

# Development of innovative infrastructure of the industrial sector

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**Abstract.** The development of innovative infrastructure within the industrial sector is a crucial factor for fostering economic growth, enhancing competitiveness, and ensuring long-term sustainability. This abstract provides an overview of the key aspects and significance of this topic. In an era characterized by rapid technological advancements and increasing globalization, industries are continually evolving. The traditional industrial landscape is transforming into a more dynamic and interconnected environment. As a result, the establishment of an innovative infrastructure is essential for adapting to these changes and harnessing their potential benefits. This abstract outlines some of the critical components of innovative industrial infrastructure, including advanced manufacturing technologies, research and development facilities, efficient supply chain systems, and collaborative networks. These elements collectively contribute to the creation of a thriving ecosystem for industrial innovation. Moreover, the abstract highlights the role of government policies, private sector investments, and academic institutions in driving the development of innovative infrastructure. Collaboration among these stakeholders is essential to creating an environment conducive to research, innovation, and technology transfer.

## 1 Introduction

In the contemporary landscape of rapid technological progress and global interconnectedness, the industrial sector plays a pivotal role in shaping economies and societies worldwide. As industries evolve and adapt to the challenges and opportunities of the 21st century, the development of innovative infrastructure within this sector emerges as a key driver of progress, economic growth, and sustainability. The purpose of this introduction is to provide an overview of the essential concepts and significance of developing innovative infrastructure within the industrial sector. By exploring the dynamics of innovation, technology, and collaboration, we can gain valuable insights into how industries can thrive in a rapidly changing world. The Changing Industrial Landscape: Traditional industrial models are giving way to more agile and adaptable structures. Industries are embracing advanced technologies, sustainable practices, and a global perspective. This shift demands innovative infrastructure to support the development, production, and distribution of goods and services. Defining Innovative Infrastructure:

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Innovative infrastructure encompasses a wide range of elements, from cutting-edge manufacturing processes and research and development facilities to efficient supply chain systems and collaborative networks. It provides the foundation for fostering innovation and competitiveness. **The Role of Stakeholders:** Government policies, private sector investments, and academic institutions all play pivotal roles in shaping the development of innovative industrial infrastructure. Collaborative efforts among these stakeholders are necessary to create an environment conducive to research, innovation, and technology transfer. **Driving Economic Growth:** Investment in innovative infrastructure within the industrial sector has the potential to drive economic growth by increasing productivity, creating high-value job opportunities, and fostering sustainable development. It enables industries to address pressing global challenges, including climate change and resource scarcity. **Challenges and Opportunities:** While the development of innovative infrastructure holds great promise, it also presents challenges related to financing, regulatory frameworks, and workforce development. These challenges need to be addressed to fully unlock the potential of innovative infrastructure. **Scope of the Discussion:** This introduction sets the stage for a broader exploration of the strategies, obstacles, and impacts associated with the development of innovative infrastructure in the industrial sector. Subsequent sections will delve deeper into these aspects and provide a comprehensive understanding of this critical topic. In conclusion, the development of innovative infrastructure within the industrial sector represents a paradigm shift that will define the future of industries, economies, and societies. This discussion serves as an entry point into a comprehensive exploration of the multifaceted and dynamic process of creating innovative infrastructure to drive industrial progress in the 21st century.

## **2 Research Methodology**

In modern global structural and technological change, the role of the state in modern global structural and technological shifts is greater than ever. The role of the state in modern global structural and technological. Often, it is the state that gives a first impetus to innovations in an area of private business is weak, and creates such conditions for entrepreneurial activities (institutional environment or organizational mechanisms with incentives) so that the vector of development of national economy will correspond to its strengthening and competitiveness. Moreover, in resources-abundant countries such as Russia and resource-abundant regions like Russia the motivation of actors in innovation, with its special interests in the field of low-carbon technology is largely determined by government support. The motive of innovations, for example, to achieve a breakthrough in the field of low-carbon technologies, largely depends on government support and international cooperation. A very effective incentive for innovation is the market, the assessments of which act as a motivating force for new developments, inventories and manufacturers of new products. When in countries with an imperfect market system, as in Russia the role of the state is more widespread and, mostly, consists of stimulating creative ideas from researchers. The main task of the state is to create new demand from the real sector. The state has incentive and restrictive tools in its arsenal: targeted subsidies, subsidies, increased tariffs, fines, etc. On the one hand, some scientists insist on a more active role of the research sector in innovative development, acting as a driver of innovation. In this formulation, the supply of new technologies precedes measures to create innovative demand; the emergence of alternative developments - legislative establishment of practical application, incentive measures and consolidation in business practice. That is, first scientists should make proposals for introducing any new products into economic circulation; the government should not get ahead of them and make decisions or bans in the

