. Conformity assessment and monitoring capabilities of project KPIs are important early on so that any weaknesses are identified and corrected early in implementation. An example of such a practice is the establishment of specific stages in cooperation with a project company to ensure the timeliness and objectivity of the monitoring process, while ensuring an effective partnership between public and private parties.

3) the need for transparent reporting and compliance with standards.

The next level of interaction is realized through the *relationship between a private partner and an investor or sponsor*. When it comes to structuring PPPs, a critical decision for the procurement authority is to select the appropriate financial combination to increase the risk and profitability of the project, making it profitable to finance and attractive to invest. The uncertainty and turbulence of global trends in

global economic development, makes the risks associated with project, quite unpredictable. For example, failure to address climate risks could jeopardize the

project's banking capacity. In this context, it becomes obvious that climate cannot be neglected when structuring such projects. Incorporating climate mitigation and resilience measures into PPP structuring and financial modeling is becoming increasingly important [2].

The basis for the formation of interaction between a private partner and an investor or sponsor can be considered financial eligibility criteria. These criteria include the following:

- Impact potential. The purpose of this criterion is to provide the donor with a fundamental rationale for the proposed project and an explanation of why it is worth funding. The criterion may differ between projects, since the areas of social infrastructure are diverse. For example, for healthcare-related PPP projects, such criteria may include reducing mortality, increasing the level of accessibility of medical services and improving the quality of their provision to the population.

- Necessity and level of urgency. Project proposals should describe the financial, economic, social and institutional needs of the country and barriers to access to domestic (public), private and other international sources of funding. This is important because most bilateral and multilateral adaptation funds will only support proposals that meet the highest priority needs in the country, region and sector.

- Efficiency and effectiveness. Although economic and social efficiency is a common selection criterion for most investors and sponsors, demonstrating quantitative indicators can be difficult. Therefore, in many cases, investors may require justification for different financial, social and environmental costs to choose an adaptation solution instead of an alternative.

- Long-term sustainability and wider impact. The project proposal should demonstrate what benefits will be generated through investment not only during the project implementation phase, but also what benefits will be maintained after the end of the project life cycle. Thus, it is possible that investors will require the national government to commit to infrastructure maintenance and local capacity building that will ensure future development in a particular sector (e.g. high-scale pilot projects

and capacity building activities).

In addition to the impact of the project (which is assessed separately), proposals may be requested to demonstrate collateral benefits to the wider economy (e.g. job creation, poverty alleviation and increased incomes and financial inclusion, especially among women); social prosperity (e.g. better access to education, cultural preservation, social inclusion, improved sanitation); environment (e.g. improvements in air, water, soil and biodiversity quality); gender empowerment (e.g. describing how the project will close gender gaps).

- Alignment with national sustainable development goals. Project proposals should clearly describe how the proposed activity aligns with the country's national sustainable development goals and other relevant national plans.

- Organizational capacity and experience. Another criterion characteristic of most multilateral and bilateral investments is the institutional context in which the proposed project will be implemented. Project developers should be prepared to describe the organization's credentials or past work experience. Investors are interested to see how the project will be coordinated and how the planned investments will support existing social sector development activities.

The fourth level of interaction is realized through relations between the state, a private partner and the end user of social services. The main idea of guaranteeing free or partially paid social services to citizens of the country is to ensure the most equal access for all. To do this, it is necessary to create equal opportunities for the formation of educational, creative, labor and human potential and conditions for its implementation. Accordingly, the existence of a significant differentiation in the consumption of social infrastructure services generates inequality bordering on injustice. Regional policy mIt should be aimed at overcoming imbalances in the development of individual regions, but this does not mean aligning them in terms of economic indicators. First of all, it is about standardizing the standard of living of the population, ensuring equal access to quality educational and medical services, modern comfortable housing, ensuring equal employment conditions as the main source of

income for the population.

At the same time, the state should not assume the entire scope of functions for the implementation of uniform standards of living standards of the population – this is fraught with irresponsibility of local authorities, inefficiency of budget expenditures and management in general. Therefore, a balance between the powers of central and local authorities is needed. The ultimate goal of public policy is to improve the quality of life of the general population. However, the quality of life is the result of a number of objective and subjective factors, the latter having both a national (or even global) and regional character, that is, they change under the influence of decisions of central or local authorities. The latter include the quality and accessibility of the vast majority of social services (medical, educational, housing and communal, transport, etc.).

In turn, the role of services as a result of the activities of the social sphere is constantly growing. At the same time, the role of some types is associated with servicing the sphere of material production, the processes of distribution, exchange and consumption of products of material production, which ensures the continuity of the reproduction system. The role of others is to ensure the development of the workforce, raising the educational, cultural and technical level, improving health and developing the ability to work, ensuring proper rest.

Thus, the formation of interaction between key stakeholders to ensure the effectiveness of innovation processes can be implemented on the basis of a four-level interaction model, where the key stakeholders are the state, private partner, investors (sponsors), special agencies, innovation clusters and the end user (population of the country). Each level of interaction has its own characteristics and corresponding impact on the effectiveness of innovation processes, which can be achieved only if the relevant requirements and criteria are met.

3.2. Directions of formation of public-private partnership to ensure innovative development of territories

The processes of globalization of the world economy contribute to the development of international relations, which in turn are an important component of

the country's regional policy. This necessitates the provision of effective state support and national legislative and regulatory support in the field of social infrastructure development. According to China's National Integrated Public-Private Partnership Information Platform (PPP), 10,312 PPP projects were registered by the first half of 2021 with a total investment of 16.4 trillion yuan. These projects are located across the country and cover 19 sectors, including energy, transport, water protection, ecology and environmental protection, municipal engineering, integrated urban development, agriculture, forestry, science and technology, tourism, healthcare, aged care, education, culture and sports. According to information from the same source, as of the beginning of 2022, PPP contracts have been signed for 7934 projects with investments of 13.1 trillion yuan, 5280 projects have entered the construction stage with an investment of

8.7 trillion yuan and 1988 projects have entered the operation stage with an investment of 2.8 trillion [1.12].

The participation of the private sector in the formation of social infrastructure is crucial to promote the development of territorial infrastructure by catalyzing innovation, competition and the use of financing opportunities, as well as the implementation of these solutions. In a rapidly evolving global landscape, private sector actors are making bold new commitments to achieve their social development goals and adapt to inclusive economies thanks to their shareholders and new regulatory pressures.

Public-private partnership (PPP) is a mechanism by which the government procures and develops the social infrastructure of territories using the resources and innovative expertise of the private sector. Where governments face challenges in developing social infrastructure and need more effective social services, partnering with the private sector can help create new solutions and attract investment. A special feature of PPPs is the combination of skills and resources of both the public and private sectors through the sharing of risks and responsibilities. This enables governments to draw on the expertise of the private sector and focus on policy, planning and regulation by delegating certain operations [12].

According to the materials of the United Nations Economic Commission for Europe «Guidebook on Promoting Good Governance in Public-Private Partnership» [14], an international typology of models of infrastructure projects of public-private partnership has been adopted:

– BOT (Build - Operate - Transfer): a private partner carries out construction and operation (mainly on property rights) for a fixed period, after which the object is transferred to the state;

– BTO (Build - Transfer - Operate): a private partner builds an object that is transferred to the state (concession) in ownership immediately after the completion of construction, after which it is transferred to the concessionaire;

– VOO (Build - Own - Operate): a private partner builds an object and carries out further operation, owning it on property rights, the validity of which is not limited;

– DBFO (Design - Build - Finance - Operate): a private company develops and builds a medical institution in accordance with the requirements and standards approved by the authorities, as well as finances capital expenditures and manages the facility;

– DBFM (Design - Build -Finance -Maintain): this type of contract provides for the additional provision of non-clinical services, including individual (cleaning, logistics, security, etc.);

– DBB (Design - Bid - Build): a model based on the separation of the functions of development and creation of a medical institution between an independent private developer and another private company acting as a contractor;

– BOOT (Build - Own - Operate - Transfer): a private investor builds an object owned by him, the authority provides medical services for a certain period, then ownership passes to the authority;

– BOLB (Buy - Own - Lease - Back): a private contractor buys a medical institution, and then, under a leasing agreement, transfers it to the management of the authorities.

In contrast to the above classification of the United Nations Economic Commission for Europe, the practice adopted by the World Bank, in addition to infrastructure projects, characterizes the basic principles of risk distribution between the state and the private sector, and also differentiates them into the following four categories [14]:

1) Management and Lease Contracts – a PPP model when a private company takes over the management of a public infrastructure facility for a fixed period of time. At the same time, the ownership right and the obligation to finance remain with the state. The following varieties of this model fall into this group:

- CU – Management Contract – the state pays a private company its expenses for managing its assets; the state is responsible for operational risks;
- LC – Lease Contract – the state leases its property (infrastructure facilities) to a private operator on a reverse basis; operational risks are assumed by a private company;

2) Concessions – a PPP model where the private sector assumes management of state- owned property (infrastructure facility) and significant investment risks over a certain period. This group includes the following types of model:

- ROT – Rehabilitate, Operate and Transfer – a private investor restores the classifications of the most common PPP models during implementation, reconstructs an existing facility, then operates it within the established contractual period, assuming the associated risks, and then returns the object to the state;
- RLT – Rehabilitate, Lease or Rent and Transfer – a private investor restores (reconstructs) an existing object, then leases or leases it from the state owner for a period of time specified in the contract, assuming all associated risks, and then returns it to the state;
- BROT – Build, Rehabilitate, Operate and Transfer – a private company carries out new construction (reconstruction) of an infrastructure facility, then operates it during the term of the contract, assuming all associated risks, and then

returns it to the state;

3) Greenfield Projects – a private company or a joint public-private enterprise carries out the construction and operation of a new infrastructure facility during the contract period, after which the object can be returned to the state. This group includes the following types of model:

- BLT – Build, Lease and Transfer – a private investor builds a new infrastructure facility, assuming its own risks, transfers the finished object to the state, then leases and operates it, assuming all risks until the end of the lease term. The state usually provides a private company with a guarantee of minimum income through the purchase of infrastructure services for a long period ("take-or-pay contracts") or compensation for the minimum Traffic;

- OT – Build, Operate and Transfer – a private investor carries out the construction and operation of a new infrastructure facility, assuming risks, then transfers it to the state after the expiration of the contract. A private investor may have ownership of the created objects during the contract period. The state usually provides a private company with a guarantee of minimum income through the purchase of infrastructure services for a long period or compensation minimum traffic;

- SMO – Build, Own, and Operate – a private investor carries out the construction, ownership and operation of a new infrastructure facility, assuming all risks. The state usually provides a private company with a guarantee of minimum income through the purchase of infrastructure services for a long period or compensation for minimum traffic;

- Merchant – a private investor carries out the construction of a new infrastructure facility, winning a competition at a free competitive auction, under which the state does not provide a guarantee of income to a private investor. A private company assumes all construction, operational and other risks for the project;

- Rental - a private investor carries out the construction, ownership and operation of a new infrastructure facility, assuming all risks, and then leases it to the

state, usually for a period of 1 to 15 years. At the same time, the state provides a private partner with a guarantee of minimum income through the purchase of infrastructure services for a short period;

4) Divestitures – a private company acquires a stake in a state-owned enterprise that owns an infrastructure facility through public sale of assets, privatization programs and other mechanisms. This group includes the following models:

- Full – the state transfers 100% of the shares of the state-owned enterprise to a private company;
- Partial – the state transfers some stake in a state-owned enterprise to a private company. This may involve transferring the management of an infrastructure facility to a private company [14].

