Is information openness important for innovation infrastructure?

Research of technoparks in Moscow

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ABSTRACT

The creation and development of innovative infrastructure allows the economic development to be stimulated. A common form of such infrastructure is technology parks (technoparks). In recent years, the largest network of technoparks in the world has been developed in Moscow. Its purpose is to test the hypothesis that there is a relationship between their information openness and the operational performance of their management companies. The results obtained suggest that there is no significant statistical relationship between these indicators. The article proposes measures for increased information openness and transparency of technology parks, which is a current trend in the field of innovation policy in developed countries. In addition, the article discusses the threats and risks for technology parks and local authorities associated with a low level of information openness of the innovation infrastructure.

***Key words*:** Urban Innovations, Innovative infrastructure, Open Innovations, Technology parks, Information openness.

Introduction

Innovation is accepted as a key factor in economic growth. Developed at the end of the twentieth century, the concept of National Innovation Systems (NIS) allowed governments and scholars to take a comprehensive look at such complex phenomena as "innovation" and to identify the objects and subjects of innovation policy (Freeman, 2004). With the development of the concept and practice of state management of innovative development, regional innovation systems began to stand out as independent factors, and regional authorities began to be endowed with appropriate powers. At the same time, studies of the spread of innovations in space have shown that their greatest concentration is a characteristic not so much of regions as of specific "points" (Scherer, 1982; Teece et al., 1994). Cities are considered to be such points (Hall, 1998; Bettencourt et al., 2007), due to the fact that innovative companies, educational and scientific organizations, and innovative infrastructure are located in cities (Harmancioglu and Tellis, 2018).

Such conclusions allowed researchers and practitioners of innovative development management to look for ways to apply them to the theories of urban development, above all, the concept of sustainable development of the city. The result was the idea of knowledge-based urban development, which underlies the concept of a "smart city" that has become widespread in recent decades.

Currently, cities around the world have accumulated quite a lot of experience in implementing innovation policy. Many countries have transferred authority in the field of innovation development from the national to the regional and local level, but this has not always led to goals and objectives being achieved. That is why the focus of much current research is on improving the effectiveness of innovation policy at the local level, as well as studying problems existing in this area. Recently, the theory of organizational capacity has been developed, stating that the ability of local authorities to increase the openness of innovation policy and involve the widest possible range of actors within the city in the processes of creating and implementing innovations will lead to the development of the city in the future (Van den Berg et al., 2018).

A number of authors point to the need to study and take into account the local context before counting on innovations to develop the city. Special attention is paid to the main consumers of innovations – local residents. A population's lack of demand for innovation and its unwillingness to introduce innovations can lead to the failure of innovation policy. In the most trivial form, Rabari and Starper (2015) write about this, pointing to the connection between the well-being of the city and its readiness for innovation. A more comprehensive approach is proposed by Caragliu et al (2019), who proposed their own metric that assesses the readiness of the local community to introduce innovations. This metric evaluates the human and social capital of the city, transport and IT infrastructure. The results obtained by Caragliu in a number of works show that cities with a high index value have the best results in implementing innovation policy. In addition, the chance to implement an active innovation policy is higher in cities which have the necessary characteristics. Other authors using similar metrics came to similar conclusions (Dassin et al, 2018), including the example of Russian cities (Terelyansky and Melnikov, 2016). They importantly confirmed the results (Delatte et al., 2017) that it is the local authorities who are able to effectively overcome the limitations connected with the characteristics of the local community.

Cities that implement innovative policies and have the necessary resources and powers for this, in general, are more developed (Caragliu and Del Bo, 2018) than other cities. Such an effect becomes possible only with the involvement of all stakeholders in the management processes – the local community, innovative businesses, educational and scientific organizations. The principle of public collaboration is becoming an essential element in city management systems (Rudnev, 2012). If this principle is observed in practice, it generally affects the urban governance system, making it more participatory, involving the local community in a wider range of issues and moving toward sustainability of urban development (Bolivar, 2018; Baker and Mehmood, 2015; Morisson and Doussineau, 2019). Thus, the local community becomes not only a consumer of innovations, but also participates in their creation (Batista et al., 2016). This expands opportunities for authorities to create innovative infrastructure such as living laboratories, where residents can independently choose which innovations they would like to test and then disseminate them within the city (Kokareva et al., 2018; Marvin et al., 2018). The inclusion of representatives of the local community on the management bodies of the innovation infrastructure can not only have an economic effect, but also increase the confidence of the population in local authorities (Puerari et al., 2018). This approach is clearly demonstrated for Italian cities (Battaglia, 2014). Thus, further improvement of innovation policy will lead to further development of public sector innovations defined as implementation by a public sector organization of new or significantly improved processes (OECD, 2016).

