

Classification of sectoral innovations in diamond processing

Clasificación de innovaciones sectoriales en el procesamiento de diamantes

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ABSTRACT:

Article presents the results of research of innovative activity of participants of the diamond-diamond market in Russia. The content of the technological and product innovations is determined by the strategic planning documents of the industry enterprises. It is established that Russian diamond producers have an average technological position compared with leading foreign colleagues. Based on the results of factor analysis, the challenges and threats of the world economy, influencing the development of diamond production, were singled out. The author suggests applying the classification of sectoral innovations for the implementation of strategic goals: product, organizational, technological innovations that will produce an effect in production and reduce the costs of business processes, marketing, management, logistics, distribution of economic resources and production factors. Integration of various components of the classification of industry innovations will ensure the growth of the innovative potential of the diamond processing industry. The quality of the innovative infrastructure and the integration of information links will allow to activate innovative processes.

Keywords: infrastructure, diamond industry, industry innovation, technological level, evaluation, classification.

RESUMEN:

El artículo presenta los resultados de la investigación de la actividad innovadora de los participantes del mercado de intercambio de diamantes en Rusia. El contenido de las innovaciones tecnológicas y de productos está determinado por los documentos de planificación estratégica de las empresas de la industria. Está establecido que los productores rusos de diamantes tienen una posición tecnológica promedio en comparación con los principales colegas extranjeros. Con base en los resultados del análisis de factores, se destacaron los desafíos y las amenazas de la economía mundial que influyen en el desarrollo de la producción de diamantes. El autor sugiere aplicar la clasificación de innovaciones sectoriales para la implementación de metas estratégicas: producto, organización, innovaciones tecnológicas que producirán un efecto en la producción y reducir los costos de los procesos de negocios, comercialización, administración, logística, distribución de recursos económicos y factores de producción. La integración de varios componentes de la clasificación de innovaciones de la industria asegurará el crecimiento del potencial innovador de la industria de procesamiento de diamantes. La calidad de la infraestructura innovadora y la integración de enlaces de información permitirán activar procesos innovadores.

Palabras clave: infraestructura, industria del

1. Introduction

The diamond industry of Russia is a multilevel structure. It includes two interdependent sectors: the diamond mining sector and the diamond processing sector. The diamond mining, as a kind of economic activity associated with the extraction of minerals, is a technologically organized activity requiring the continuity of the innovation process. However, a significant increase in the efficiency of diamond mining is theoretically associated with arise innovations that when technological is changed. The demonopolization of the infrastructure services market and the innovative development of service entrepreneurship based on the vertical integration of the diamond pipeline can play an important role in the development of the diamond mining industry. A feature the Russian diamond industry is the presence of the world's largest diamond mining sector with underdeveloped jewelry, diamond processing and tools production (Nikolaev et al., 2016).

Innovative development of the complex is conditioned by a variety of factors that ensure the innovative potential and innovative activity of market participants. The problems of innovation activity of companies operating in the diamond processing sector are especially topical. The innovation process in the diamond processing industry is limited by the laws of mechanics, the level of development of information technologies, the degree of penetration into production processes of robotics and artificial intelligence, the level of development of modern geoinformation and geolocation technologies (Nikolaev, Grigoryeva and Gulyaev, 2016). An important role in the modern economy is played by allocative, organizational, process of innovations, which substantially increase the efficiency of production through optimization of business processes, marketing, management, logistics, distribution of economic resources and factors of production (Damanpour and Schneider, 2006). Innovative development of the industry is conditioned by a variety of factors that ensure the innovative potential and innovative activity of market participants. Considering the corporate concepts of the main producer of rough diamonds PAO ALROSA (Annual reports of ALROSA, 2016), when examining the sectoral innovation process, it is worth paying attention to the problems of innovation of major market participants. There is a need to connect state regulation of the innovation process in the field of pricing, improving the quality of products and rebranding, promoting the brand, optimizing the distribution network, etc. (Mohtasham et al., 2017).

2. Material and methods

The research was carried out on the basis of the report and analytical information of the largest companies of the diamond industry published on official websites of companies (Annual reports of ALROSA, 2016; Mohtasham et al., 2017; Program for innovative software...; Ministry of Industry of the Republic of Sakha, 2015), industry analytical and consulting agencies: AWDC (Bain and Company, 2013), JUNWEX (Analytical review of the current...), DeBeers (De Beers, 2014) and Diamond Pipeline (Even-Zohar, 2017). Scientific approaches to the research of the global diamond market are based on the theory and practice of the following scientists (Nikolaev et al., 2016; Pototskaya, 2013; Samsonov et al., 2017; Radhakrishna, 2007) and others. Theoretical and methodological bases of research were based on scientific works related to the issues of innovative development of economic sectors of the following scientists (Salimova and Khakhaleva, 2017; Galvão et al., 2017; Bhat and Bowonder, 2017; Koki Costa da Nogami et al., 2018; Antioco and Kleijnen, 2010).

Changes in the diamond market in conditions of unstable demand call for the development of adaptive mechanisms to increase the investment and innovative attractiveness of the processing sector to obtain added value and export-oriented products. Development of proposals for attracting investments should be formed taking into account the assessment of the investment and innovative potential of the diamond industry, regional characteristics, factors and challenges (Aletdinova, 2013). The definition of these aspects this is the field of scientific research.