According to the methodology of the World Bank, an infrastructure project can be considered as a public-private partnership project only if a private company assumes part of the operational risks along with operating costs and associated risks. And this does not depend on whether a private company operates a state-owned infrastructure facility independently or jointly with a state body through ownership of a block of shares in the company that owns the facility or another Way. For example, in the models of the first group under consideration ("Management and Lease Contracts"), the transfer of part of operational risks to a private company is usually carried out through the mechanism of contractual obligations. In the models of the third and fourth groups ("Greenfield Projects" and «Divestitures»), in addition to the transfer of risks under the contract, the method of transfer through the acquisition by a private investor of a block of shares in the company – the balance holder of an infrastructure object is used [14].

At the same time, to achieve a successful PPP, a thorough analysis of long-term development goals and risk sharing is necessary. The legal and institutional framework in the country should also support this new model of service delivery and provide effective PPP management and monitoring mechanisms. A well-drafted PPP

agreement for a project should clearly allocate risks and responsibilities [11]. The development of next-generation PPP infrastructure should include clear messages at all stages of the tender and award process. Procurement organizations should promote innovative development of territories based on inclusiveness and social justice, including relevant provisions in tender documentation, price requests and key performance indicators, and ensure compliance through a proper oversight process. In addition, early market research on PPP consultations will help in drawing up the proper terms of reference and attracting high-quality bidders.

In our opinion, network cooperation in the form of innovation clusters based on public- private partnership should be considered as a source of ensuring the effectiveness of innovation processes in the social sector. Network cooperation is understood as the process of establishing long-term formal and informal relations between key stakeholders, united in an innovation chain by vertical and horizontal links, based on trust and common goals, norms, traditions, rules, objectives and results for the social sector. Public-private partnership is an institutional and organizational alliance between governments, regional governments and businesses, based on joint financing of projects.

It is advisable to distinguish the following areas of public-private partnership in the organization and development of social infrastructure: formation of initiatives for innovation clusters; organization of innovation clusters; assistance in the technical development of suppliers, the creation of cluster infrastructure entities; co-financing of research and development of innovation clusters; organization of international cooperation of innovation clusters; attraction of foreign investment in innovation clusters [10,13]. The form of implementation of these areas are joint public-private programs.

Therefore, it becomes obvious that the organizational ***and economic mechanisms for managing innovation activity for the development of social infrastructure of territories*** should be based on a cluster model of economic development.

In the context of promoting the activation of public-private partnerships to ensure innovative development of territories based on the cluster approach, we propose to focus on the following factors of influence:

1. Implementation of knowledge as a basis for supporting innovative projects for the development of social infrastructure of territories. In clusters there is an accumulation of knowledge of a commercial and industrial nature and their rapid diffusion [3,4].

2. Competition is an incentive for partnership. In the cluster, due to internal competition between producers, innovations are created.

3. Collaboration is a way to generate new ideas and opportunities. Accelerating innovation as a result of cooperation between suppliers and manufacturers, as well as between competitors in achieving common goals.

4. Cluster connections will identify weaknesses in cluster value chains, as well as attract investors and businesses to fill these niches. Clusters stimulate the development of small and medium-sized businesses in the regions through the formation of subcontracting (outsourcing) relations, when small and medium-sized enterprises perform the functions of producing products, works and services for key cluster actors; opening new zones of entrepreneurship in the production chain of the cluster (value chain).

5. Technological cooperation is a method of attracting investment. In the cluster, innovations can be concentrated within the framework of international technological cooperation clusters (joint ventures, franchise enterprises, transnational corporations), as well as public-private partnerships [5].

Innovative socially oriented type of economic development of regions and the state as a whole determines the special place of innovation clusters in the organizational and economic mechanism of management of innovation activity of development of social infrastructure of territories.

The signs of the innovation cluster are a significant (in comparison with industry and state indicators) share of innovative products of the cluster, as well as

the formed innovation infrastructure, which includes the interaction of key stakeholders of the regional innovation system (educational institutions, research and development centers, technology transfer centers, business incubators, technology parks, centers forcollective use of scientific equipment, public organizations, financial institutions, cluster centers development, etc.).

Innovation cluster is a set of geographically localized in a certain territory, complementary, competing economic entities (including suppliers, producers, as well as consumers), connected by relations of cooperation with each other, as well as with state and local governments, united on an informal basis around a research or research and educational center, in order to create a favorable environment for the dissemination of innovations in the social sphere, as well as increase innovation activity and competitiveness of organizations-subjects of the cluster, regions and the national economy [6].

A significant role in the cluster model of the economy belongs to industrial associations (subjects of regional cluster policy), which initiate the creation of clusters in the region, assist in the development of national and regional competitiveness strategies based on the provision of information on the level of competition, social needs of the population, new market opportunities and new global trends in technology development. Associations contribute to increasing the competitiveness of the cluster by establishing links between cluster actors, key stakeholders, as well as interaction with local governments and the government of the country on improving legislation.

Cluster development centers are important infrastructure elements to support cluster initiatives and projects in the social sector. The main functions of cluster development centers include:

– information-legal, organizational and methodological support of the process of formation and development of the innovative cluster of social infrastructure of territories;

– organization of production cooperation (subcontracting) of cluster

participants between themselves and other organizations of the social sector;

– organization of technology transfer and commercialization.

Measures to intensify the public-private partnership to ensure innovative development of territories through the formation of innovation clusters should be divided into three groups: economic incentives and financial support; organizational support of cluster initiatives; communication support of partnership.

Economic incentives and financial support for the partnership of cluster subjects are implemented through:

1) financing the creation of cluster infrastructure on the basis of public-private partnership with the participation of business structures;

2) competitive financing of investment projects;

3) preferential lending for innovation and investment projects aimed at developing the social infrastructure of territories with the participation of business structures. Organizational support for cluster initiatives includes:

1) provision of premises and equipment for joint activities of innovation cluster participants;

2) organization of interaction of innovation clusters with subjects of social infrastructure of territories.

Communication support of the partnership is aimed at:

1) creation of a database of cluster business entities in order to collect statistical and analytical information;

2) creation of Internet portals (business-to-business B2B; business-to-administration B2A; consumers-to-administration C2A).

The principles of activation of innovation clusters on the basis of public-private partnership, in our opinion, include:

– the principle of complementarity, which is manifested in the interaction of innovation processes of cluster-united regions. Complementarity can be achieved through the interaction of the internal business environment and external institutions, that is, the highest effect can be obtained through an increasing number of interactions

with each subsequent stage of the system;

– the principle of dissipation, which manifests itself through an increase in the growth rate of scientific knowledge, the accumulation of the flow of innovation and the gradual restoration of the intellectual structure, which, in turn, determines the dissipative nature of innovation clusters based on public-private partnership [7];

– the principle of programming, which involves the development of partnership-based strategies for the development of social infrastructure of regions, taking into account priority long-term and short- term goals [8];

– The principle of compatibility is aimed at comparing the innovative level of development of regions by cluster partnership in order to identify signs of adaptability and dissipation.

Based on the expediency of using the cluster innovation model for the development of social infrastructure of territories, and based on the interaction of key stakeholders outlined by us to ensure the effectiveness of innovation processes in the social sector, *organizational and economic mechanisms for managing innovation activity in the development of social infrastructure of territories* shown in Fig. 3.2. It should be noted that this mechanism is based on the functioning of an innovative cluster for the development of social infrastructure of territories, which is a HUB center that unites eight areas of social infrastructure (Employment, Environment, Investment, Transport and Communication Services, Education, Public Health and Social Services, Culture and Sports, Social Security), which correspond to the indicators that determined the level of development of the social infrastructure of the region in section 2 Thesis.

The proposed organizational and economic mechanism for managing innovation activity of development of social infrastructure of territories is a transformation of the influence of the external environment as the main source of innovative changes within the framework of the functioning of the innovation cluster, which simultaneously acts as a source of resources that the social infrastructure as an open system uses at the entrance of its activities to ensure the expected result.

The output within the framework of the proposed mechanism (Figure 3.2), in accordance with the proposed content of eight areas of the social HUB-center of the innovation cluster, is a new configuration of interaction between key stakeholders to ensure the effectiveness of innovation processes in the social sector and create new potential for its growth.

The object of state regulation is the subject area, which combines the choice of social infrastructure for the implementation of innovative changes in each of the components of the HUB-center of the innovation cluster. It is proposed to implement measures for introducing innovative changes in the subject area of the components of the HUB- center of the innovation cluster on the basis of analysis and comparison of the level of development of social infrastructure in different regions

The main idea is to use the innovative experience of leading regions in certain areas of social infrastructure. That is, the experience of regions with the best integral indicators can be used to implement innovative projects in less developed regions.

The methodological basis of state regulation in the spheres of social infrastructure is based on the principles and forms of public-private partnership as a universal toolkit, compliance with which should be a prerequisite for making regulatory decisions on the introduction of innovative changes.

The main driving element of the interaction of components within the mechanism is the adoption of appropriate decisions on methods of managing innovation activity for the development of social infrastructure of territories. This set of methods is a variable component, depending on the presence of potential for change and the influence of external factors. Making managerial decisions on methods of managing innovation activity development of social infrastructure of territories is implemented by the relevant heads of structural components and individual social infrastructure facilities. These managers should organize and implement strategic plans for innovative development of the HUB, research and development for the implementation of the planned HUB innovation projects, and ensure continuous monitoring of the implementation of the planned activities.