Innovation infrastructure: technoparks

Innovations are one of the key drivers of economic growth and competitiveness of the economy (Solow, 1956; Romer, 1986). At present, not national, but regional and local politicians are beginning to play an increasingly important role in innovative development. First of all, they are aimed at realizing the existing innovative potential of the regions and cities, its companies, universities, scientific organizations, communities and people (Tyurchev, 2021).

The innovation infrastructure arose as a result of the need to ensure localization of firms. The key creator of innovation, introducing it into the economy, is business (Drucker, 1998). Subsequent research has shown that the close proximity of innovative companies increases their combined economic and social impact. The authors often talk about the presence of the so-called cluster effect (Porter, 1998). Well-known global clusters are Silicon Valley in the USA, Catalan clusters in Spain, Automotive clusters in Germany. The innovation infrastructure works in a similar way. Moreover, many innovation zones appear around technoparks. An example is the same Silicon Valley, which appeared on the basis of the Stanford Research Park (Adams, 2005).

Technoparks are one of the most common types of innovation infrastructure in the world (Rios-Martinez, 2019). The main purpose of this infrastructure is the joint localization of companies to reduce the costs of their interaction, as well as providing them with additional services. In different countries, this type of infrastructure can be called differently: technology parks, science parks, innovation parks, science and technology parks, etc. However, their essence remains the same - attracting innovative business to a specific zone and receiving benefits from this from the effect of joint localization. UNESCO in its reports emphasizes the growing role and popularity of this type of innovative infrastructure in the world. If earlier most of the technology parks were located in the United States, now a large number of facilities have appeared in developing countries, primarily in Asia. Currently, China has already surpassed the United States in the number of technoparks. In the 2000s alone, more technoparks were created than in the period from the 1950s to the 2000s (UNESCO, 2019).

In the case of innovative companies, there are additional effects associated with the flow of knowledge, competencies and skills from related activities (Yang, Motohashi, and Chen, 2009; Link and Scott, 2003). This allows companies to create new products and services, including within the framework of joint projects. In addition, firms can compete for the workforce they need to create their products and services. Therefore, the opportunity to find the necessary competencies in the labor market within the framework of the technopark also encourages firms to be located in the areas of technoparks.

An effectively functioning technopark, whose residents are technology companies, can become a noticeable point of economic growth (Hu, 2007). In this regard, publications related to the evaluation of the effectiveness of technoparks have been developed. To encourage companies to move to the technopark various tax benefits are used, for example, a reduction in property tax, income tax, etc. Besides that, technoparks provide their residents with additional services on the basis of engineering centers, prototyping and certification centers, coworking spaces, business incubators.

Since technoparks compete with each other for attracting companies to their areas, the openness of information about the technopark itself, its preferences and benefits can become a

serious competitive advantage. The study of the experience of successful clusters and technoparks confirms this thesis (Lee and Kin, 2018; Higher School of Economics, 2019). The existing Russian ratings of the effectiveness of technoparks in their assessment also suggest taking into account the information openness of technoparks (Association of Clusters and Technology Parks of Russia, 2020). The UNESCO report says the same, according to which management companies of technoparks often lack the competencies to build a competent policy of openness, without which the development of innovations is impossible. As a result, many technoparks in the world are declining and do not bring the expected benefits to the economy (UNESCO, 2019).

Increasing the information openness of technoparks not only about themselves, but also about their residents also fits into the logic of the open innovation concept. Information about the existing collaborative infrastructure (coworking, live laboratories, joint projects, etc.) will increase the likelihood of attracting companies and improve the results of their activities (Han et al., 2012).

At the same time, the importance of information openness for innovation infrastructure remains the subject of separate case studies; there are no quantitative measurements on this topic. So, the knowledge about such a connection between the information openness of the innovation infrastructure and its operational results remains very limited. In this regard, the paper hypothesizes that a higher information openness of technoparks corresponds to a greater operational efficiency of their resident companies, expressed in revenue and number of employees. Obtaining evidence on the impact of the information openness of the innovation infrastructure on the activities of resident companies is also important for city managers, who will be able to fine-tune the requirements for technology parks applying for state support.

Technoparks of Moscow

Technoparks as a tool for stimulating the development of high-tech sectors of the economy first came into the focus of state policy in 2006, which resulted in the program "Creation of Technoparks in the field of high technologies in the Russian Federation", adopted by the Decree of the Government of the Russian Federation No. 328-R of 10.03.2006.

