
**INDUSTRIES AND INTERINDUSTRY
COMPLEXES**

Innovations as a Factor in the Development of the Natural Resources Sector

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Abstract—The article discusses the effects of resource wealth on the economic development of individual countries. It describes modern behavioural strategies used by mining companies, including those taken in response to the emergence of new technologies. It contains an analysis of the main lines of development in the natural resources sector under current conditions. It also discusses opportunities for collaboration between companies operating in the natural resources sectors of Russia and the UK, focusing on those based on digitalization as well as the use of technological and financial innovations.

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Introduction. The natural resources sector has always been a very important element in the global economy. Revenues within this sector continue to play a key role in such areas as investment, production, and finance in resource-rich countries.

Today, however, the goals for the natural resources sector are changing due to the influence of several trends, among which are resource and energy conservation, the need to solve environmental and social problems, and efforts to increase economic efficiency. It is therefore important to understand how and to what extent investments in the extraction of mineral resources influence GDP growth, and also how to evaluate the impact of natural resources on economic growth taking into account the institutional characteristics of different national economies.

At the same time, it should be kept in mind that in developing economies companies which are most advanced financially and institutionally and able to use the latest business practices are those which operate in the natural resources sector. This makes it possible to use their potential in order to achieve such important goals as:

- establishment of multipurpose export-oriented holdings which will control value-added chains with the aim of expanding the volume and range of products;
- creation of channels for the large-scale transfer of the latest technologies and business culture practices to countries with developing economies.

As the current situation in the world economy as a whole and in the natural resources sector in particular is unstable, fostering international economic collaboration is of particular importance. It reduces the negative impact of economic and political uncertainty in

the world on the development of individual countries and reduces the likelihood of different kinds of conflicts. International collaboration in the natural resources sector means implementing various innovations and digital technologies as well as using ecologically-friendly industrial practices, which helps to reduce tensions and find mutually beneficial solutions even in such difficult situations as the one which has developed in recent years in relations between Russia and the UK.

Literature review. It has long been discussed how the natural resources sector influences economic and institutional processes in different countries. The points of view expressed by various researchers differ from each other quite significantly.

A number of researchers claim that there is a particular paradox associated with the natural resources sector. On the one hand, if an economy is based on natural resources, it impedes the development of high-tech industries in the country. On the other hand, mining operations create a demand for the latest technologies and are in many cases knowledge-intensive.

According to S. Doroshenko and A. Shelomentsev, today's science is trying to reconsider the role of natural resources which has long been seen in black or white: either as a blessing for the economy or as a "resource curse" [1]. At the same time, despite the large number of publications on the subject emphasising such weaknesses of resource-based economies as fluctuations in revenues due to changes in prices on global markets, low diversification levels, significant social stratification, corruption, etc., there has been no conclusive proof that being a resource-based country will inevitably lead to being a backward country.

At present, science has less radical views on the link between economic growth and the availability of natural resources. Attempts are being made to describe the complex influence of the natural resource factor on the economy, including its influence on the development of institutions [2]. Noteworthy in this respect are the works by V. Polterovich, V. Popov, and A. Tonis, as well as P. Collier, who suppose that resource wealth can degrade the quality of institutions if the development level of these institutions is below a certain “indifference” threshold [3, 4].

When analyzing competitive positions in international markets, a resource-based approach which stems from the classical theory proposed by A. Smith and D. Ricardo is often used. This approach looks at how countries differ in terms of factors of production available to them.

Meanwhile, many elements of the resource-based approach are debatable. In particular, a well-known model proposed by E. Heckscher and B. Ohlin, which assesses trade flows taking into account only factors of production available to countries, is often criticized. Among the disadvantages of this model is the fact that it does not take into account the impact of trade barriers and technological differences between countries, which are very important in today’s world.

The classical disproof of the Heckscher-Ohlin model is Leontief’s paradox, which demonstrates that international competitiveness and the structure of global trade flows cannot be determined only by differences in resource endowment. This paradox was confirmed by J. Hartigan [5] using an example of industries which depend on capital-intensive raw materials.