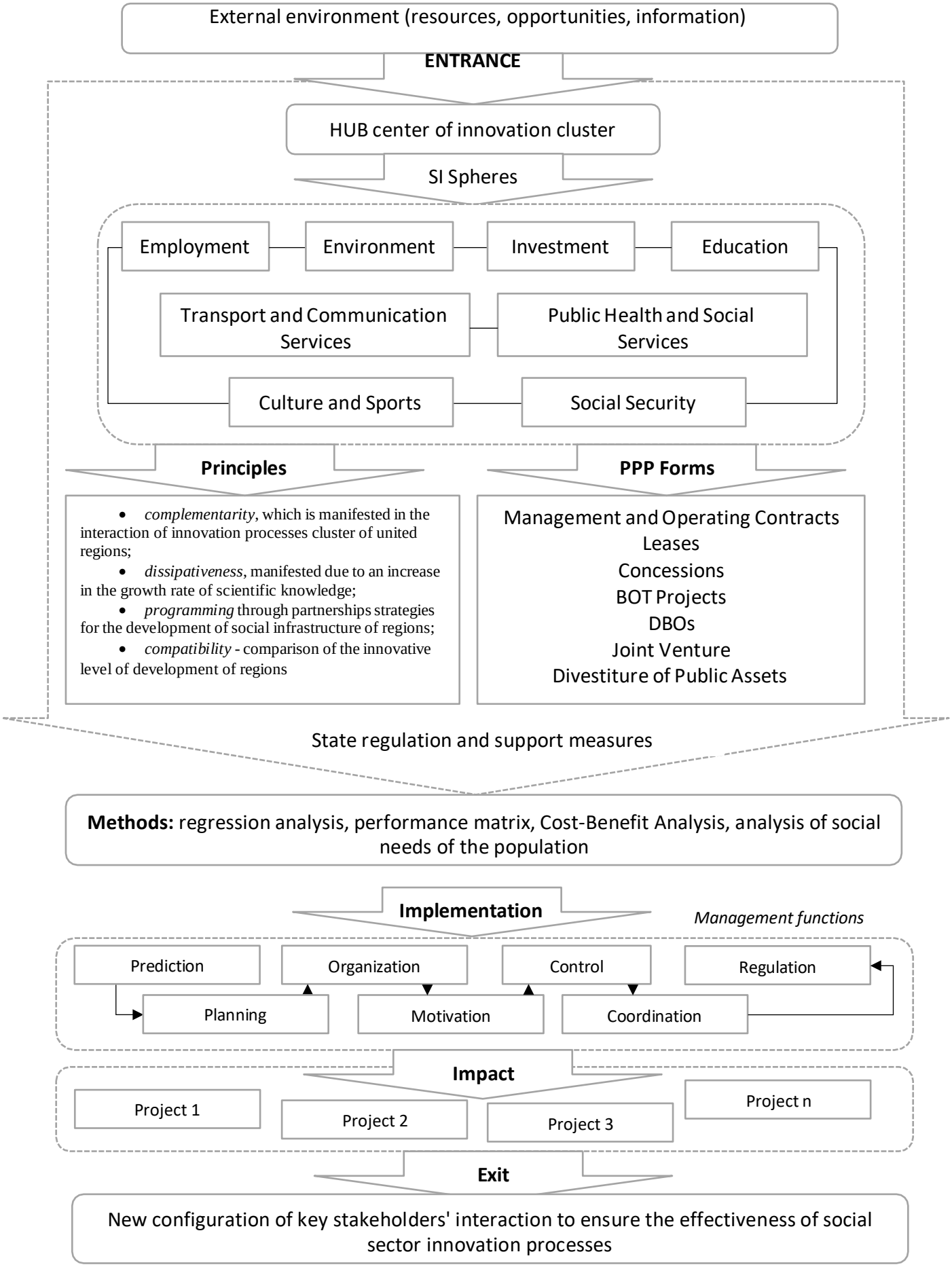


Fig.3.2.Organizational and economic mechanisms for managing innovation activity, development of social infrastructure of territories

To determine the priority of innovative projects for the development of social infrastructure, it is advisable to use multiple regression coefficients, with the help of which it is possible to determine the sphere of social infrastructure that requires the greatest innovative transformations (Table 3.2., Fig.3.3, Fig.3.4).

Table 3.2.

Defining the sphere of social infrastructure that requires the greatest innovative transformations using multiple regression coefficients

N=31	b*	Std.Err. of b*	b	Std.Err. of b	t(18)	p-value
Intercept			0,000	0,005	0,000	1,000
Participants in Work-related Injury insurance, x8.3	0,033	0,047	0,033	0,047	0,708	0,505
Health Technical Personnel in Health Care Institutions, x6.2	0,052	0,015	0,052	0,015	3,487	0,013
Number of Health Care Institutions, x6.1	-0,080	0,024	-0,080	0,024	-3,276	0,017
Number of Employed Persons By Urban Areas, x1.2	1,783	0,081	1,783	0,081	21,955	0,000
Growth Rate of Total Investment in CultureSports and Entertaiment, x3.6	-0,031	0,011	-0,031	0,011	-2,871	0,028
Elderiv CareBeds per 1 000Elderly Population, x6.4	0,047	0,009	0,047	0,009	5,010	0,002
Number of Employed Persons By Urban and Rural Areas, x1.3	-0,477	0,071	-0,477	0,071	-6,678	0,001
Average Education Enrolment per 100 000 population Secondary Education, x5.1	0,171	0,019	0,171	0,019	8,857	0,000
Growth Rate of Total Investment in Health and Social Service, x3.5	0,084	0,008	0,084	0,008	9,893	0,000
Expenses on Subsidyto Participation in BasicMedical Insurance, x6.6	0,202	0,017	0,202	0,017	11,963	0,000
Growth Rate of Total Investment in Social Security and Social Organization, x3.7	0,093	0,010	0,093	0,010	9,004	0,000
Number of puplic Museums, x7.2	0,090	0,018	0,090	0,018	4,984	0,002
Rate of DomesticGarbage HarmlessTreatment, x2.4	0,011	0,010	0,011	0,010	1,120	0,305

Main Pollutant Contents Emission in Waste Gas, x2.1	-0,122	0,019	-0,122	0,019	-6,527	0,001
Broadhand SubscabersPort of intemet, x4.2	-0,306	0,045	-0,306	0,045	-6,748	0,001
Passenger-kilometers,(100 million passenger-km), x4.1	0,152	0,023	0,152	0,023	6,473	0,001
Growth Rate of Actual Funds Available for Investment from State Budget, x3.2	0,063	0,010	0,063	0,010	6,569	0,001
Number of Beds in Health Care Institutions, x6.3	-0,299	0,064	-0,299	0,064	-4,669	0,003
Enterprises With E-commerceTransactions, x4.3	-0,048	0,012	-0,048	0,012	-3,914	0,008
Number of Orphans, x6.5	-0,069	0,023	-0,069	0,023	-3,030	0,023
Number of Traffic Accidents, x8.1	-0,037	0,015	-0,037	0,015	-2,521	0,045
Population CoverageRate of Radio Programs, x7.4	-0,023	0,012	-0,023	0,012	-1,869	0,111
Average Education Enrolment per 100 000 population Higher Education, x5.2	0,013	0,008	0,013	0,008	1,568	0,168
Investment in Urban EnvironmentalInfrastructure x2.3	-0,026	0,026	-0,026	0,026	-1,004	0,354

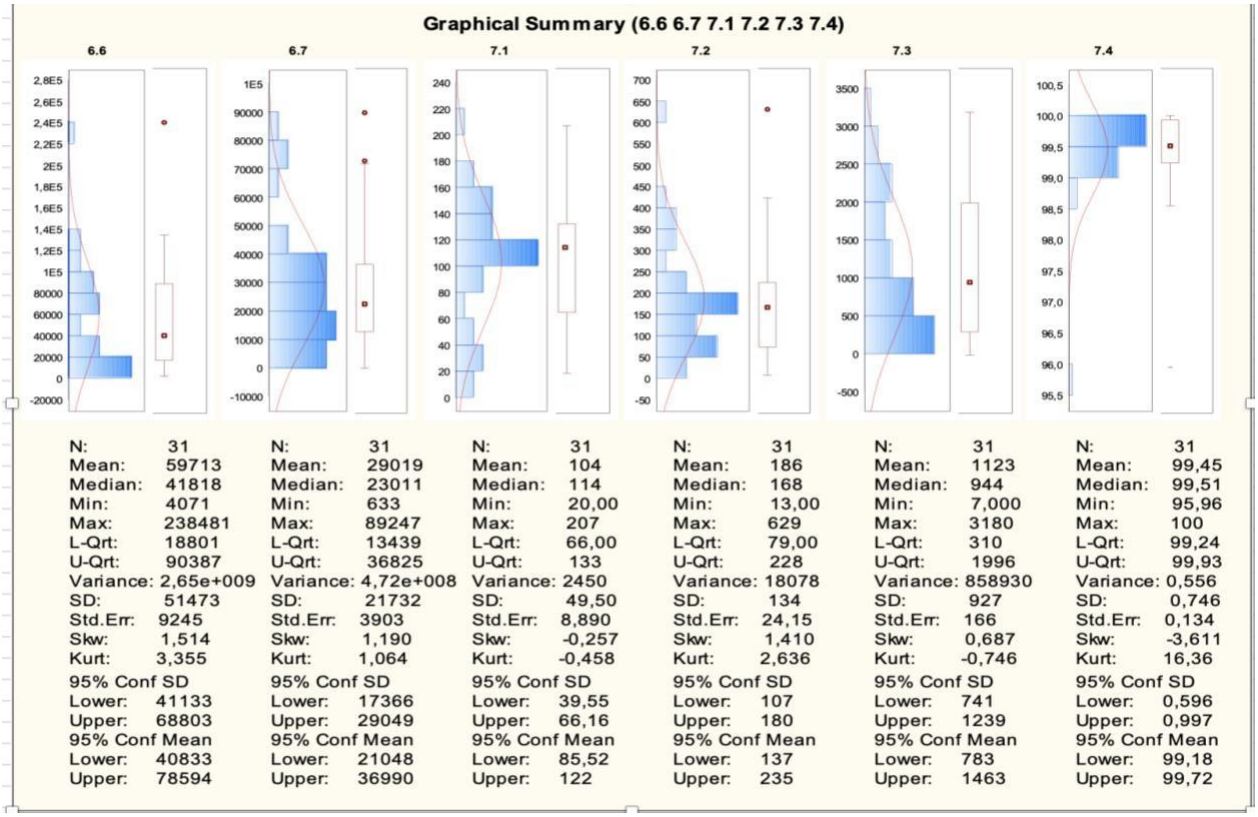
3.3. Promoting the impact of innovation on the social development of territories.