The current regulatory legal act regulating the activities of technoparks in Moscow is the Decree of the Moscow Government dated 11.02.2016 No. 38 "On measures to implement the industrial and investment policy of the City of Moscow". According to the document, the technopark is a land plot with capital construction facilities, engineering and transport infrastructure located on it, which has an official status fixed by a separate regulatory legal act and provides preferential conditions for conducting scientific, technological, industrial and innovative activities. A technopark resident is a legal entity or an individual entrepreneur - a tenant of space, whose main activity is research and development, ICT or manufacturing. The status of a technopark is assigned for 10 years, but requires an annual mandatory confirmation.

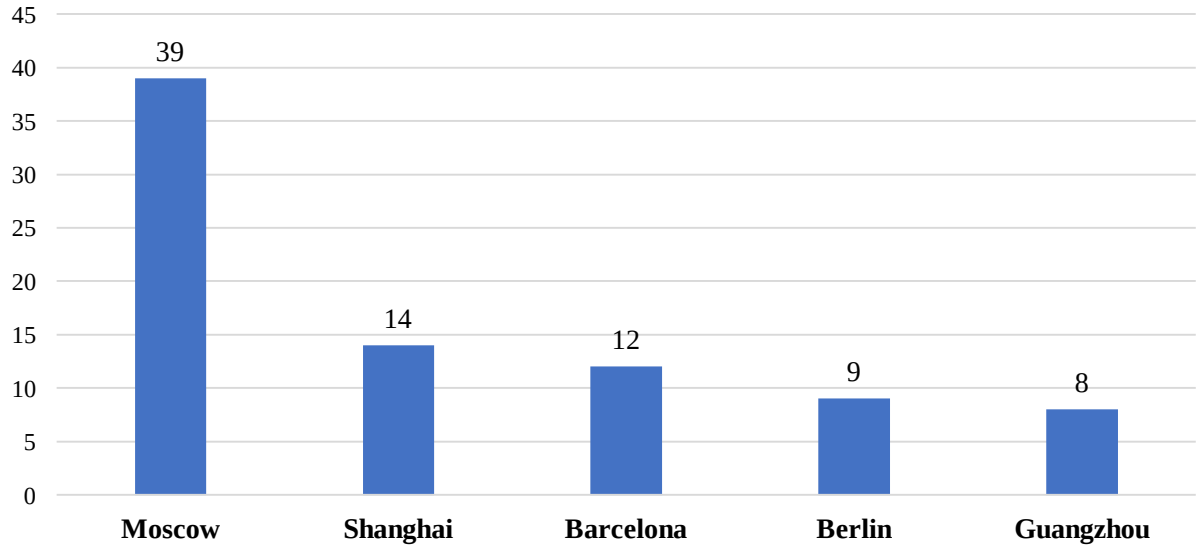
Moscow is one of the world leaders in the number of technoparks (Higher School of Economics, 2020). As of 2020, there were 36 technoparks located within the city, and the nearest pursuer, Shanghai, has more than half as many (Figure 1).

In the 21st century Moscow faced the question of the future of industrial zones. Many of them stopped functioning and over time they began to turn into storage areas and landfills.

This entire "rust belt" occupied an area of 18.8 thousand hectares, or about 17% of Moscow's land base. Since 2011, the city authorities have been implementing projects to revitalize these zones.

In order to attract new companies, the city authorities decided to support the creation of a network of technology parks, whose residents can only be organizations of certain types of activities related primarily to the production of electronics and microelectronics, instrumentation, IT, energy, optics, medicine and pharmaceuticals, and biotechnologies. Tax benefits (for profit, property and land taxes) and lower rental payment rates were established for all residents of technoparks. In addition, a range of support measures was developed for residents of technoparks – compensation of companies' costs for leasing foreign and domestic equipment, compensation of expenses for patenting and certification of goods when entering foreign markets. The best indicator of the demand for services and infrastructure of technoparks is the average occupancy of space, which averages 96.5%. Specialized infrastructure has been created in technology parks - nanotechnology centers, centers for youth creativity, coworking spaces, congress halls, prototyping centers, exhibition halls.

Figure 1: Top 5 cities in the world by the number of technology parks, 2020



Source: Rating of Innovative Attractiveness of World Cities (Higher School of Economics, 2020).

Currently, the project to create technoparks in the city continues to develop. As of 2021, there are 39 technoparks in Moscow with a total area of more than 2 million m^2, of which residents are about 1,500 companies that create more than 50 thousand vacancies for the city. Such development became possible thanks to the joint efforts of federal and regional executive authorities (Plieva, 2017). In addition, the city is implementing a project to create creative parks. A number of researchers also refer to creative industries as innovative, in connection with which it can be stated that the Moscow authorities are aimed at expanding support for various types of innovative activities in the city. A large number of technoparks operating in one city allows us to quantify the relationship between their effectiveness and information openness.