A number of researchers develop these ideas and suggest that not only resource endowment, but also intangible assets should be taken into account. These assets let high-tech industries create competitive advantages of a more complex nature [6, 7].

M. Porter also criticises one-sided models which highlight only particular advantages. He proposes an idea that long-term competitive advantages based on innovation should also be taken into account. In contrast to Heckscher and Ohlin, Porter emphasizes the role of so-called advanced factors which are based on knowledge and can improve competitiveness. Taking mineral exploration and extraction as an example, the interaction between tangible (fixed) and intangible assets (licenses, technology, etc.) enables the natural resources sector to reach a high level of economic efficiency.

It can thus be concluded that a truly competitive resource-based economy should rely on high-tech solutions which make it possible to use resources efficiently.

What we see in the world today contradicts the opinion that only developing countries are involved in large-scale mining. For example, P. Kaznacheev

describes the experience of countries which export natural resources and have also managed to achieve high levels of economic growth and the Human Development Index (Australia, Canada, Malaysia, Norway, and Chile) [8].

It should be noted that it is difficult to take into account the impact of intangible assets on production and financial results. However, a number of researchers have made progress in this area [9–12].

As can be seen from the above, today it is necessary to analyze the role of the natural resources sector in terms of its possible contribution to improving the competitiveness of national economies. This analysis should cover such issues as increasing added value through the use of advanced processing techniques, a growing demand for and a wider use of innovations among resource companies, ways to increase production performance in the mining sector, as well as ways to reduce environmental damage from its activities.

Behavioural strategies for mining companies. In 2017, there was an increase in global prices for resources, which improved the performance of natural resources sectors in most countries. According to PwC, the revenues of the world’s top 40 mining companies grew by 23% [13]. Another factor which boosted revenue growth was the use of new corporate strategies aimed at increasing free cash flows and the current rate of return, allocating capital more effectively, restructuring low-margin assets, and optimizing production chains.

The block diagram below (Fig. 1) shows the main methods and tools that have recently been used by mining companies in order to solve short-term and long-term development issues.

Among tools which help mining companies to increase their current financial sustainability are the minimization of project costs and sales of low-margin assets. The main tools which contribute to the sustainable development of these companies are activities aimed at setting the stage for long-term business growth (such as an increase in mineral reserves and the introduction of innovations into production) as well as search for alternative financing mechanisms combined with an increase in reporting quality and the introduction of technologies which give boosts to market confidence.

In recent years, while trying to increase its investment appeal, the mining sector has been giving priority to *short-term goals*, such as reducing costs and increasing the profitability of existing assets. In a number of cases, mining companies even decided to sell their low-margin assets and reduce capital expenditure on exploration.

In 2014, exploration expenditure among the world’s top 40 mining companies decreased by 53%, with another decrease by 24% in 2015 and one more decrease by 21% in 2016, dropping to 7.2 USD billion,