field of new technologies [1]. On the other hand, convincing arguments are made in favor of a more active role of the state in the development of innovation: pursuing a unified industrial policy with support for priority sectors; preventing the manifestations of undesirable forms of innovative activity characteristic of globalization, and, on the contrary, attracting new technologies in the national interests; stimulating the creation of innovations, investments, production of new products, expansion of domestic innovative demand in the form of government orders and public procurement; regulation of the financial sector and employment. In this view, the state acts as the first link in the innovation chain, in which initiatives and understanding of the goals of the innovation movement, the composition of the innovation system, operating conditions, and development vectors at the national, regional and local levels are formed. Most likely, innovation processes and demand for new products are interdependent. Innovations are created based on the needs of the audience, but new developments also create a qualitatively different demand, a different level of production and lifestyle. Thus, semiconductor and microprocessor technologies caused rapid growth and mass adoption of computer technologies; new ways of organizing production have spurred globalization processes.

### **3 Results and Discussions**

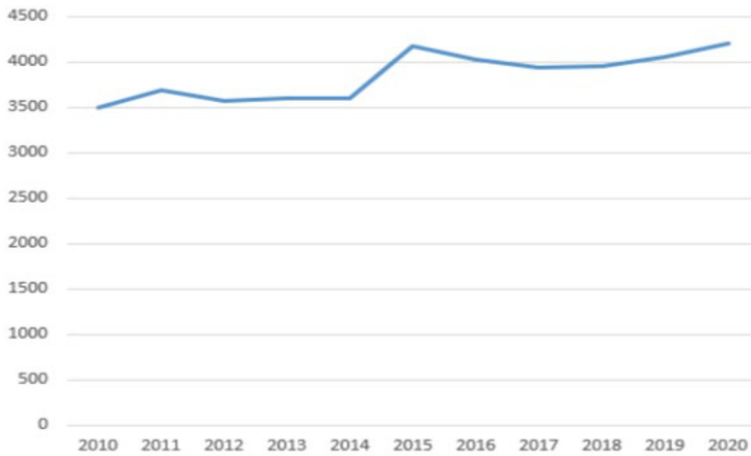
The impact of innovation infrastructure on the economy using the example of Silicon Valley Silicon Valley is an example of the most successful and oldest ongoing project for the development of innovation infrastructure in the world. Moreover, Silicon Valley is one of the largest centers of innovative development in the world, on which a number of major studies have been carried out. The example of the valley shows how innovative infrastructure can influence economic growth at the level of a municipality, state and entire country, and in some ways, the world. Taking into account the fact that economic growth due to the influence of Silicon Valley developments is based on the development and commercialization of innovations, we can say that studying the impact of the Valley on the economy is an example of the influence of innovation infrastructure on the innovation economy. The impact of innovation infrastructure on the economy at the local level has been studied for a considerable time, with consolidated data published already in the early 2000s. Thus, in the work of Elzy Echeverri and Sofia Ayala, three territories of innovative development in the cities of San Jose, Austin and Boston were compared [4]. It has been demonstrated that the significant growth observed since the early 1980s in a number of high-tech areas in Austin is associated with the development of industries supporting activities in Silicon Valley, due to the physical proximity of the Texas city of Austin and California's Silicon Valley. Employment in the innovation sector grew between 1990 and 2000 (in Austin, for example, it grew from approximately forty thousand to more than ninety thousand people). The growth of employment in the high-tech, highly paid sector, which generates a product with significant added value, allows accelerating economic growth and contributes to the economic well-being of the population. In locations where large research universities are located, that is, in regions with a high concentration of qualified specialists and related knowledge, it makes sense to organize high-tech cities (technopolises). Such actions allow the crystallization of a full-fledged innovation infrastructure, streamlining the interaction of existing elements [3]. It should be noted that the impact of centralization of innovative development on the economy is twofold. At the federal and regional levels, they increase the innovation component in the economy, since the efficiency of innovation activity in technopolises is higher. However, at the local level, such localization leads to an imbalance in the development of territories, negatively affecting residents of areas not affected by the transformation, who receive less potential

investment. Using the example of the city of Austin, it was demonstrated that such negative trends can be compensated by dispersing innovation infrastructure throughout the territory, encouraging high-tech firms located in technopolises to establish branches in cities located at some distance from the technopolis. This has a positive effect on regional development by transferring resources to less developed areas, and also provides an opportunity for specialists who do not have enough money to live in a relatively expensive technopolis to still work for the benefit of the companies that are part of it. In addition, Austin is also building knowledge collaborations, i.e. professional training and retraining of personnel in those areas that are typical for the nearby technopolis. As an alternative solution, the example of Route 128, a piece of Boston's innovation infrastructure, illustrates a more self-sustaining model of successful technology industry development, formed by a few large corporations, rather than a network of small organizations, as in San Jose or Austin [4].