Data and Methodology

Moscow Technoparks

As of the end of 2021, 39 technoparks operated in Moscow, receiving state support in the form of benefits and subsidies. Every year, technoparks are re-accredited, providing the authorized body with information about their operating performance.

In recent years, many studies have been conducted to assess the level of information openness of certain objects: companies, authorities, etc. (da Cruz et al., 2016; Ardron, 2018; Knizhnikov, 2021). One of the most common methods is the analysis of official websites based on specially designed checklists.

To assess the level of openness of Moscow technoparks, the method of evaluating the websites of public authorities of Brown University adapted for the purposes of the work was used (Table 1). This checklist has been supplemented with specific parameters that reflect information about the services and activities of technoparks. According to each of the criteria, the sites of technoparks were rated from 0 to 4 points and then the results were summed (Table 2).

Table 1: Criteria for assessing the level of information openness of technoparks' websites

№	Parameter
1	• Information about contacts • Addresses of offices and centres • News • Links to residents' websites • The presence of links to accounts in other social networks
2	Information about the infrastructure and activities of the technopark
3	Resident's personal account
4	The possibility of online submission of applications for rent, for becoming an investor and a resident, for holding events, for work and internship
6	Subscription to publications
7	Countering corruption (presence of a commission)
8	Privacy Policy
9	Use of "cookies" files
10	Measures to simplify the use of the site by people with disabilities
11	Translation of the website into foreign languages (English)
12	The presence of a search button for the necessary information
13	Ask a question button
14	Availability of an interactive map with information about the units of the technopark
15	Availability of documentation, activity reportsg
16	Availability of information about prices for services
17	Availability of information about benefits for residents
18	Availability of information about career guidance programs

***Source**:* compiled by Author on the basis of West (2008).

Table 2: Distribution of openness points and average revenue of management companies of technoparks in Moscow

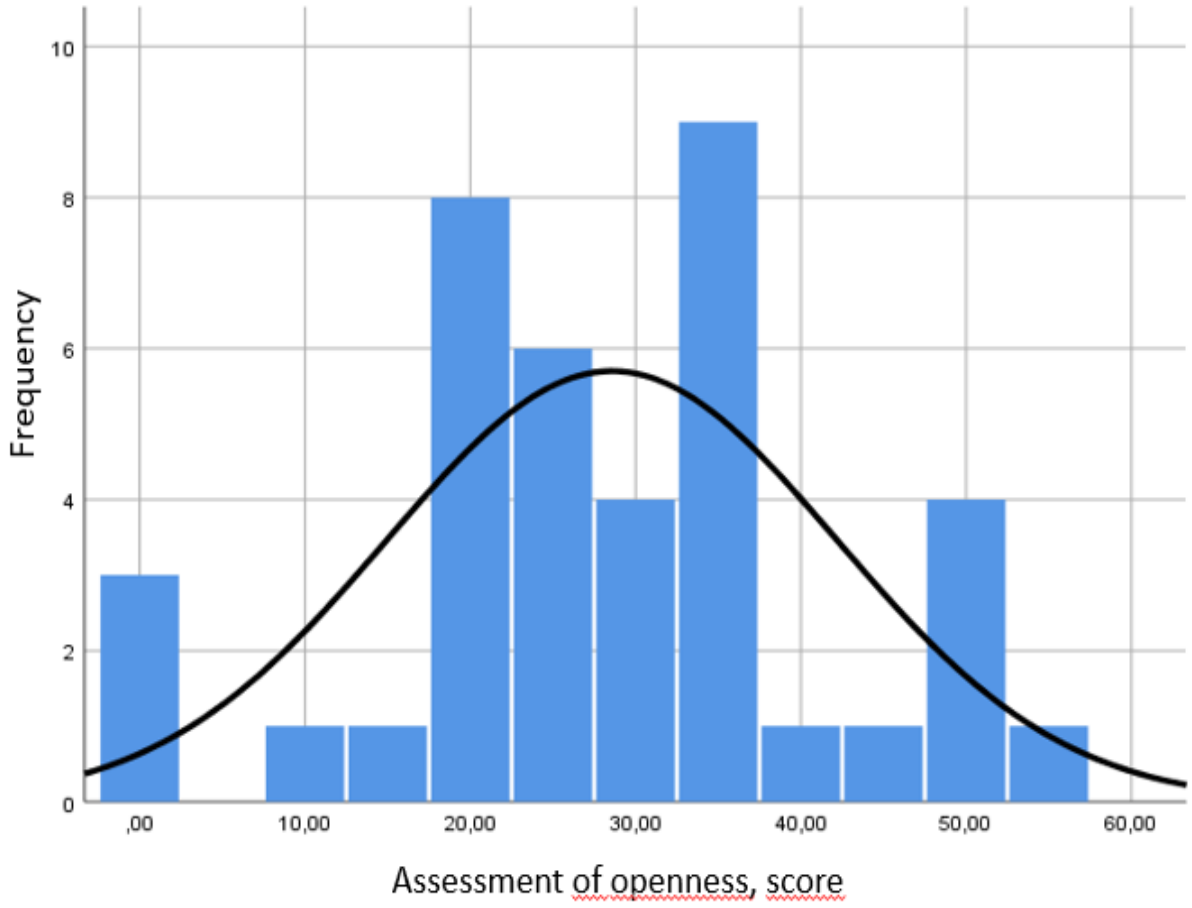
№	Technopark	Openness points
1	Eleron	36
2	Russian Space Systems	22
3	Precision radio laser systems	12
4	Agat	27
5	Scientific Research Institute of Precision Instruments	25
6	NIKIET	25
7	NIISSU	34
8	Pulsar	34
9	Poluys	36
10	Radiofizika	36
11	Vodny Stadion	50
12	Svyaz engineering	30
13	Module	25
14	Photonika	18
15	CNIITMASH	48
16	ELMA	32
17	Technopolis "Moscow"	56
18	ITELMA	18
19	Kalibr	47
20	Otradnoe	19
21	VTI	38
22	Skolkovo	51
23	Gorizont	No website
24	High-tech Innovation Center RIKOR	15
25	Soyuzmultfilm	19
26	Slava	52
27	Temp	No website
28	Sapfir	No website
29	Mosgormash	33
30	Tecon	18
31	MSU Science Park	36
32	MZTA	22
33	Strogino	33
34	Nagatino	33
35	Technospark	26
36	Phystechpark	32
37	TISNCM	22
38	Krasnoselsky	31
39	Kurchatov Institute	23