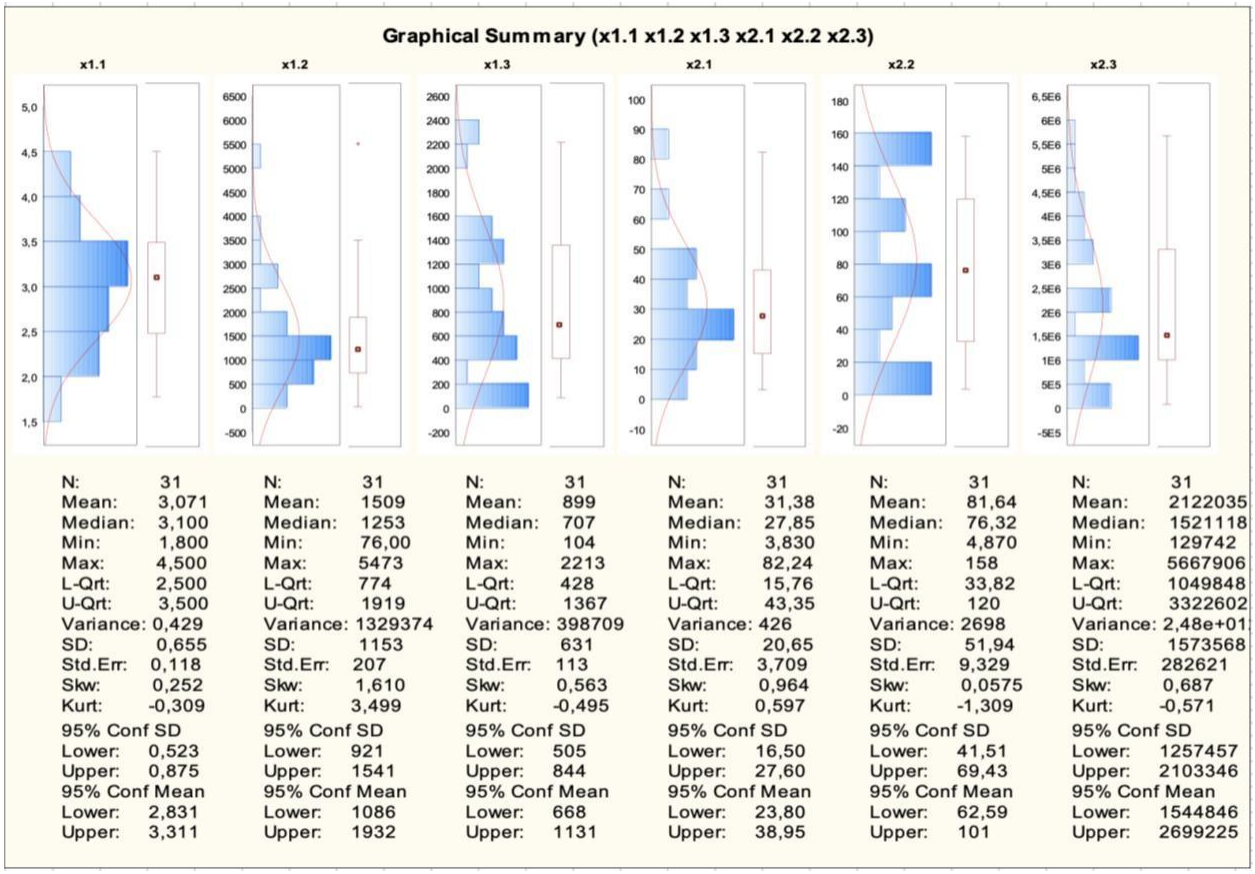
Accordingly, the following areas of social infrastructure required the greatest innovative transformations in 2022: "Environment", "Education" and "Social Security".

Based on the assessment of the indicator of comprehensive benefits from the implementation of innovative projects, the whole process of innovative behavior can be divided into several stages: stage 1 – deciding on the need for innovation; Stage 2 – deciding on the scale of innovation (own R & D or imitation); Stage 3 – selection of the most optimal option for innovative projects; Stage 4 – management of implemented innovative projects (decision to continue or terminate the project).

First stage. The decision on the need for innovative transformations is made on the basis of the projected development of the social infrastructure object in the future. At the same time, the social infrastructure object takes into account the increase in

diversity caused by scientific and technological progress, due to the fact that the level of internal entropy can be reduced by investments that do not require innovative transformations. If a social infrastructure object assumes that in the near future obsolescence will exceed a critical level (profitability will drop to zero), it decides whether innovative transformations are needed.





Rice. 3.3. **Analysis of the normal distribution in terms of social infrastructure of territories**

The second stage. The decision on the scale of innovation is made under the influence of three main factors affecting the complex win: the expected cash inflow or expenditure, the probability (risk) of both capital costs and profits, the time of implementation (implementation) of an innovative project and obtaining a positive effect. Also here it is necessary to take into account the amendment for the perception of risk by the object of the social infrastructure, depending on the location on the curve of obsolescence and depending on investment policy.

The third stage. The choice of one of several alternative innovative projects can be based on the indicator of complex winning. When deciding on innovative transformations, a social infrastructure object may face the problem of choosing an innovative solution from a sufficiently large number of alternative projects.

The fourth stage. The management of innovative projects accepted for

implementation is also carried out taking into account the consequences for the reliability of the system. At the same time, as the project is implemented, when approaching the moment of obtaining a positive effect from innovation, the expected indicators of complex gains are converted into realized ones: the actual implementation period, the actual capital costs. The expected additional profit, the period of its receipt and the probability are also modified. All this forces the social infrastructure object to reconsider the generalized gain and, based on this, make a decision either to continue innovative transformations, or to refuse to further implement the project with replacement with an alternative project or without replacement. The factor that prompts the abandonment of a project with dubious prospects is the margin of economic reliability, which is determined by current profitability, market share and resulting profit, as well as the available time margin. Also, external factors may force the project to be abandoned, under the influence of which the level of uncertainty of a social infrastructure object will increase sharply, such as force majeure, as happened during the COVID-19 pandemic. At the same time, new and ongoing projects are competing for resources, so the model becomes dynamic, that is, for each planned period it should be solved separately, taking into account already implemented projects and those that can be accepted for implementation.

Comparison of the effectiveness of the selection of innovative projects can be carried out according to the formula for maximizing the maximization of net present value:

$$I = max\ (NPVi). \quad (3.1)$$

In order to decide on the need to implement an innovative project, it is necessary to evaluate the effectiveness of its innovative development using the matrix "Efficiency / Reliability" (Fig. 3.4.).

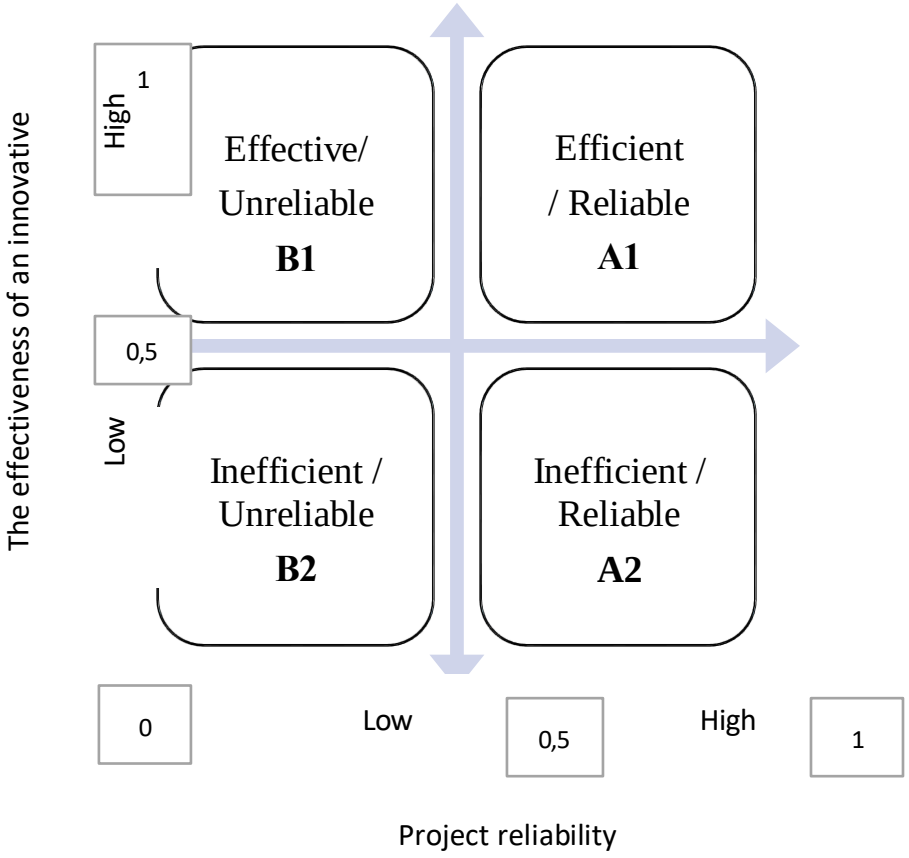


Fig.3.4. **Efficiency/Reliability matrix for prioritizing innovative social infrastructure projects**

According to this matrix, priority projects are those that fall into quadrant A1, since these projects have the highest efficiency and highest reliability. Innovative projects with high efficiency and low reliability (quadrant B1) require additional risk analysis. The use of risk management tools will allow developing scenarios for overcoming possible risks and ensuring their leveling if necessary. Innovative projects that fall into quadrant B2 (low efficiency and high reliability) should be reviewed to find ways to improve efficiency. In this case, the use of Cost-Benefit Analysis will be appropriate. Finally, those projects that fall into quadrant B2 (low efficiency and low reliability) should be considered as projects that need revision and revision.

Thus, the proposed organizational and economic mechanisms for managing innovation activity for the development of social infrastructure of territories is a transformation

of the influence of the external environment as the main source of innovative changes within the framework of the functioning of the innovation cluster, which simultaneously acts as a source of resources that the social infrastructure as an open system uses at the entrance of its activities to ensure the expected result. The methodological basis of state regulation in the spheres of social infrastructure is the forms of public-private partnership as a universal toolkit, and the relevant principles, compliance with which should be a prerequisite for making regulatory decisions on the introduction of innovative changes.

To determine the priority of innovative projects of social infrastructure, it is proposed to use multiple regression coefficients, with the help of which it is possible to determine the sphere of social infrastructure that requires the greatest innovative transformations and the matrix "Efficiency / Reliability.

Conclusions to Chapter 3

The third section of the thesis is devoted to the substantiation of the main directions of improving the organizational and economic mechanisms for managing innovation activity, the development of social infrastructure of territories. The main scientific and practical results are as follows:

1. The formation of interaction between key stakeholders to ensure the efficiency of innovation processes in the social sector is substantiated on the basis of a four-level interaction model, where the key stakeholders are the State, private partner, investors (sponsors), special agencies, innovation clusters and the end user (population of the country). Each level of interaction has its own characteristics and corresponding impact on the effectiveness of innovation processes, which can be achieved only if the relevant requirements and criteria are met.

2. The result of the formation of interaction between key stakeholders is a certain degree of involvement of relevant stakeholders who are actively involved in the process of planning, developing and implementing social policy, which can be implemented

through the application of the map of responsibility of institutions in shaping the policy of development of social infrastructure of territories.

3. Organizational and economic mechanisms for managing innovation activity of development of social infrastructure of territories have been proposed, which is a transformation of the influence of the external environment as the main source of innovative changes within the framework of functioning of the innovation cluster, which simultaneously acts as a source of resources that the social infrastructure as an open system uses at the entrance of its activities to ensure the expected result. The methodological basis of state regulation in the spheres of social infrastructure is the forms of public-private partnership as a universal toolkit, and the relevant principles, compliance with which should be a prerequisite for making regulatory decisions on the introduction of innovative changes.

4. It is determined that the object of state regulation is the subject area, which combines the choice of the sphere of social infrastructure for implementation of innovative changes in each of the components of the HUB-center of the innovation cluster. It is proposed to implement measures for introducing innovative changes in the subject area of the components of the HUB-center of the innovation cluster on the basis of analysis and comparison of the level of development of social infrastructure in different regions. The main idea is to use the innovative experience of leading regions in certain areas of social infrastructure. That is, the experience of regions with the best integral indicators can be used to implement innovative projects in less developed regions.