Using the example of the United States, it has been demonstrated that at the local level, the development of innovative infrastructure contributes to the growth of the well-being of the population, but, at the same time, can lead to economic imbalances and distortions that can be smoothed out. In the modern structure of the economy, the largest share is occupied by the service sector. It is believed that for the service sector, innovative activity plays the least significant role in comparison with the sphere of industrial production or agriculture. Such argumentation casts doubt on the need for massive development of innovation infrastructure, recommending that such actions be carried out locally, focusing on regions whose specialization includes industry. However, modern empirical data speaks in favor of a different interpretation. In Italy, a study was conducted on the impact of innovative activity on the services market using the database of the Italian enterprise accounting system CIS II [3]. According to its results, innovative activity is one of the factors explaining differences in the economic performance of enterprises. It has been demonstrated that innovative firms are superior to non-innovative ones in such a parameter as the level of productivity; in addition, accelerated economic growth has been identified for them. The economic performance of firms in the service sector depends not only on the fact of innovation activity, but also on the amount of financial resources allocated for innovation, as well as on the type of innovation activity carried out. Investments in ICT showed the greatest economic returns. The authors demonstrated empirical evidence of the growing importance of innovation as a driver of service competitiveness, and as a critical determinant of both labor productivity and economic growth. This suggests that the development of innovation infrastructure is also important for countries with post-industrial economies. That is, the development of innovative infrastructure has a beneficial effect on economic growth at any level of development of the country, thus the limiting factor in the development of innovative infrastructure will not be the level of economic development, but the availability of sufficient resources for its development. The impact of the development of innovation infrastructure on the regional economy is also an interesting topic of research, as was shown in the example of Silicon Valley. The gross regional product per capita of residents of the Silicon Valley technopolis in 2019 was 128 thousand US dollars per year [5]. According to this indicator, the population of the region is one of the first in the world, and taking into account the youth of a large number of residents, these characteristics are almost unique. The highest level of gross domestic product per capita in the world is recorded in the Middle Eastern gas producer - Qatar and amounts to about 128.6 thousand US dollars (as of 2017). Other similar places on the planet in terms of area and per capita income are the Macau Peninsula (US\$115,000 per capita per year) and European Union member Luxembourg (with a gross domestic product of US\$107,000 per year per capita). In addition, the total volume of production of goods and services in Silicon Valley is also extremely high, exceeding that of, for example, a developed country such as Finland [6]. The figure for Silicon Valley was \$275 billion. Such a high level of economic

development in a number of regions (in particular, in the United States, these include certain areas of southwestern Connecticut, Seattle and Boston) leads to a number of problems, such as rising housing costs, inequality and related cultural transformations and clashes. At the national and federal levels, the role of technopolises and other territories for the development of innovative infrastructure can hardly be overestimated. It should be noted that the modern United States, in terms of information, largely relies on the power of its own industry in the field of ICT: the Internet, large enterprises producing electronics such as Apple, using components developed by companies such as Intel, software such as Windows and information services like Google [7]. All these giant enterprises, bringing multi-billion-dollar profits and large revenues to the state budget, allowing the US government to control the information environment on a planetary scale to create a favorable economic climate, appeared and grew in Silicon Valley.

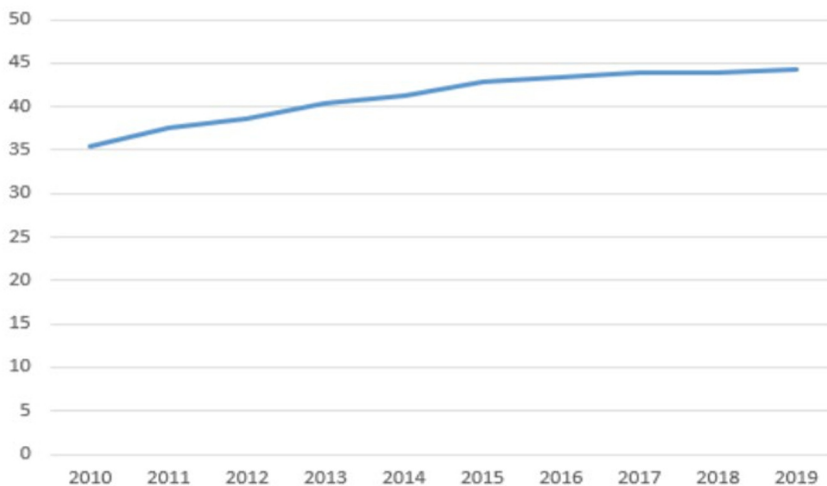
Innovative infrastructure influences the development of an innovation-based economic system in Russia. The development of innovative technology has not such much history, and it is difficult to identify large projects for creating innovations like "Silicon Valley", as well as assess its impact on the development of the country's national budget. The development of innovation infrastructure is still undergoing an analysis, but some indicators for the development of innovation technology are still published by government authorities and are available for analysis. On the electronic portal of the National Information and Analytical Center for Monitoring Innovation Inherent in Scientific and Technical Activities and Regional Innovation Systems, information on innovation is available to the Russian Federation's Science Minister [8]. These indicators are monitored as part of monitoring to achieve the results in the framework of target programs and other strategic documents that take into account the impact of innovative activity on the program under consideration in Russia. The data published by the country's Science and Higher Education Ministry is important and significant for this study. There are three main categories that can be divided into: innovation potential, the support for innovations and the results of activity in development. The indicators were published by the ministry to include: innovation potential, financial support for innovation and the results of innovation activity [2]. A number of indicators are under consideration, the values of them vary in terms of change from year to year. In addition, it should be emphasized that both upward and downward directions of indicators can positively characterize the development of the domestic economy [9]. An indicator "Innovation potential", showing what resources of innovation activity are available in the country, includes information about companies performing scientific research and development; data on the number of institutions performing science-based research and development; as well as data on the number of students in high education institutions per 10,000 population. First graph describing the dynamics of change in number of research and development companies is presented below. The first graph depicts the dynamics of changes in the number of organizations in this field, as well as the dynamics that are occurring in the number of organizations.