***Source*:** compiled by the author.

The results obtained demonstrate a high level of differentiation of technoparks in terms of their openness. A number of Moscow technoparks ("Horizon", "Temp" and "Sapphire") do not have their own websites, and therefore their assessment was not carried out. The frequency distribution of openness ratings is shown in Figure 2. It is worth noting that this distribution is close to normal, which allows you to use standard tools of econometric analysis.

It is important to note that there are three types of technoparks in Moscow according to the form of ownership: private, state and mixed (for example, when the founders of the technopark are a state research institute and private companies). In general, these three forms are evenly distributed throughout the technopark: 12 technoparks are state-owned, 12 are mixed, and another 15 are private. However, in terms of the number of residents, private technoparks are clearly in the lead (872 companies), while state-owned and mixed companies account for 281 and 319 companies, respectively. This is due to the fact that often state and mixed technology parks are created for one or more residents in order to receive appropriate benefits. For example, the state technoparks Krasnoselsky, Soyuzmultfilm, Eleromn, NIKIET, Pulsar and AGAT have from 1 to 8 residents. Almost half of the mixed technoparks (Radiophysics, NIISSU, Research Institute of Precision Instruments, Russian Space Systems, Precision Radiolaser Systems) have from 3 to 10 residents.

Figure 2: Frequency distribution of estimates of the openness of Moscow technoparks