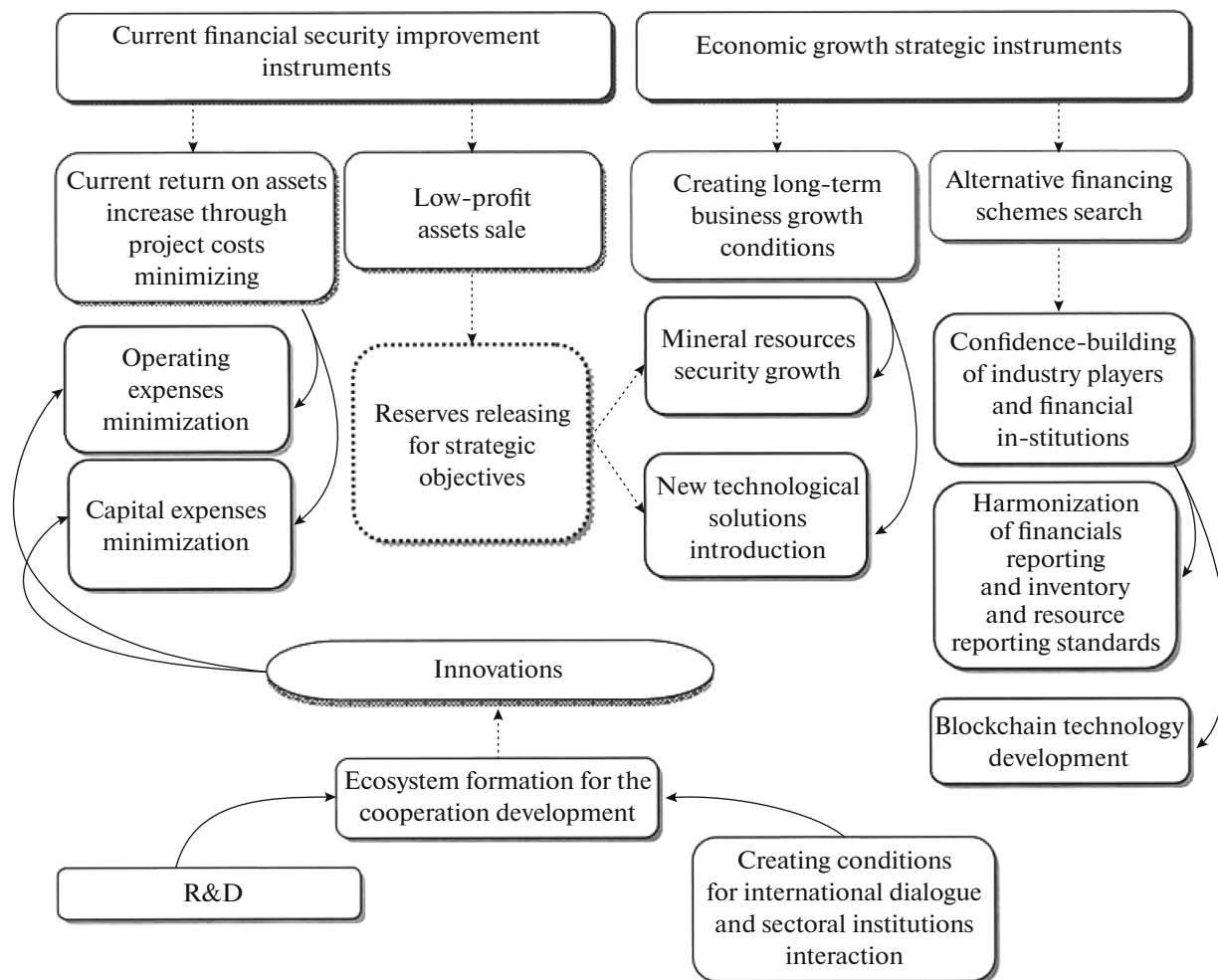


Fig. 1. Main tools for raising funds necessary for the current and future activities of mining companies.

which accounted for approximately one-third of the figure in 2012 [14].

It cannot be unequivocally asserted that such decisions were strategically erroneous because part of the funds released can be directed to the creation and acquisition of assets which are more cost-effective and contribute to the long-term development of companies. However, the approach in which a company focuses on a small number of “reliable” projects that are already being developed and refuses to take part in projects that are at phase zero (and, as a result, riskier) may adversely affect the situation with resource reserves in the leading mining companies in the near future and cast doubt on the prospects of their long-term development.

A significant reduction in capital expenditure aimed at improving the current financial situation negatively influences companies’ resource reserves, which has become a problem for the entire natural resources sector (Figs. 2 and 3) [15, 16].

Among the risks that the world’s top mining companies have faced in the last 3 to 5 years are the following:

- the risk of spontaneous acquisitions of low-quality mining assets when prices for natural resources are high;
- the risk of shifting attention from the growth of production profitability to economies of scale;
- the risk of imbalance between short-term and strategic goals (not least because of investor pressure).

Moreover, analysts at the Ernst and Young analytical agency considered limited access to capital to be one of the key risks for mining companies in the period from 2015 to 2017 [17].