**Fig. 1.** Number of organizations performing scientific research research and development (units)

The diagram illustrates the gradual increase in the number of such organizations. In addition, noticeable fluctuations in their number in the period 2014-2016 are clearly visible, which may be due to fluctuations in foreign exchange rates against the backdrop of falling oil prices, as well as the introduction of economic sanctions and counter-sanctions, as well as the implementation of import substitution programs [10].

It can be seen that, in contrast to the total number of organizations in the field of innovation, the total number of workers employed in the field of innovative development is falling. The reasons for the observed phenomenon may be different. On the one hand, the share of workers employed part-time or on the basis of civil contracts, which were not taken into account when collecting data, may have increased. On the other hand, we can talk about an increase in productivity and labor efficiency in the field of innovative developments, which is indirectly confirmed by the graphs presented below.



**Fig. 2.** Share of researchers under the age of 39 in the total number of Russian researchers (percentage)

It can be seen that during the observation period, in the overall structure of employment of Russian researchers, there was a noticeable increase in the share of researchers aged 39

years and younger [11]. It is clear that in the last five-year period the values of the indicator tend to stabilize, which indicates that they have reached the maximum optimal values.

## 4 Conclusions

The development of innovative infrastructure within the industrial sector is a multifaceted and dynamic process that holds immense potential for shaping the future of industries, economies, and societies. Through the exploration of the preceding discussion, we can draw several key conclusions:

**Innovation as a Cornerstone:** Innovation is undeniably the cornerstone of success within the industrial sector. It drives competitiveness, enhances productivity, and empowers industries to address pressing global challenges. As industries increasingly recognize the importance of innovation, investment in innovative infrastructure becomes a strategic imperative.

**Collaboration is Key:** The development of innovative infrastructure is not the sole responsibility of any one entity. It requires collaborative efforts among governments, private sectors, academic institutions, and research organizations. By fostering a culture of collaboration, stakeholders can leverage their respective strengths to create an environment conducive to research and innovation.

**Economic Growth and Sustainability:** Innovative infrastructure has a direct impact on economic growth. By creating high-value jobs, enhancing efficiency, and supporting emerging technologies, it contributes significantly to a nation's prosperity. Moreover, the emphasis on sustainability ensures that growth is achieved without compromising environmental and social well-being.

**Overcoming Challenges:** While the benefits of innovative infrastructure are evident, challenges related to financing, regulatory frameworks, and workforce development must be addressed. Governments and industry leaders must work together to find innovative solutions to these obstacles.

**Global Competitiveness:** In a world characterized by rapid technological advancements and global competition, nations and industries must strive to maintain their competitiveness. The development of innovative infrastructure allows them to stay at the forefront of innovation, ensuring their relevance on the global stage.

**Sustainable Development Goals:** The United Nations' Sustainable Development Goals, particularly those related to innovation, sustainability, and industry, can be advanced through the development of innovative infrastructure. It aligns industry objectives with global efforts to combat climate change, promote responsible consumption, and reduce inequalities.

In conclusion, the development of innovative infrastructure within the industrial sector is not merely an option; it is a strategic necessity. It is a means to foster innovation, drive economic growth, and create a more sustainable and inclusive future. As we move forward, continued investment, collaboration, and adaptability will be essential to harness the full potential of innovative infrastructure and to address the complex challenges of the 21st century. The journey towards the industrial sector of the future begins with innovative infrastructure.

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