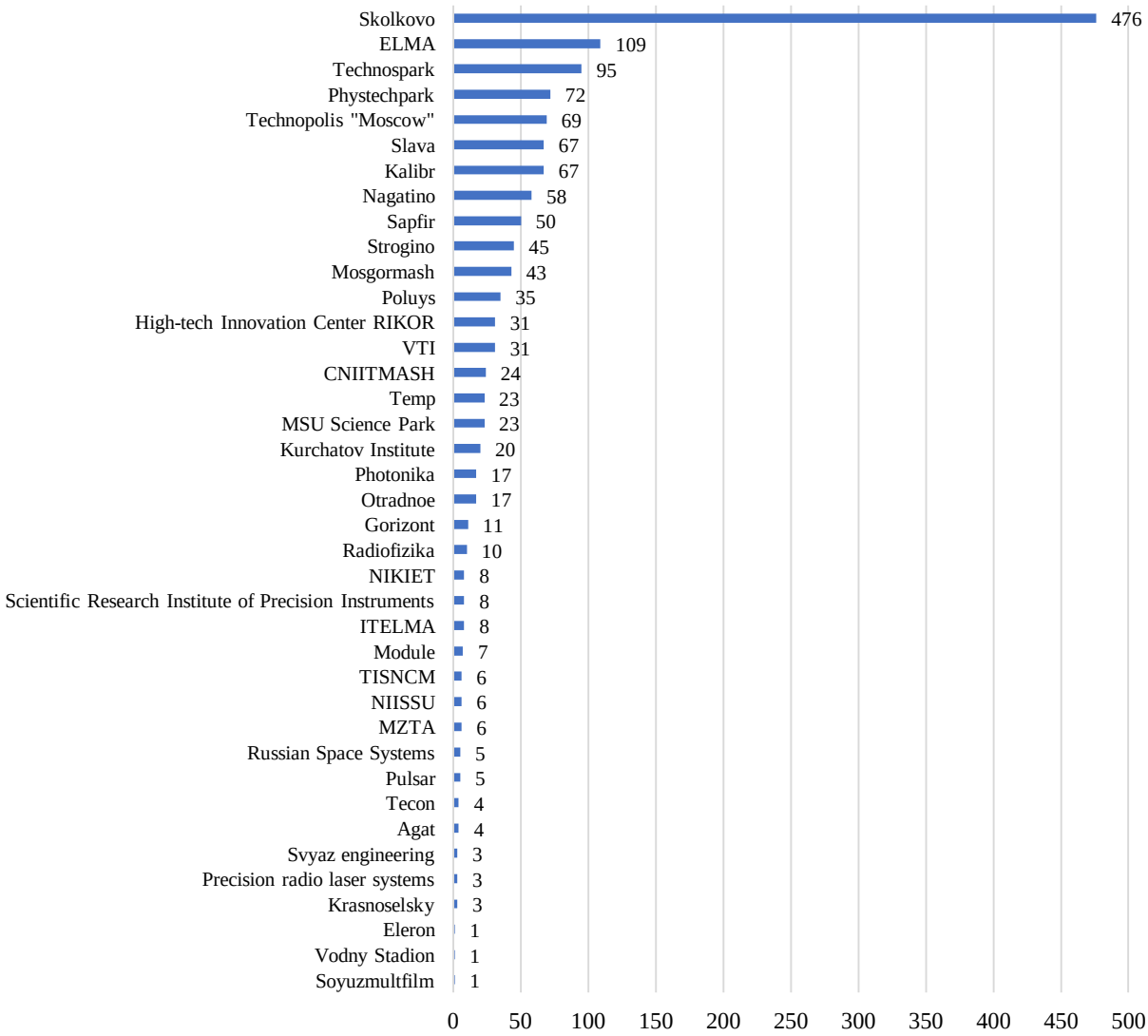
Note: the figure additionally shows the normal distribution curve.
Source: compiled by the author.

Residents of Moscow technoparks

As part of a study of the impact of the openness of Moscow technoparks on the operating results of their resident companies (revenue and number of employees), at the first stage, using the iMoscow service, a list of resident companies of Moscow technoparks was formed. Thus, 1473 companies were included in the study sample. The distribution of resident companies by technoparks is shown in Figure 3.

Based on the tax reporting data presented in the SPARK-Interfax system, data were obtained on the number of employees and revenue of resident companies of Moscow technology parks in the period from 2017 to 2021. Additionally, data was collected on the types of activities of organizations, which showed the prevalence of activities related to innovation (Figure 4).