If there are very high risks involved, potential investors who look for risk premiums usually refrain from taking part in such projects. According to E&Y analysts, mining companies which seek to provide investors with additional income resort to such alternative sources of finance as streaming agreements, royalty agreements, the issue of high-yield bonds, pro-

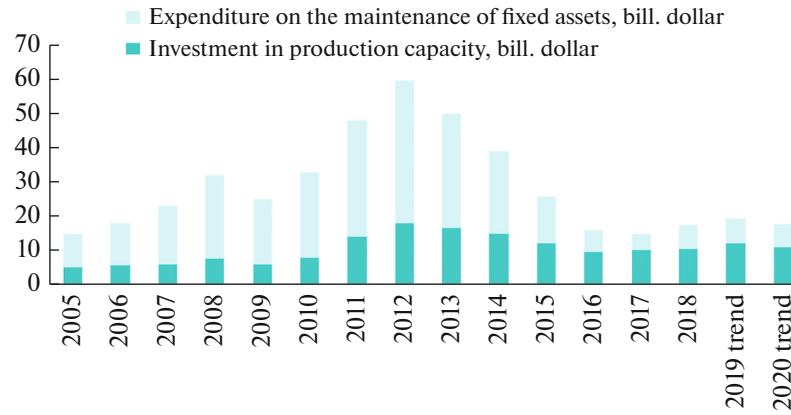


Fig. 2. Capital expenditure in the mining sector.

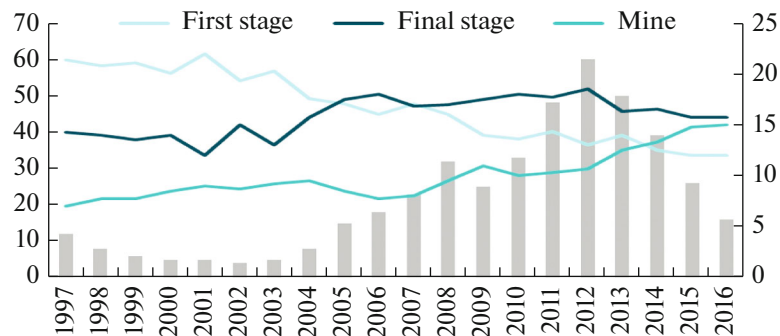


Fig. 3. Global exploration costs at different mine development stages.

duction sharing agreements, and selling company shares in exchange for funding [18].

All the sources of finance mentioned above are associated with high risks. They are quite expensive for companies and, in addition, they can result in diluted profits, loss of rights to a mineral deposit, and limitations on attracting other sources of finance. However, today many mining companies are in a difficult financial situation, which forces them to use such sources of finance along with other ones.

If events continue to develop as they have, the main factors affecting the activities of mining companies in the next decade will be the lack of high-margin assets and more demanding shareholders' requirements concerning profitability. All this will be happening against the background of a decrease in the supply of high-grade ores.

Operating in such a complex capital market environment, mining companies need investors who are ready to invest in the long term. In order to find and attract such investors, companies need to develop high-quality risk minimization, profitability maximization, and asset appreciation plans. To do this, it is necessary to start by improving production performance.

The circumstances described above seem to be calling for a revision of the behavioural strategies used by mining companies. On the one hand, the desire to reduce operating costs by all means possible and to get rid of low-margin assets should be looked upon more critically. On the other hand, it is necessary to *introduce new technological solutions* on a larger scale, using investments in innovations and digital technology, human resources of the future, and the development of ecosystems which foster constant interaction.

The main growth areas for the natural resources sector under current conditions. The experience of economically developed countries which export mineral resources shows that the effective development of mining industries is based on innovation. In addition, it should be taken into consideration that as the geological settings where mining takes place are becoming more complex and high-grade ores are running out, mining operations require an increasing number of new technical solutions.

At the same time, it is often said that it is the natural resources sector that should become a catalyst for the innovative development of resource-based economies since it creates effective demand for new technologies and is able to ensure their transfer to other industries.