5. In order to determine the priority of innovative projects of social infrastructure, it is proposed to use multiple regression coefficients, with the help of which it is possible to determine the sphere of social infrastructure that requires the greatest innovative transformations and the matrix "Efficiency / Reliability.

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ANNEXES

Annex A

Input data for calculating the level of development of social infrastructure in the territories of China

	Employment (X1)			Environment (X2)				Investment (PPP) (X3)				
Region	Unemployment Rate (%)	Number of Employed Persons By Urban Areas(10 000 persons)	Number of Employed Persons By Urban and Rural Areas(10 000 persons)	Main Pollutant Contents Emission in Waste Gas by Region (10 000 tons)	Main Pollutant Contents Discharged in Wastewater (10 000 tons)	Investment in UrbanEnvironmental Infrastructure (10 000 yuan)	Rate of Domestic Garbage Harmless Treatment %	Growth Rate of Total Investment in Infrastructure %	Growth Rate of Actual Funds Available for Investment from State Budget,%	Growth Rate of Total Investment in Central Govemment Projects,%	Growth Rate of Total Investment in Education, %	Growth Rate of Total Investment in Health and Social Service, %
	x1.1	*x1.2.*	*x1.3*	*x2.1*	*x2.2*	*x2.3*	*x2.4*	*x3.1*	*x3.2*	*x3.3*	*x3.4*	*x3.5*
Bejing	3,2	1013	145	8,21	4,87	2195863	100	-6,2	-18,4	37,1	17,4	22,8
Tianjin	3,7	534	107	10,72	15,52	406949	100	4,4	-25,4	-36,3	9	30,5
Hebei	3,1	2133	1510	82,24	153,53	3657128	100	-7,8	6,3	14,5	19,3	27,7
Shanxi	2,3	1014	701	41,94	61,61	1227003	100	8,2	52,9	12,9	12,5	47,4
Inner Mongolia	3,8	790	428	43,35	76,71	1123116	99,9	-4,2	-2,9	-1,9	5,4	42,9
Liaoning	4,3	1483	707	80,63	119,86	1049848	99,8	9,8	15,4	3,3	19,2	24,2
Jiilin	3,3	718	510	20,29	76,32	634073	100	3,4	-12,4	-1,5	-10,1	82,2
Heilongjiang	3,2	892	528	27,85	85,14	1094573	100	10,3	33,7	11,2	37,5	16,7
Shanghai	2,7	1195	170	13,57	7,51	1259338	100	-0,6	1,3	49,4	59,9	51,2
Jiangsu	2,5	3515	1348	44,34	119,49	4229827	100	2,3	11,6	-6,3	5,6	18
Zhejianng	2,6	2804	1093	38,05	49,87	3790177	100	1,3	-8,4	-20,4	32,6	37
Anhui	2,5	1816	1399	44,58	120,04	3057511	100	7,4	19,6	38,1	27,5	62,4
Fujian	3,3	1503	694	24,51	55,69	2007258	100	4	4,4	-5,3	10,3	5,4
Jiangxi	2,8	1317	925	32,42	109,57	3322602	100	2,5	4,5	11	18,4	24,1
Shandong	2,9	3386	2089	65,87	156,28	5041214	100	-6	-18,9	-12,2	20,8	13,1
Henan	3,4	2627	2213	49,81	151,85	5667906	100	0,3	4	3,7	2	4,8
Hubei	3	1919	1367	28,69	156,75	3005685	100	9,9	-12,3	-4,6	53,6	63,8
Hunan	2,3	1897	1361	26,18	151,82	2399124	100	3,6	0,2	-5,9	1,8	-3,7
Guangdong	2,5	5473	1599	62,96	158,08	4398527	100	-7	5,3	6,4	38,3	5
Guangxi	2,5	1359	1185	26,48	95,82	1521118	100	15,6	-1,3	-29,2	0,2	-0,7
Huinan	3,1	324	220	3,83	17,17	258893	100	7,6	-3,5	12,2	0,2	42,8
Chongqing	2,9	1108	560	15,76	33,82	2063093	96,6	8,5	7,3	12,3	24,8	24,4
Sichuan	3,6	2522	2205	34,97	135,82	4720372	100	0,5	10,9	-20,4	7,1	28,2
Guizhou	4,5	995	891	22,37	118,35	1255021	99	-20,6	-11,7	-50,2	1,6	-15
Yunnan	3,8	1309	1465	32,01	69,43	1402702	100	7,5	-22,2	-31,4	-30,6	34,1
Tibet	2,6	76	118	4,43	13,71	129742	99,7	-18,5	40,3	-56,2	6,8	60,9
Shaanxi	3,5	1253	838	21,02	50,74	2311014	100	-11,3	-11,3	20,6	-27,2	12,8
Gansu	3,4	626	693	18,46	66,13	865108	100	4,2	-10,1	-13,6	24,5	35,6
Qinghai	1,8	173	104	6,57	7,94	147759	99,4	3,3	-1,8	-28,8	-2,7	31,7
Ningxia	4,1	225	120	12,29	24,5	361573	100	-2,8	47	-21,7	46,9	-21,2
Xinjiang	2	774	586	28,25	66,98	1178976	100	16,2	-2,2	-2,2	-11,8	5

	Transport and Communication Services (X4)			Education (X5)		Public Health and Social Services (X6)						
Region	Passenger - kilometers ,(100 million passenger -km)	Broadband Subscabers Port of intemet (10 000 r ports)	Enterprises With E-commerce Transactions , %	Average Education Enrolment per 100 000 population Secondary Education	Average Education Enrolment per 100 000 population Higher Education	Number of Health Care Institutions	Health Technical Personnel in Health Care Institutions per 1000 Persons	Number of Beds in Health Care Institutions (10 000 beds)	Elderiv Care Beds per 1 000 Elderly Population (bed)	Number of Orphans	Expenses on Subsidy to Participation in Basic Medical Insurance	Number of Social Organizations
	x4.1	*x4.2*	*x4.3*	*x5.1*	*x5.2*	*x6.1*	*x6.2*	*x6.3*	*x6.4*	*x6.5*	*x6.6*	*x6.7*
Bejing	149,59	2030,8	23,5	1024	5313	10699	13,2	13,03	28,3	1331	4071	12892
Tianjin	171,01	1352,5	7,3	1953	5153	6076	8,87	6,87	23,3	570	4988,6	6357
Hebei	682,13	5012,5	7,5	3429	2926	88162	7,51	45,5	30,4	5386	83267	36825
Shanxi	221,32	2478,8	6,6	2880	3112	41007	8,09	22,89	25,2	4907	16337	18533
Inner Mongolia	164,82	1750,1	7,5	2454	2351	24948	8,82	16,66	44,2	2022	18495,3	17288
Liaoning	431,43	3274	5,9	2062	3742	33051	7,9	32,45	22,6	3990	36234,6	26893
Jiilin	208,72	1743,1	5,6	2423	4550	25344	9,15	17,65	27,8	3506	20264,4	13439
Heilongjiang	190,24	2260,4	6	2367	3448	20578	7,95	26,05	28,5	2899	39281,4	20313
Shanghai	134,65	2340,4	11,3	1139	3691	6308	9,2	16,04	28,7	1209	8228	17368
Jiangsu	991,53	7464,3	10,4	2233	3531	36448	8,13	54,86	39,3	5604	122496,3	89247
Zhejianng	713,62	6237,8	11,9	2162	2632	35120	8,85	36,99	33,4	2529	64401	72825
Anhui	753,6	3889	12,5	3138	3089	29554	7,12	41,1	38,7	5689	117749	35615
Fujian	313,97	3546,6	11,8	2583	3023	28693	7,03	22,38	40,9	2452	33074,6	35436
Jiangxi	603,91	2642,3	10,6	3712	4001	36764	6,77	30,73	34	4413	18800,7	28300
Shandong	706,81	7037	14,8	2622	3429	85715	8,39	67,29	30,2	7940	57065,3	63687
Henan	985,32	5631	7,1	3578	3424	78536	7,65	72,13	25,1	17141	71130,3	49917
Hubei	620,77	3667,8	10,8	2413	3914	36529	7,83	43,4	39	5073	76901	31536
Hunan	857,69	3513	11	3161	3487	55677	7,64	53,27	33,4	12342	76111,5	38384
Guangdong	940,86	9333,7	11,3	2306	2922	57964	6,88	58,9	28,3	13083	96445,7	71834
Guangxi	521,94	3579,2	9,8	3792	3432	34112	7,82	31,9	30,1	9692	66192,7	29485
Huinan	89,94	1096	13,8	3112	2839	6277	7,89	6,14	8,5	725	16576,6	8830
Chongqing	281,17	2612,1	13,6	3128	3505	21361	7,68	24,07	28,8	2707	41818	18561
Sichuan	596,57	6708,5	12,6	2760	2925	80249	8,04	66,2	25,2	18060	238480,7	45535
Guizhou	410,16	2045,1	10,7	3533	2593	29292	8,03	29,69	28,1	9387	118030,5	14742
Yunnan	283,36	2431,9	11,5	3318	2593	26885	8,12	33,03	17,9	8573	135280,6	23011
Tibet	30,16	254,2	9,9	2976	2871	6907	7	1,97	35,6	4650	10740,5	633
Shaanxi	435,53	2943,8	11,9	2395	1634	34971	9,32	28,45	26,6	4715	19416,6	31210
Gansu	335,9	1622,6	9,3	2868	4279	25759	8,07	18,32	36,4	6078	99292,2	21554
Qinghai	85,01	438,3	12,7	3719	2999	6408	8,7	4,22	24,6	1258	19583,7	5997
Ningxia	55,92	596,6	9,3	3380	1613	4571	8,36	4,12	33,2	722	29968,4	5070
Xinjiang	260,78	2251,6	6	2906	2749	16970	7,74	18,61	28,8	4063	90386,7	8274