Figure 3: Number of resident companies of Moscow technoparks, 2021



***Source**:* Compiled by the author based on iMoscow data.

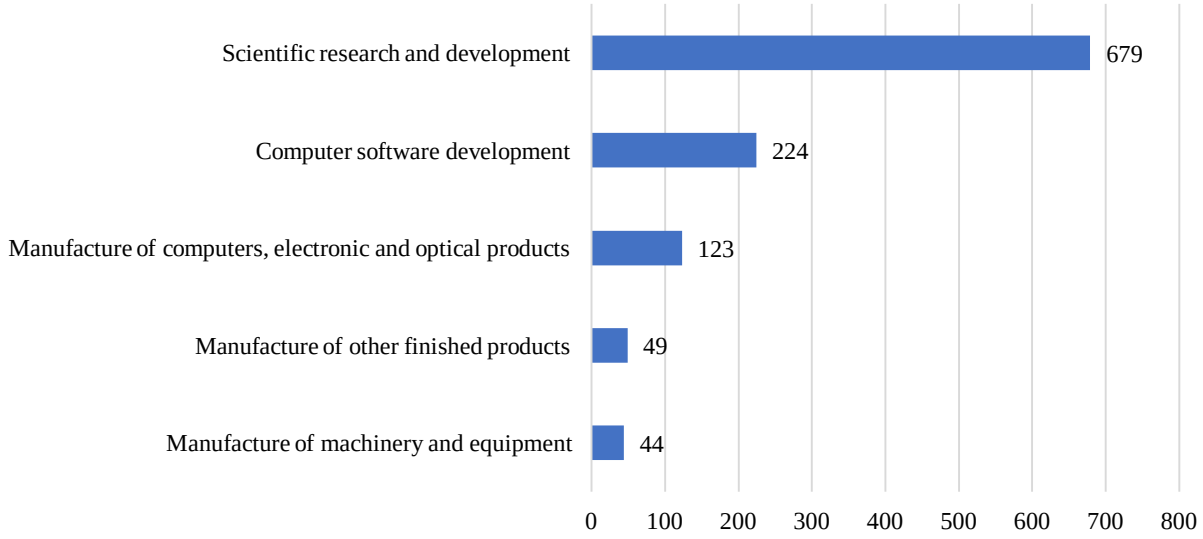
In total, the top 5 activities cover 76% of all technopark residents, and the most popular activity was Scientific research and development (679 companies). The average values of employment and revenues of residents in Moscow technoparks show growth in the period 2017-2021, despite external shocks such as the COVID-19 pandemic (Table 3).

Statistical analysis

Before starting the analysis, data on resident companies were aggregated at the level of their technoparks and average revenue and number of employees of their residents in the period from 2017 to 2021 were calculated.

To test the hypothesis about the impact of information openness on the operational performance of technopark resident companies, an ordinary least square regression (OLS) was used. Two models were built, in which the average employment of technopark residents and their revenues were used as dependent variables. As a control variable, we used the "size" of the technopark in the form of the number of its residents. The analysis additionally considered the form of ownership of the technopark (state, mixed or private). The results are presented in tables 4 and 5.

Figure 4: Top 5 economic activities of residents of Moscow technoparks, 2021



Source: Compiled by the author based on SPARK-Interfax data.

Table 3: Descriptive statistics of the main operating indicators of residents of Moscow technoparks, 2017-2021

Indicator	Units	N	Min	Max	Mean	Dispersion
Employment, 2017	people	1473	1	945	25,25	4493,506
Employment, 2018	people	1473	1	911	26,61	4812,061
Employment, 2019	people	1473	1	2208	31,61	10094,585
Employment, 2020	people	1473	1	985	31,48	6543,176
Employment, 2021	people	1473	1	1395	32,94	7192,226
Revenue, 2017	rubles	1473	8000	19 723 125 000	321890916,48	2139609423001373440,000
Revenue, 2018	rubles	1473	2000	23 536 109 000	350784625,73	2520237368026330100,000
Revenue, 2019	rubles	1473	11000	34 106 765 000	277319610,41	2159006352683747580,000
Revenue, 2020	rubles	1473	1000	32 499 855 000	303747291,29	2543367606575731200,000
Revenue, 2021	rubles	1473	6000	35 432 270 000	340678997,11	2897374321946260000,000

Source: Compiled by the author based on SPARK-Interfax data.

The results show that, in general, for all technoparks, information openness is insignificant when it comes to the number of employees and revenue. At the same time, But it can be noted that information openness plays a completely different role at different forms of ownership.

If we are talking about revenue, the significance of openness assessment is higher for private technoparks than for state or mixed technoparks. From the point of view of employment, the situation is reversed - information openness is more important for state and mixed technology parks than for private parks. At the same time, models in which the dependent variable is the number of employees are of higher quality (according to the P-square test) than models related to revenue.

Table 4: Results of the OLS analysis. Dependent variable: employment (people)

	All		**Government**		**Mixed**		**Private**	
	B	**sign.**	**B**	**sign.**	**B**	**sign.**	**B**	**sign.**
Openness score	-1,949	,804	17,740	,082	11,340	,079	-18,357	,372
Number of residents	17,989	,000	15,165	,003	8,513	,047	18,718	,000
Constant	270,071	,252	-453,192	,127	111,636	,538	848,369	,144
N	39		12		12		15	
R-squared	0,843		0,827		0,576		0,867	
Adj. R-squared	0,834		0,788		0,482		0,845	

Source: Compiled by the author

Table 5: Results of the OLS analysis. Dependent variable: revenue (bln rub.)