Table 1. A comparative analysis of innovation processes in the natural resources sector and secondary (processing) sectors of the economy

Factor	Features of innovation processes	
	natural resources sector	secondary sectors
1. Opportunities to create new sources of income	There are quite strict limits to the opening of new facilities due to objective factors (exploration data on the geology of ore bodies)	Limits are usually much less strict; fashion and other behavioural factors often create demand
2. Innovation life cycle	New technology is used for a long time; constant updates are usually not necessary	New technology is used for a relatively short time and needs regular updates, which stimulates innovation processes
3. Complementarity degree	The degree of complementarity is low; transfer between industries is usually limited	The degree of complementarity is high; as a rule, innovation transfer to other industries takes place on a large scale
4. Cost/income ratio	Innovation costs are usually very high; returns are relatively low; the introduction of innovations is often curbed due to the risk of overproduction, which results in a loss of the economy of scale	Initial innovation costs are usually not very high, which significantly facilitates their introduction

However, the validity of this statement is questionable, especially if we consider the Russian economy. The significant scale of Russia’s natural resources sector cannot by itself be a condition which is sufficient for innovation processes to start happening.

Innovation processes differ significantly depending on whether they occur in the natural resources sector or a secondary (processing) one. As shown in Table 1 (based on [19]), the introduction of innovations in the natural resources sector is hampered for numerous reasons. Under these conditions, it is possible to improve the performance of mining companies through vertical integration which will cause income redistribution within value-added chains.

In many cases, market prices for ores or their concentrates are quite low, which means that mining companies are not able to make significant profits. At the same time, products made using ore concentrates have much higher rates of return. This situation hinders the process of introducing innovations at the stage of ore extraction.

This is the reason why the vertical integration of companies which use large volumes of natural resources makes it possible not only to ensure the technological and organizational homogeneity of production and marketing processes but also to create opportunities for the continuous funding of mineral extraction operations despite volatile prices for mineral resources. Moreover, end product manufacturers gain reliable access to raw materials in the volumes they need.

In essence, the creation of supply chains including extraction, processing, production, and distribution improves companies’ financial and economic sustainability, allows them to mobilize resources for invest-

ment, and use them for development and modernization purposes at all production stages. At the same time, the introduction of innovations within a vertically integrated structure results in powerful synergistic effects at all stages of end product creation.

The process of integration between primary and secondary sectors becomes even more effective when it goes beyond national borders. In this case, companies face fewer resource and financial limits and have easier access to innovations, including those in the area of resource extraction.

Digitalization of Mining Companies as a Factor Influencing Development. One of the main difficulties that mining companies face in their attempts to optimize their operations is the analysis of data needed to make management decisions. The most advanced information technologies based on coding are required in order to increase the speed and quality of this analysis. According to analysts at Deloitte, digital technologies for data collecting, storage, and processing can in themselves become a spur for the emergence of new business models [20]. However, it is often not enough to simply start implementing new technology in an organization. What is needed here is a transition to digital thinking in the process of developing corporate strategies.

Timely access to data on value-added chains will enable mining companies to update their geological models, mine plans, and financial models frequently enough and to shorten the planning cycle. The creation of so-called digital mines whose operations are regulated by centres which collect and analyze data from all the company’s departments along with the use of innovations in mineral extraction and processing

can dramatically improve mining companies' performance.

An example of using a fundamentally new approach to gaining competitive advantages is Rio Tinto, an Anglo-Australian corporation. It opened a new division called Rio Tinto Ventures whose task is to create joint ventures with owners of mineral assets in a format which involves the use of Rio Tinto's engineering and technical potential, sales channels, and intellectual property in the development of ore deposits owned by their partners.

The main difference between digital transformation and automation is a dramatic increase in the efficiency and quality of decision-making. Not every project which involves implementing or upgrading enterprise software can be considered an example of digital transformation. This kind of transformation is large-scale and complex and it involves the use of such tools and technologies as the Internet of things, machine learning, artificial intelligence, cloud computing, etc.

It is true that some digital technologies are already being used by leading resource companies (for example, innovations such as foresight methodologies, miniature and fibre optic sensors for automated drilling rigs and robots, UAVs, mine modelling tools, the Global Positioning System (GPS), geographic information systems (GISs), etc.), but it is still extremely rare for such technologies to be integrated within unified ecosystems. A study conducted by Dell Technologies, in which several thousand executives from all over the world took part, showed that 71% of companies recognize that it is necessary to undergo digital transformation in order to remain competitive in a changing world, but 95% of companies have not yet undergone this transformation¹. In other words, businesses are not yet fully prepared for change [21].