	Culture and Sports (X7)					Social Security (X8)		
Region	Number of puplic Libraries	Number of puplic Museums	Number of publications Juvenile and Children's Books	Population Coverage Rate of Radio Programs (%)	Actual Popularizat on Rate of Cable Radio and TV (%)	Number of Traffic Accidents	Number of Grassroot Trade Unions	Participants in Work-related Injury insurance
	x7.1	*x7.2*	*x7.3*	*x7.4*	*x7.5*	*x8.1*	*x8.2*	*x8.3*
Bejing	20	79	3180	100	110,24	5363	3,4	1307,2
Tianjin	20	69	1012	100	86,79	7548	1,6	408,4
Hebei	177	172	1053	99,79	23,83	4268	12,5	1084,7
Shanxi	128	182	139	98,84	110,49	9213	5,3	640,1
Inner Mongolia	117	168	375	99,74	23,3	3576	5,2	338,2
Liaoning	129	65	1056	99,48	36,63	4876	5,7	807,9
Jiilin	66	105	2636	99,51	60,64	11026	2,8	392,4
Heilongjiang	103	177	694	99,94	40,18	5133	4,1	444,4
Shanghai	22	116	1686	100	134,33	930	4,8	1097,3
Jiangsu	123	366	1996	100	52,32	10529	14,6	2340,6
Zhejianng	103	425	2445	99,79	74,93	11262	13,6	2741,6
Anhui	133	223	1868	99,94	36,28	10267	11	718
Fujian	96	140	668	99,85	63,05	8578	9,4	984,4
Jiangxi	114	189	2349	99,23	35,53	4352	7,9	563,5
Shandong	153	629	2256	99,51	45,39	12660	10,5	1921,9
Henan	169	367	471	99,66	20,05	18696	13,8	1045,4
Hubei	117	227	1169	99,89	60,24	31757	10	828,3
Hunan	144	162	997	99,42	26,42	8625	11,6	853,8
Guangdong	150	339	944	99,98	54,4	25693	13,7	4068,6
Guangxi	116	169	2002	98,56	46,28	19131	6,3	551,3
Huinan	24	39	224	99,35	49,91	2998	1,5	184,9
Chongqing	43	111	167	99,49	50,84	4782	4,4	765,7
Sichuan	207	267	2743	99,17	29,21	9636	14,1	1472,1
Guizhou	99	97	229	95,96	65,2	18052	5,5	529,9
Yunnan	151	165	681	99,6	25,85	6884	6,7	541,9
Tibet	82	13	49	99,24	27,75	557	0,9	49,6
Shaanxi	117	312	540	99,36	56,51	4887	10,7	629,6
Gansu	104	228	310	99,43	18,47	2856	3,6	278,7
Qinghai	50	24	7	99,1	57,32	1821	1,4	95,9
Ningxia	27	64	125	99,93	44,78	1588	1,2	143,8
Xinjiang	110	78	731	99,15	33,3	5372	3,6	456,1

Annex B

Standardized input data matrix for determining the level of development of social infrastructure in Chinese regions

	x1.1	*x1.2.*	*x1.3*	*x2.1*	*x2.2*	*x2.3*	*x2.4*	*x3.1*	*x3.2*	*x3.3*	*x3.4*	*x3.5*	*x3.6*	*x3.7*	*x4.1*	*x4.2*	*x4.3*
Bejing	0,197	-0,430	-1,195	-1,122	-1,478	0,047	0,285	-0,886	-1,128	1,681	0,183	-0,146	-0,457	0,917	-0,945	-0,566	3,691
Tianjin	0,961	-0,845	-1,255	-1,000	-1,273	-1,090	0,285	0,337	-1,492	-1,342	-0,219	0,179	-1,780	2,058	-0,872	-0,873	-0,897
Hebei	0,044	0,541	0,967	2,463	1,384	0,976	0,285	-1,071	0,157	0,750	0,274	0,061	-0,939	-2,258	0,871	0,782	-0,841
Shanxi	-1,177	-0,429	-0,314	0,512	-0,386	-0,569	0,285	0,776	2,580	0,685	-0,051	0,891	-0,479	-0,597	-0,701	-0,364	-1,096
Inner Mongolia	1,113	-0,623	-0,746	0,580	-0,095	-0,635	0,127	-0,655	-0,322	0,075	-0,391	0,701	0,047	-0,290	-0,893	-0,693	-0,841
Liaoning	1,877	-0,022	-0,305	2,385	0,736	-0,681	-0,031	0,960	0,630	0,289	0,269	-0,087	0,358	1,545	0,016	-0,004	-1,294
Jiilin	0,350	-0,686	-0,617	-0,537	-0,102	-0,946	0,285	0,222	-0,816	0,092	-1,133	2,357	0,113	0,413	-0,744	-0,696	-1,379
Heilongjiang	0,197	-0,535	-0,588	-0,171	0,067	-0,653	0,285	1,018	1,582	0,615	1,145	-0,403	1,541	0,312	-0,807	-0,462	-1,266
Shanghai	-0,567	-0,272	-1,155	-0,862	-1,427	-0,548	0,285	-0,240	-0,103	2,188	2,216	1,051	0,494	-0,865	-0,996	-0,426	0,236
Jiangsu	-0,872	1,740	0,711	0,628	0,729	1,339	0,285	0,095	0,432	-0,106	-0,382	-0,348	-0,557	-0,610	1,927	1,890	-0,019
Zhejianng	-0,719	1,123	0,307	0,323	-0,612	1,060	0,285	-0,020	-0,608	-0,687	0,910	0,452	0,779	0,459	0,979	1,336	0,406
Anhui	-0,872	0,266	0,791	0,639	0,739	0,594	0,285	0,683	0,848	1,722	0,666	1,523	0,218	-0,339	1,115	0,274	0,576
Fujian	0,350	-0,005	-0,325	-0,333	-0,500	-0,073	0,285	0,291	0,058	-0,065	-0,157	-0,879	0,139	0,724	-0,385	0,119	0,377
Jiangxi	-0,414	-0,166	0,041	0,051	0,538	0,763	0,285	0,118	0,063	0,606	0,231	-0,091	0,638	-0,528	0,604	-0,290	0,037
Shandong	-0,261	1,628	1,884	1,671	1,437	1,855	0,285	-0,863	-1,154	-0,349	0,346	-0,555	-0,417	0,122	0,955	1,697	1,227
Henan	0,502	0,970	2,080	0,893	1,352	2,253	0,285	-0,136	0,037	0,306	-0,554	-0,904	0,590	2,182	1,905	1,061	-0,954
Hubei	-0,108	0,356	0,741	-0,130	1,446	0,562	0,285	0,972	-0,811	-0,036	1,915	1,582	0,708	0,384	0,662	0,174	0,094
Hunan	-1,177	0,337	0,731	-0,252	1,351	0,176	0,285	0,245	-0,161	-0,090	-0,563	-1,262	0,489	-0,257	1,470	0,104	0,151
Guangdong	-0,872	3,438	1,108	1,530	1,472	1,447	0,285	-0,978	0,105	0,417	1,183	-0,896	-0,014	-0,692	1,754	2,735	0,236
Guangxi	-0,872	-0,130	0,452	-0,237	0,273	-0,382	0,285	1,630	-0,239	-1,049	-0,640	-1,136	-0,211	-1,221	0,325	0,134	-0,189
Huinan	0,044	-1,028	-1,076	-1,334	-1,241	-1,184	0,285	0,707	-0,353	0,656	-0,640	0,697	-1,574	1,577	-1,149	-0,989	0,944
Chongqing	-0,261	-0,348	-0,537	-0,756	-0,921	-0,037	-5,080	0,810	0,209	0,660	0,537	-0,078	2,675	-0,335	-0,497	-0,303	0,887
Sichuan	0,808	0,879	2,068	0,174	1,043	1,651	0,285	-0,113	0,396	-0,687	-0,310	0,082	1,379	0,086	0,579	1,548	0,604
Guizhou	2,182	-0,446	-0,013	-0,436	0,707	-0,551	-1,293	-2,548	-0,779	-1,914	-0,573	-1,739	0,717	-0,862	-0,057	-0,560	0,066
Yunnan	1,113	-0,173	0,896	0,031	-0,235	-0,457	0,285	0,695	-1,326	-1,140	-2,113	0,330	-0,172	-0,044	-0,489	-0,385	0,292
Tibet	-0,719	-1,243	-1,237	-1,305	-1,308	-1,266	-0,188	-2,305	1,925	-2,161	-0,324	1,459	-1,315	0,289	-1,353	-1,369	-0,161
Shaanxi	0,655	-0,222	-0,097	-0,502	-0,595	0,120	0,285	-1,474	-0,759	1,002	-1,951	-0,567	0,288	0,799	0,030	-0,154	0,406
Gansu	0,502	-0,766	-0,327	-0,626	-0,299	-0,799	0,285	0,314	-0,696	-0,407	0,523	0,393	-0,676	-1,401	-0,310	-0,751	-0,331
Qinghai	-1,941	-1,159	-1,260	-1,201	-1,419	-1,255	-0,662	0,210	-0,265	-1,033	-0,779	0,229	-2,380	-1,169	-1,166	-1,286	0,632
Ningxia	1,571	-1,113	-1,234	-0,924	-1,100	-1,119	0,285	-0,494	2,273	-0,740	1,594	-2,000	0,003	-0,064	-1,265	-1,215	-0,331
Xinjiang	-1,636	-0,637	-0,496	-0,151	-0,282	-0,599	0,285	1,699	-0,285	0,063	-1,214	-0,896	-0,207	-0,339	-0,566	-0,466	-1,266