	All		**Government**		**Mixed**		**Private**	
	B	**sign.**	**B**	**sign.**	**B**	**sign.**	**B**	**sign.**
Openness score	21,113	,676	187,225	,265	20,522	,809	34,366	,041
Number of residents	-11,897	,187	-143,206	,060	-126,496	,041	-2,988	,116
Constant	2224,661	,144	183,007	,970	6549,694	,028	16,598	,969
N	39		12		12		15	
R-squared	0,048		0,340		0,392		0,310	
Adj. R-squared	-0,005		0,193		0,257		0,205	

Source: Compiled by the author

Results

The results obtained did not confirm the hypothesis of the study that there is a connection between the information openness of Moscow technoparks and the results of the operational activities of their residents. This goes against a large number of qualitative studies, in which information openness is one of the attributes of leading technoparks. However, the very fact of the appearance of such a case indicates a certain level of information openness of

the object under study, in our case, a technopark. At the same time, an additional analysis that considers the forms of ownership of technoparks shows that depending on the type of technopark (state, mixed, private), these results may differ.

This result reflects the specifics of the Moscow network of technoparks – some of them are located in the areas of companies that are part of the contours of state corporations (for example, Aileron and NIKIET are part of Rosatom) or other state organizations. The status of the technopark allows them to attract primarily their contractors or subsidiaries to their areas in order to receive appropriate benefits.

Technoparks that are not associated with any large company are forced to compete with each other to attract better residents. In many respects, this explains that for private technoparks, the quality of the company (the amount of revenue) is important, and not its size (the number of employees). Thus, private technoparks are interested in attracting to their areas as many companies as possible with good revenues and less employment so that they do not take up much space.

On the contrary, for state and mixed technology parks, whose residents are mainly the same state-owned companies and their closest counterparties, it is important to maintain and increase employment as the most important factor in social stability in the country.

That's why technoparks associated with large companies (regardless of whether it is a private company or a state-owned one) are able to attract counterparties or subsidiaries of their parent organization as residents, i.e. there is no need for them to be open to information. Moreover, such information secrecy can be a protective mechanism for them against possible attempts to start competition for residents with them.

Conclusion

The results obtained logically fit into the theory of the fragility of systems. Open systems do not always demonstrate higher efficiency than closed ones (Baranov, 2008). However, for the long-term effectiveness of the system, it is necessary to "meet a certain set of requirements", the absence of even one element (in our case, openness) threatens the long-term functioning of the system (Leskov, 1996). That is why, in order to assess such a non-linear process as innovative development, the authorities need to develop and conduct assessments of the systems they manage on a regular basis. At the same time, it is important to consider both current quantitative indicators of activity (the number of residents, the revenue of the management company, etc.) and qualitative ones (information openness, the quality of services provided, etc.).

At the same time, systems are able to evolve and move from one state to another. This means that even the currently closed information technology parks, under certain circumstances (loss of communication with a large parent company, for example, as a result of its liquidation), will be forced to start competing with other technology parks to attract residents in order to continue functioning. One of the tools in this case will be information openness, reflecting willingness to attract new residents on transparent terms.

These results indicate the importance of the openness of the innovation infrastructure. Technoparks in a competitive environment will have to increase their openness to attract

innovative businesses. In turn, technoparks that operate at the expense of the state budget and attract state-owned companies receive only temporary competitive advantages. The state, as the creator of the innovative infrastructure, is interested in the long-term nature of its projects and must show long-term efficiency and real economic effect. In this regard, an urgent recommendation may be a comprehensive assessment of the activities of technoparks – not only associated with the results of their operational activities (output), but also with the short and long-term impact on the economy of the city (outcome), including their information openness.

A number of conclusions can also be drawn for public authorities, since almost half of Moscow's technoparks (24 out of 39) are state or mixed ownership. If it is in the interests of the state to increase the economic effect of the activities of its technoparks, then they, like private ones, will be focused on attracting high-performing residents, but this will require higher information openness.

The modern trend towards the creation of innovative infrastructure implies not only project information openness but also involvement of the widest possible range of stakeholders, especially local communities (US Economic Development Administration, 2021). Involvement of the local population can both increase the utility of projects for society and increase trust in local authorities and government institutions. The data used also cannot be called biased due to ongoing events, as it is limited to 2021. On the contrary, as sanctions are imposed on state-linked companies, an interesting further development of the work will be to answer the question of whether state-owned and mixed technology parks will become more open in order to compete for successful companies with private technology parks.

Limitations

Despite the fact that this article was prepared in the context of Russia's isolation from international partnerships and sanctions, this does not devalue its results. The main residents of the innovation infrastructure are national companies, not international ones, and Russia is no exception in this regard. Therefore, the information openness of the innovation infrastructure is aimed primarily at internal users, and not external ones.

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