The Use of Financial Markets (Stock Exchanges) as a Source of Investment for Mining Companies. The leaders of the mining industry understand very well that its transformation requires not only technological innovations but also new sources of investment. Access to such sources can be obtained through financial markets, but it can be done only if companies build relationships with potential investors very carefully. This is where the importance of trust increases dramatically, especially in the context of volatile prices for natural resources and a decrease in ore quality.

The trust of investors can be won by providing them with detailed information on the company's mineral reserves and its financial performance indicators. The key role here is played by resource appraisal conducted in accordance with strict international standards. Among the most famous international

assessment codes are CIMVAL (Canada), SAMVAL (South Africa), VALMIN and JORC (Australia). If a company's performance is assessed using such codes, it can be listed on stock exchange markets and obtain financial resources which can be used for development purposes.

In the current economic climate, there is a constant need to assess mineral assets. Today, if a mining company is listed on stock exchange markets, it has to regularly publish data on its mineral resources and ore reserves. Most big mining companies conduct resource revaluations twice a year.

Regular revaluations of mineral assets are important not only to investors but also to corporate management. Such revaluations enable executives to monitor the real value of the company and to assess the need for extra funds necessary to compensate for losses which the company may suffer if its reserve estimates fail.

The Development of Ecosystems for Interaction in the Natural Resources Sector. In order to make effective changes to companies operating in the natural resources sector, it is necessary to have a new look at their future. An analysis of the situation shows that mining companies rarely seek collaboration in the area of innovations.

Of course, such collaboration may be hindered by legal restrictions or the structure of mining companies which creates conditions for being isolated and solving development issues independently. However, challenges that the industry faces today require a much wider interaction between companies both within the sector and operating in different sectors. Mining companies need to form collaborations with both equipment manufacturers and innovation development companies. It means that both parties will need to go beyond traditional business practices limited by procurement contracts and switch to different forms of continuous collaboration.

In other words, companies will need to develop so-called ecosystems within which digital technologies and standardized procedures will be used to integrate the activities of large, medium, and small mining companies, equipment manufacturers, suppliers of auxiliary materials, innovation developers, geologists, scientific and educational institutions, and also financial structures operating in the natural resources sector. Integration in the form of an ecosystem will make it possible to obtain more pronounced synergistic effects which will benefit all participants, ultimately making the industry highly competitive and profitable.

Unfortunately, today mining companies can rarely be called innovators (Table 2). Studies conducted by Deloitte in Canada, Australia, Africa, and Latin America show that expenditure on innovations in the mineral resource sector are still very low, especially in comparison with other sectors [20].

¹ Dell Technologies. URL: <https://www.delltechnologies.com/en-us/perspectives/esg-it-transformation-maturity-curve-report/> Accessed: 15.12.2018

Among the factors hindering innovation activities in the mineral resource sector are:

- long payback periods for projects aimed at implementing innovations in ore extraction and primary processing;
- investors’ and shareholders’ requirements that mining companies’ stocks should always give high dividends;
- the trend among mining companies to avoid risks associated with the introduction of innovations as these risks may affect current revenues;
- prejudice against innovations that require a longer period of time to bring the intended effect even if they result in significant qualitative improvements;
- many mining companies lack a clear concept regarding innovations;
- issues associated with intellectual property rights.

Collaboration in the mining sector using a unified ecosystem will help mining companies tackle the obstacles mentioned above and reduce risks in the process of implementing innovations. As a rule, if an ecosystem includes small research and service companies, there is no need for a huge budget to implement innovations. For example, the experience of small companies in improving the efficiency of geological exploration may be useful for large companies, while advanced mineral processing technologies can be transferred in the opposite direction.