	x5.1	*x5.2*	*x6.1*	*x6.2*	*x6.3*	*x6.4*	*x6.5*	*x6.6*	*x6.7*	*x7.1*	*x7.2*	*x7.3*	*x7.4*	*x7.5*	*x8.1*	*x8.2*	*x8.3*
Bejing	-2,518	2,441	-0,947	4,360	-0,890	-0,216	-0,928	-1,081	-0,742	-1,691	-0,796	2,220	0,739	2,099	-0,472	-0,839	0,462
Tianjin	-1,170	2,248	-1,141	0,595	-1,204	-0,918	-1,095	-1,063	-1,043	-1,691	-0,870	-0,119	0,739	1,259	-0,172	-1,242	-0,590
Hebei	0,972	-0,429	2,305	-0,587	0,766	0,078	-0,041	0,458	0,359	1,481	-0,104	-0,075	0,458	-0,995	-0,623	1,201	0,202
Shanxi	0,176	-0,205	0,325	-0,083	-0,387	-0,651	-0,145	-0,843	-0,483	0,491	-0,030	-1,061	-0,816	2,107	0,056	-0,413	-0,319
Inner Mongolia	-0,442	-1,120	-0,349	0,552	-0,705	2,014	-0,777	-0,801	-0,540	0,269	-0,134	-0,807	0,390	-1,014	-0,718	-0,435	-0,672
Liaoning	-1,011	0,552	-0,009	-0,248	0,100	-1,016	-0,346	-0,456	-0,098	0,512	-0,900	-0,072	0,042	-0,537	-0,539	-0,323	-0,122
Jiilin	-0,487	1,523	-0,332	0,839	-0,654	-0,286	-0,452	-0,766	-0,717	-0,761	-0,603	1,633	0,082	0,323	0,305	-0,973	-0,609
Heilongjiang	-0,569	0,198	-0,532	-0,205	-0,226	-0,188	-0,585	-0,397	-0,401	-0,014	-0,067	-0,463	0,659	-0,410	-0,504	-0,682	-0,548
Shanghai	-2,351	0,491	-1,131	0,882	-0,736	-0,160	-0,955	-1,000	-0,536	-1,650	-0,521	0,608	0,739	2,961	-1,081	-0,525	0,216
Jiangsu	-0,763	0,298	0,134	-0,048	1,243	1,327	0,007	1,220	2,771	0,390	1,338	0,942	0,739	0,025	0,237	1,672	1,671
Zhejianng	-0,866	-0,783	0,078	0,578	0,332	0,499	-0,666	0,091	2,016	-0,014	1,777	1,427	0,458	0,834	0,338	1,448	2,141
Anhui	0,550	-0,233	-0,155	-0,926	0,541	1,242	0,026	1,127	0,304	0,592	0,275	0,804	0,659	-0,550	0,201	0,865	-0,228
Fujian	-0,255	-0,312	-0,192	-1,005	-0,413	1,551	-0,683	-0,518	0,295	-0,155	-0,342	-0,491	0,538	0,409	-0,031	0,506	0,084
Jiangxi	1,383	0,863	0,147	-1,231	0,013	0,583	-0,254	-0,795	-0,033	0,209	0,022	1,323	-0,293	-0,576	-0,611	0,170	-0,408
Shandong	-0,199	0,176	2,202	0,178	1,877	0,050	0,519	-0,051	1,595	0,996	3,295	1,223	0,082	-0,223	0,530	0,753	1,181
Henan	1,189	0,170	1,901	-0,466	2,124	-0,665	2,533	0,222	0,962	1,320	1,346	-0,703	0,283	-1,131	1,358	1,492	0,156
Hubei	-0,502	0,759	0,137	-0,309	0,659	1,285	-0,109	0,334	0,116	0,269	0,305	0,050	0,592	0,308	3,152	0,641	-0,098
Hunan	0,584	0,245	0,941	-0,474	1,162	0,499	1,482	0,319	0,431	0,815	-0,179	-0,136	-0,038	-0,903	-0,025	0,999	-0,069
Guangdong	-0,657	-0,434	1,037	-1,135	1,449	-0,216	1,645	0,714	1,970	0,936	1,138	-0,193	0,712	0,099	2,319	1,470	3,693
Guangxi	1,499	0,179	0,036	-0,318	0,072	0,036	0,902	0,126	0,021	0,249	-0,127	0,949	-1,191	-0,191	1,418	-0,189	-0,423
Huinan	0,512	-0,534	-1,133	-0,257	-1,241	-2,993	-1,061	-0,838	-0,929	-1,610	-1,094	-0,970	-0,132	-0,062	-0,797	-1,265	-0,851
Chongqing	0,536	0,267	-0,499	-0,440	-0,327	-0,146	-0,627	-0,348	-0,481	-1,226	-0,558	-1,031	0,055	-0,028	-0,552	-0,615	-0,172
Sichuan	0,002	-0,430	1,973	-0,127	1,821	-0,651	2,734	3,473	0,760	2,087	0,602	1,748	-0,374	-0,803	0,114	1,560	0,655
Guizhou	1,123	-0,829	-0,166	-0,135	-0,040	-0,244	0,835	1,133	-0,657	-0,095	-0,662	-0,964	-4,677	0,486	1,270	-0,368	-0,448
Yunnan	0,811	-0,829	-0,267	-0,057	0,130	-1,675	0,657	1,468	-0,276	0,956	-0,156	-0,477	0,203	-0,923	-0,264	-0,099	-0,434
Tibet	0,315	-0,495	-1,106	-1,031	-1,454	0,808	-0,202	-0,951	-1,306	-0,438	-1,287	-1,158	-0,280	-0,855	-1,132	-1,399	-1,010
Shaanxi	-0,528	-1,982	0,072	0,986	-0,104	-0,455	-0,188	-0,783	0,101	0,269	0,937	-0,629	-0,119	0,175	-0,538	0,798	-0,331
Gansu	0,158	1,198	-0,315	-0,100	-0,620	0,920	0,111	0,769	-0,344	0,007	0,312	-0,877	-0,025	-1,187	-0,817	-0,794	-0,742
Qinghai	1,393	-0,341	-1,127	0,447	-1,339	-0,735	-0,944	-0,780	-1,059	-1,084	-1,205	-1,204	-0,467	0,204	-0,959	-1,287	-0,956
Ningxia	0,901	-2,008	-1,204	0,152	-1,344	0,471	-1,062	-0,578	-1,102	-1,549	-0,908	-1,076	0,645	-0,245	-0,991	-1,332	-0,900
Xinjiang	0,213	-0,642	-0,684	-0,387	-0,605	-0,146	-0,330	0,596	-0,955	0,128	-0,803	-0,423	-0,400	-0,656	-0,471	-0,794	-0,534

Annex C

Calculation of integral coefficients of the level of development of social infrastructure in Chinese regions

	$d_{0i} = \sqrt{\sum_{j=1}^{m}(x_{ij} - x_{0j})^2}$												
	x1.1	*x1.2.*	*x1.3*	*x2.1*	*x2.2*	*x2.3*	*x2.4*	*x3.1*	*x3.2*	*x3.3*	*x3.4*	*x3.5*	*x3.6*
Bejing	4,57094137	14,9631297	10,7261709	0,04499517	0	4,86854643	0	6,68142019	13,749941	0,25660358	4,13448749	6,26386741	9,80924249
Tianjin	8,41892773	18,3497764	11,1239845	0,11134125	0,04204261	11,1778591	0	1,85411541	16,5823203	12,4570192	5,93033719	4,74515882	19,8456484
Hebei	3,94127088	8,39161705	1,23952215	14,4198438	8,19178793	1,63289168	0	7,66999766	5,87345451	2,06587168	3,77307892	5,27305949	13,0596424
Shanxi	0,58302824	14,9564205	5,73386185	3,40639922	1,19335349	7,96474179	0	0,85222196	0	2,25963461	5,14281031	2,14994898	9,94691439
Inner Mongolia	9,32845178	16,4968505	7,99134873	3,66312314	1,91303577	8,34174227	0,0248996	5,54157331	8,42151398	4,46362005	6,79887141	2,74191992	6,90757943
Liaoning	14,5757059	11,975634	5,6884453	13,8337552	4,90129217	8,61287001	0,09959839	0,54542206	3,8035078	3,60457727	3,79168841	5,97208051	5,36951093
Jiilin	5,24725413	17,0080203	7,273994	0,63544404	1,89232144	10,2335598	0	2,18168822	11,5331553	4,39428331	11,2160491	0	6,5665177
Heilongjiang	4,57094137	15,7860439	7,12104045	1,35320518	2,3883445	8,44684989	0	0,46352885	0,99706675	2,47502286	1,14852343	7,61644423	1,28713149
Shanghai	1,88901149	13,7668406	10,4684016	0,22250284	0,00258344	7,84917866	0	3,75829885	7,20147039	0	0	1,7060551	4,75863147
Jiangsu	1,14273534	2,88388606	1,87661791	3,84894879	4,86980142	0,83520794	0	2,57277821	4,61340816	5,26214583	6,74906299	7,31711234	10,4504769
Zhejianng	1,49255228	5,35858187	3,1461519	2,74648769	0,75061195	1,4239507	0	2,95627809	10,1634867	8,26348674	1,70596107	3,62699149	3,59748656
Anhui	1,14273534	10,060108	1,66185241	3,8946898	4,91664869	2,75195662	0	1,03118857	2,99923326	0,21657553	2,40288974	0,69598527	6,03877863
Fujian	5,24725413	11,8558784	5,78707606	1,00304107	0,9573258	5,41184147	0	1,9819487	6,36216976	5,07489594	5,63128069	10,4710952	6,43251066
Jiangxi	2,33211294	12,9928313	4,16078589	1,91710525	4,06334602	2,22140331	0	2,49927406	6,33596106	2,50100718	3,94221237	5,99269164	4,1488649
Shandong	2,82185666	3,27640531	0,03856444	9,02736963	8,49766415	0,15861251	0	6,56264175	13,9434635	6,43596855	3,49943021	8,47667947	9,56385073
Henan	5,97020914	6,09287846	0	4,95856009	8,00768406	0	0	3,36640991	6,46754552	3,54229633	7,67363168	10,6353451	4,34747699
Hubei	3,35824264	9,50139931	1,79508232	1,44950559	8,55050216	2,8623144	0	0,52851078	11,4978587	4,94583939	0,09085	0,60104268	3,86826367
Hunan	0,58302824	9,61939467	1,82063477	1,17158203	8,00441551	4,31520112	0	2,11404311	7,51178253	5,18683881	7,72673624	13,0995385	4,77776163
Guangdong	1,14273534	0	0,94554104	8,20036918	8,70090985	0,65074636	0	7,16718671	6,12823882	3,13609637	1,06795099	10,5804531	7,23369393
Guangxi	1,14273534	12,7315505	2,65051259	1,20324498	3,06616732	6,94468885	0	0,00479375	7,94548385	10,4784629	8,158165	12,2005309	8,33286251
Huinan	3,94127088	19,9433682	9,96226844	0	0,05607905	11,8158556	0	0,98484901	8,6035955	2,34713662	8,158165	2,75589147	18,0537264
Chongqing	2,82185666	14,3324759	6,85313599	0,33380938	0,3106616	5,24800944	28,7839357	0,78950375	5,62407963	2,33453456	2,8200581	5,93096476	0
Sichuan	7,55604594	6,55075176	0,00016052	2,27433724	6,35625701	0,36259243	0	3,28225299	4,77112019	8,26348674	6,38133681	5,17674993	1,68115133
Guizhou	17,0011034	15,0841521	4,38335407	0,80618944	4,77341395	7,86455848	2,48995984	18,0330167	11,2872154	16,8256235	7,78002391	16,7726698	3,83387928
Yunnan	9,32845178	13,0429	1,40328809	1,86251434	1,54496088	7,34697804	0	1,00788563	15,254629	11,0732527	18,7473972	4,1073321	8,10681198
Tibet	1,49255228	21,9107659	11,008083	0,00084435	0,02896643	12,3868464	0,22409639	16,0336241	0,42940082	18,9138668	6,45405801	0,80543199	15,9242923
Shaanxi	6,73980641	13,3960767	4,7418634	0,69305771	0,77991617	4,55096887	0	10,0702009	11,1478684	1,40681654	17,3652137	8,55044283	5,69923273
Gansu	5,97020914	17,6725314	5,79469815	0,50200298	1,39105541	9,31574878	0	1,91749942	10,7350204	6,73183694	2,86847023	3,85515195	11,2291338