A Case Study of International Collaboration Regarding Innovations: Russian and British Natural Resources Sectors. As mentioned above, it is possible to improve the performance of the natural resources sector and ensure that innovations are introduced to the industry more widely through international collaboration. The interaction between Russia and Great Britain can play an important role in this process. There are a number of circumstances which make this collaboration desirable:

- 1) Mining companies in both countries suffer from high price volatility, which forces them to sell low-margin assets and limit investment in new projects. There are numerous examples of this, including Rio Tinto selling its interest in the Grasberg mine in Indonesia, British Steel and Rolls-Royce cutting jobs to minimize costs, Lukoil and Rosneft selling a number of assets, etc.
- 2) The lack of funds forces mining companies in both countries to use new sources of finance, including capital dilution (Anglo American’s agreement to sell 21.9% stake in the Quellaveco large-scale copper mining project in Peru to the Mitsubishi Group; transfer of a 19.5% stake from Rosneft to Glencore).
- 3) Mining companies in both countries are characterized by “patchwork digitalization”, which means that they use separate software tools that partially duplicate each other, making data exchange time-con-

Table 2. Expenditure on innovations in the mineral resource, consumer, and high-tech sectors

Year	R&D/GDP, %		
	mineral resource sector	consumer sector	high-tech
2005	0.90	2.85	8.00
2006	1.10	2.75	8.35
2007	0.30	2.75	7.10
2008	0.40	2.90	7.15
2009	0.30	3.20	7.20
2010	0.30	3.00	6.80
2011	0.30	3.10	6.65
2012	0.35	3.05	6.80
2013	0.36	3.00	7.30
2014	0.25	3.25	7.70
2015	0.30	3.35	8.20
2016	0.38	3.40	8.80

suming. At the same time, they use smart equipment and production lines, but these are not integrated into a unified ERP system².

4) From 2014, the activities of Russian and British companies have been influenced by political factors (Brexit, as a result of which relations between Great Britain and the European Union suffered; bilateral economic sanctions enacted by Russia and Western countries). These factors significantly limit collaboration prospects, technology transfer, and investment exchange.

The interaction between ministries and departments within the UK-Russia Intergovernmental Steering Committee on Trade and Investment which was stopped by the British side in March 2014 has not resumed yet. The tenth (and last) session of the Committee was held in Moscow in November 2013.

As part of the sanctions, the United Kingdom imposed a ban on certain financial operations in order to limit Russia’s access to capital markets. It also put restrictions on the provision of loans and investment services for a number of Russian banks (Sberbank, VTB, Gazprombank, Vnesheconombank, and Rosselkhozbank). The European Bank for Reconstruction and Development (EBRD), which is headquartered in London, stopped new investments in Russia.

Furthermore, British financial institutions were banned from providing loans to three Russian companies (Rosneft, Transneft, and Gazpromneft), trading their shares, and participating in their share issues.

However, British companies continue to collaborate with Russian ones despite the sanctions, and in

² CNews Analytics. URL: www.cnews.ru/reviews Accessed: 10.12.2018

2017, after a decline in trade between the two countries which lasted for three years, there was a positive trend.

Collaboration regarding innovations is especially important for mining companies in both countries. It would be logical to establish collaborations taking into account various programmes for innovation-driven growth implemented by the governments of the two countries.

One of the key documents for the UK in this area is The Plan for Growth, which was published in 2011. According to this document, the government of the country will create conditions for using knowledge, skills, technical resources, and capital in order to develop and commercialize innovative products and services³.

Innovate UK is a public body involved in this area. Its projects and programmes include:

- supporting the network of Catapult research centres operating in specific areas;
- supporting Knowledge Transfer Network (KTN) which consists of 15 regional centres specializing in the accumulation and transfer of knowledge on certain technologies;
- a collaborative R&D programme;
- the Eurostars Programme aimed at assisting companies in finding finance for the implementation of research projects in high-tech industries;
- supporting the UK Innovation Investment Fund (UKIIF).

In Russia, the key documents describing the country's policy regarding innovation include the Economic Growth and Innovation Economy programme, which was approved by the Government of the Russian Federation in 2014 (Decree no. 316), the Russian Innovations Strategy 2020, and Russia 2030: Science and Technology Foresight.

A special role in the modernization of Russia's economy is played by such institutions as RUSNANO, the Fund for Infrastructure and Educational Programmes, Russian Venture Company (RVC), the Foundation for Assistance to Small Innovative Enterprises, and Skolkovo Foundation.