Qinghai	0	21,1302416	11,1556994	0,01760835	0,00349355	12,3063826	0,89638554	2,21591026	8,09275567	10,3720833	8,97000095	4,52743707	25,5525946
Ningxia	12,3368775	20,7176445	10,9870753	0,16786431	0,14283382	11,3715097	0	4,80706451	0,09415119	8,57416211	0,38683924	18,9806353	7,13975085
Xinjiang	0,09328452	16,6097698	6,63924581	1,39864973	1,4299258	8,13794579	0	0	8,21154683	4,51597878	11,7674438	10,5804531	8,30759228
	x3.7	*x4.1*	*x4.2*	*x4.3*	*x5.1*	*x5.2*	*x6.1*	*x6.2*	*x6.3*	*x6.4*	*x6.5*	*x6.6*	*x6.7*
Bejing	1,60094242	8,24834194	10,8991979	0	16,1359322	0	10,5738722	0	9,07976764	4,97358711	0,02776348	20,7390504	12,3445614
Tianjin	0,01543551	7,8339846	13,0178786	21,0565311	7,12238339	0,0370035	11,8736329	14,1753015	11,07118	8,59345986	0	20,5770016	14,5480566
Hebei	19,7130272	1,11389688	3,8160369	20,5398261	0,27750776	8,23583684	0	24,4782882	1,8434956	3,74656829	1,11193025	9,09280365	5,81872556
Shanxi	7,72309956	6,90275845	9,60298119	22,9155458	1,75166707	7,00233657	3,91832928	19,7423257	6,30283389	7,10203294	0,90174436	18,6254044	10,5879409
Inner Mongolia	6,1093833	7,95262955	11,7531605	20,5398261	3,77028444	12,6815695	7,04161011	14,5045658	7,99863915	0	0,10107362	18,2652418	10,9640483
Liaoning	0,40646486	3,65035848	7,504229	24,8531896	6,30309852	3,56742841	5,35207282	21,2377376	4,09301277	9,1787382	0,56073389	15,4382483	8,2324545
Jiilin	3,12858755	7,13045265	11,7748679	25,7076785	3,94701508	0,84149584	6,95366303	12,4012813	7,71567579	5,29130964	0,41325364	17,9726487	12,1683244
Heilongjiang	3,4974043	7,47108739	10,2246391	24,5715693	4,27653094	5,02759828	8,04883853	20,8389157	5,51981743	4,84925235	0,26004204	14,9766033	10,0616142
Shanghai	9,28507908	8,54366838	9,99466286	11,9419833	14,8230096	3,80280973	11,8066107	12,0969669	8,17844341	4,72649145	0,0195752	20,0100039	10,9396834
Jiangsu	7,79595859	0	0,71418103	13,7689045	5,1186345	4,59005929	4,71261209	19,4344579	0,77532618	0,47235405	1,21487337	5,07734729	0
Zhejianng	2,96875947	0,89869581	1,958744	10,7962461	5,59547678	10,3895449	4,95775673	14,3065536	3,2099871	2,29468455	0,18398121	11,4375754	0,57102194
Anhui	6,35422426	0,65872293	6,05831348	9,70827718	0,9007772	7,14944718	6,05284055	27,9488324	2,50301426	0,59511495	1,25624645	5,50149017	6,09044025
Fujian	2,12629491	5,34195087	6,84424906	10,9831906	3,07832515	7,58008125	6,23198934	28,7823891	6,43407239	0,21424138	0,1698024	15,9244479	6,13116251
Jiangxi	7,34620161	1,74830309	9,15035229	13,3516893	0,01347851	2,48811567	4,65519492	31,259243	4,45554111	2,04680196	0,70801973	18,2145627	7,86512027
Shandong	4,24262729	0,94327934	1,07798414	6,07288843	2,88292678	5,13055908	0,01055148	17,4922898	0,06089624	3,8559514	2,60399152	12,4218423	1,38331919
Henan	0	0,00044873	2,80182421	21,5796548	0,09644716	5,15782749	0,16328156	23,2885515	0	7,17698792	13,1644289	10,5703951	3,27528122
Hubei	3,23354688	1,59952163	6,56057102	12,9408928	4,00488843	2,82903503	4,69786085	21,8024391	2,14571	0,53196391	0,97209449	9,85397155	7,05209089
Hunan	5,94882834	0,20843768	6,92395542	12,536515	0,83853387	4,81952728	1,85956418	23,3725498	0,9246623	2,29468455	6,64362478	9,95050245	5,47778076
Guangdong	8,25907733	0,02987488	0	11,9419833	4,65049849	8,26346227	1,60694788	30,1988683	0,45500845	4,97358711	7,50632698	7,61427329	0,64201903
Guangxi	11,5839118	2,56591373	6,76735594	15,0590624	0	5,11423273	5,14797972	21,8837156	4,20726471	3,91123316	3,98919003	11,2033465	7,56224857
Huinan	0,3658451	9,45850598	13,868062	7,54918843	0,9738223	8,84712752	11,8155553	21,3179556	11,3202503	25,073324	0,00115178	18,5852481	13,6929315
Chongqing	6,33775188	5,87166633	9,23313444	7,86370452	0,92853451	4,72497754	7,86341793	23,0374639	6,00436806	4,6657012	0,21893421	14,5976082	10,5795578
Sichuan	4,39207595	1,81514197	1,40840845	9,53256539	2,24295874	8,24273886	0,11033867	20,1305627	0,09141325	7,10203294	14,6650723	0	4,04577808
Guizhou	9,26516471	3,93287013	10,8565557	13,1454887	0,14127373	10,6940129	6,1070785	20,2086637	4,68220607	5,09949573	3,72688739	5,47586535	11,7536171
Yunnan	4,95733201	5,8355181	9,73483447	11,5536522	0,47317149	10,6940129	6,6166844	19,511198	3,97423266	13,6077705	3,07050793	4,01973983	9,28942637
Tibet	3,58352889	10,7543831	16,8471986	14,8400244	1,40230411	8,61974098	11,6344436	29,0629631	12,7961385	1,45503146	0,79804047	19,5756912	16,6266741
Shaanxi	1,91264565	3,59711195	8,34433928	10,7962461	4,11012189	19,564217	4,98564947	11,3820362	4,95980991	6,09397707	0,82367078	18,1125723	7,13198814
Gansu	12,8402917	5,00175029	12,1516849	16,1783224	1,79806684	1,54541091	6,86208934	19,8971668	7,52706657	1,19691879	1,45442876	7,31213866	9,70260217

Qinghai	11,2305626	9,56222923	16,1709225	9,35845827	0,01122297	7,73979763	11,7777804	15,3102238	11,9885659	7,55766475	0,02269245	18,0849507	14,6746985
Ningxia	5,0450707	10,185775	15,6004973	16,1783224	0,35748376	19,7882024	12,3130168	17,7111693	12,0238991	2,38045979	0,00110762	16,4097161	15,0033275
Xinjiang	6,35422426	6,21358178	10,2500962	24,5715693	1,65321498	9,50252319	8,93115894	22,5393712	7,44615346	4,6657012	0,58492712	8,2777563	13,8829309
	x7.1	*x7.2*	*x7.3*	*x7.4*	*x7.5*	*x8.1*	*x8.2*	*x8.3*	*d0*	*K*			
Bejing	14,2736877	16,7325839	0	0	0,7439273	0,43553639	6,30187631	2,16583623	14,5377375	0,20			
Tianjin	14,2736877	17,3465729	5,4721862	0	2,89717849	0,92158525	8,49025109	0,1762972	17,0334418	0,06			
Hebei	0,36736306	11,5523419	5,26716946	0,07925122	15,6524186	0,25968019	0,22155034	1,46725356	14,4978278	0,20			
Shanxi	2,54745874	11,0523004	10,766515	2,41815074	0,72856684	1,41283488	4,34509951	0,47750768	14,5264163	0,20			
Inner Mongolia	3,30626756	11,7554561	9,16026509	0,1214826	15,8029286	0,1718633	4,43904489	0,11405996	15,7856875	0,13			
Liaoning	2,4833743	17,5952661	5,25232191	0,48593041	12,2361847	0,35174126	3,97936562	0,78744942	15,3728165	0,15			
Jiilin	8,11505004	15,1879866	0,34454037	0,43147889	6,9610381	2,0666518	6,99516309	0,16092451	15,2935076	0,16			
Heilongjiang	4,41488764	11,3009382	7,19522799	0,00646949	11,3631188	0,39484709	5,53875848	0,21344935	14,6186782	0,19			
Shanghai	13,9700009	14,5570161	2,59862436	0	0	0,00262346	4,82487405	1,50319196	14,6713426	0,19			
Jiangsu	2,8801264	3,82603668	1,63209606	0	8,62165264	1,87508712	0	7,18771311	11,9213926	0,34			
Zhejianng	4,41488764	2,30196103	0,62895126	0,07925122	4,52303332	2,16087804	0,05023817	9,92408939	11,7849202	0,35			
Anhui	2,23520014	9,11779239	2,00405659	0,00646949	12,3240115	1,77785105	0,65108671	0,61180559	12,1374897	0,33			
Fujian	5,02920032	13,2268172	7,34651858	0,0404343	6,51316799	1,21314844	1,35844017	1,19667981	14,2120696	0,22			
Jiangxi	3,53035902	10,7088537	0,80397836	1,06548868	12,5132692	0,27156917	2,25519155	0,36165776	13,708413	0,24			
Shandong	1,19025632	0	0,9939997	0,43147889	10,140308	2,76212277	0,84450367	4,80055479	12,3144159	0,32			
Henan	0,58941362	3,79699666	8,54398193	0,20774244	16,7416154	6,20416863	0,03215243	1,35795319	13,6312578	0,25			
Hubei	3,30626756	8,93901649	4,70832521	0,02174467	7,03681425	18,355495	1,06303972	0,8303877	13,0971405	0,28			
Hunan	1,6200711	12,0634462	5,54817029	0,60453768	14,9272664	1,22740727	0,45214355	0,88566339	13,6036329	0,25			
Guangdong	1,32618065	4,6519349	5,82084332	0,00071883	8,18986086	11,913771	0,04069292	22,1195643	13,9699469	0,23			
Guangxi	3,38014835	11,7045116	1,61559646	3,72642492	9,93838045	6,50530696	3,46090768	0,34469006	14,6468638	0,19			
Huinan	13,6695795	19,2549172	10,1730498	0,75926627	9,13582124	0,11235502	8,62137272	0,02506895	17,0658315	0,06			
Chongqing	10,978441	14,8421615	10,5691625	0,46742049	8,93564321	0,33659708	5,22677943	0,70224378	15,1712984	0,16			
Sichuan	0	7,24861066	0,22233364	1,23800836	14,1653595	1,55429319	0,01255954	2,77105475	12,3954649	0,32			
Guizhou	4,76102528	15,6552821	10,138664	29,3312196	6,12618364	5,77144824	4,16022304	0,31591171	17,5580266	0,03			
Yunnan	1,28005618	11,9089533	7,27067653	0,28753279	15,0853799	0,75483596	3,13536432	0,33189463	15,3694234	0,15			
Tibet	6,37783093	20,9893532	11,4132268	1,03799336	14,5615743	0	9,42920253	0	17,8162334	0,02			
Shaanxi	3,30626756	5,5584814	8,11428327	0,73608393	7,76317454	0,35353524	0,7641226	0,46067701	14,6291652	0,19			
Gansu	4,33039414	8,89459909	9,58972392	0,58387127	17,2077444	0,09966321	6,07881883	0,07187713	15,109864	0,17			
Qinghai	10,0612579	20,2464265	11,7214801	1,45563473	7,60240749	0,03012667	8,75349912	0,00293564	17,2801658	0,05			
Ningxia	13,2250702	17,657716	10,8658759	0,00880569	10,2798808	0,02004353	9,02076619	0,01215185	17,3145825	0,05			

Xinjiang	3,84057672	16,793485	6,98264369	1,29839024	13,0845142	0,43716914	6,07881883	0,22628807	15,8526632	0,13
								dosum	456,927718	
								d0cp	14,7396038	
								ð	1,70375596	
								dosum	18,1471157	