Large joint-stock companies which are partially publicly funded, state corporations, and federal state unitary enterprises (public companies) implement innovation development programmes (IDPs).

In December 2017, Russian President Vladimir Putin instructed the Government of Russia and the Presidential Executive Office to develop the Digital Economy programme which would include measures aimed at creating legal, technical, organizational, and financial climates for the development of the digital economy in Russia⁴. Experts at McKinsey calculated

that the share of the digital economy in Russia's GDP might grow from the current 3.9% to 8 or 10% by 2025 (up to 9.6 trillion roubles)⁵.

It should be noted that Russia's industrial sector is comparable to Western ones in terms of its readiness for global digital transformation: 55% of Russian industrial enterprises spend about 1% of their budgets on digitalization and IT infrastructure development. At the same time, 6% of enterprises spend more than 5% of their budgets. In Western countries, this value rarely exceeds 5%.

According to the Trade Delegation of Russia in the UK, the two countries could collaborate on:

- joint research in various IT areas conducted by Russian and British research centres, including those based at the University of Cambridge;
- experience exchange between the most successful IT companies located in Cambridge and companies operating in Russia, including those located in the Skolkovo centre;
- joint finding of IT projects in Russia;
- participation of Russian companies and research centres in IT events held in the UK.

The natural resources sector can also be considered as a promising area for collaboration between Russia and the UK in the area of innovations. Many of the leading Russian energy and metallurgical companies (for example, Rosneft, Norilsk Nickel, etc.) are already at high levels of digital business transformation comparable to those seen in top companies around the world. As a rule, these companies rely on foreign digital technology suppliers. However, a number of Russian IT companies can and already offer interesting solutions for the mining sector. One of them is VIST Group, which has developed VG Karier, a mine fleet management system, VG Drill, an automated drilling rigs management system, and VG Safety, an automated industrial safety management system⁶.

The Russia-UK Raw Materials Dialogue, which was held for the first time at St. Petersburg Mining University in 2017 with support from the Institute of Materials, Minerals and Mining (IOM3), the Russo-British Chamber of Commerce, and the British Consulate-General in Saint Petersburg, gives significant support to the collaboration between the two countries in the natural resources sector. This is the first attempt to bring together the leading scientists and business people of Russia and the UK working in the natural resources sector as well as representatives of legislative

⁴ Presidential Executive Office. URL: <http://www.kremlin.ru/events/president/news/54983> Accessed: 28.12.2018

⁵ RBC, 2017. URL: https://www.rbc.ru/technology_and_media/05/07/2017/595cbefa9a7947374ff375d4 Accessed: 05.12.2018

⁶ Dprom.online, a website for primary sector representatives, 2018. URL: <https://dprom.online/2018/06/20/sovremennyye-vyzovy-gornodobyvayushhej-otrasli-i-puti-ih-preodoleniya/> Accessed: 20.12.2018

³ HM Treasury, 2018. URL: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/221514/2011budget_growth.pdf Accessed: 28.12.2018

and executive bodies along with prominent political and public figures.

CONCLUSION

Growing demand for innovations which has been observed in the natural resources sector in recent years is, in fact, an attempt to get rid of the dependence on mineral and energy resources. Countries buying resources want to diversify their access to them through innovations. Countries selling resources want to use innovations for creating processing facilities which will bring higher added value. In the end, both types of countries will be able to achieve their goals only through economic, scientific, and technical cooperation with each other.

At the same time, it is not only countries but also mining companies who need more opportunities for collaboration as they face such issues as a gradual decrease in ore quality, complex geological settings in new deposits, growth in fixed costs, financial limitations, and growing environmental constraints. The representatives of the sector should gradually come to the understanding that mining companies can no longer work in isolation from other market participants. In order to make sustainable changes for the better, it is necessary to develop and introduce innovations together with other companies within the sector and from other sectors, to reduce project risks by attracting new investors, to develop unified ecosystems involving a large number of participants with the aim of obtaining large-scale synergistic effects, and to collaborate more closely with national and regional authorities.

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