The research uses complex, constructive, problematic scientific approaches. The following research methods were applied: observation, bibliographic analysis of the literature and Internet materials, analysis of the data obtained, expert evaluation, factor analysis, etc. The purpose of the study is to identify promising innovative directions of the diamond processing industry in Russia. The research methodology is based on the following set of interrelated stages:

- Expert evaluation of the technological level of the diamond processing industries in Russia.
- Identification of technological challenges and factors affecting the innovative potential of the diamond processing industry.
- Identification of promising innovative directions of the diamond processing industry in Russia.

The structure of the Russian diamond processing industry shows that over 80% of the volume of production and sales of products on the Russian diamond market belongs to three large companies:

- ZAO RUIZ DIAMOND (43%);
- PAO ALROSA (13%), which includes three companies: a branch of OOO Brilliants ALROSA, OOO BARNAUL PLANT KRISTALL and OOO OREL-ALROSA;
- OAO SMOLENSK KRISTALL (32%);
- Yakut diamond processing companies (9%);
- Other (3%).

Large companies of the Russian diamond market have various organizational and legal forms of ownership: PAO (Public Joint Stock Company), AO (Joint Stock Company), OAO (Public Joint Stock Company), ZAO (Private Joint Stock Company), GUP (unitary enterprise). At the same time, not all companies timely disclose information on the results of economic activities, including in the planning and implementation of innovative development. The largest foreign diamond processing companies are mainly family businesses and prefer not to publish financial and other reports in open sources. This situation makes it difficult to analyze the competitive environment in the framework of sectoral strategic planning.

In connection with the foregoing, it is advisable to analyze the competitive environment for the purpose of researching the innovation activity of diamond-producing companies on reliable information provided by three large companies: OOO BRILLIANTS ALROSA; OAO SMOLENSK KRISTALL; OAO SAKHA DIAMOND (Annual reports of ALROSA, 2016; Mohtasham et al., 2017; Program for innovative software development....; Ministry of Industry of the Republic of Sakha, 2015).

3. Results and discussion

3.1. Assessment of the technological level of production of diamonds

Most of the Russian diamond-producing companies use equipment produced in the 1980s and 1990s (Table 1). To maintain the high technical level of the equipment, machines and mechanisms can companies with a sufficient level of profitability. The lack or insufficient production capacity of high-tech equipment, high degree of wear of the main production equipment leads to an increase in production costs, an increase in the price of brilliant, with a low quality of cut.

Table 1
Equipment applied in the technological process of diamond processing

Stage of diamond processing	Equipment	Equipment characteristics
Planning	Scanners of OGI Systems, Sarin, Helium. Automatic settings for determining the color, shape of	Automatic high-precision scanning of a diamond crystal, construction of a realistic 3D model, determination of the

	crystals	optimal position of brilliants in a diamond crystal
Marking	System for laser marking of diamonds OGI Systems, Sarin, Helium	The application of a laser marking line on the surface of a diamond
Sawing	System for laser sawing Sarin, Helium	It reduces the time and accuracy of sawing a diamond, regardless of the nature of the internal inclusions of the diamond
Bruting	Automatic peeling machines of the "Maxicut" brand, etc., the technology of grinding "crystal-crystal"	Automatic feed of diamond and video control system of the bruting processing zone, automated alignment of diamond
Diamond polishing	Semi-automatic polishing machines, cutting machines with Coborn motor	Reducing the beat of the disk, monitoring the speed of rotation of the disk
Final inspection	Scanners of OGI Systems, Sarin, Helium with software for determining the proportions of diamonds	Accuracy of measuring the angle of inclination of faces with an error of up to 0.2 ° and the error of linear dimensions up to 0.02 mm.
Accounting for the movement of rough diamonds in production	Automated inventory management systems, material flows, inventory management systems, etc.	Improving the quality of accounting and control over the movement of rough diamonds

An important direction for innovative development in the processing of diamonds is the use of synthetic and natural genesis of industrial-grade diamonds. Unique properties of diamond make it the most effective and technologically highly competitive material as an abrasive, cutting and polishing component of a diamond tool (disks, saws, cutting plates for metalworking, etc.), special diamond products (medical tools, etc.) or finished product (micron and submicron diamond powders).

As a result of the expert assessment, it was concluded that the Russian diamond processing companies have an average technological position relative to the leading foreign producers of diamonds. At present, a whole range of factors can adversely affect Russian diamond producers, including high prime cost of diamond and jewelry products in comparison with similar products of foreign producers, due to unequal tax burden and customs duty. The problems discussed limit the opportunities for the development of the Russian diamond market.

3.2. Results of factor analysis

The following processes and phenomena in the world economy are the main technological challenges and factors that significantly affect the development of the diamond processing industry. The decline in consumer demand in the global diamond market has determined some areas for the development of the industry in order to maintain long-term demand for diamond products.

The industry may face a change in consumer relations to luxury goods in Europe, Japan and the United States, which account for about 50% of diamond jewelry sales. The consumer

loses the desire to purchase diamond products and luxury goods to maintain the status of the middle class in developed markets. The new generation of consumers relatively unknown attractive properties of products with diamonds, which leads to the orientation of consumer demand for high-tech products (smartphones, computers, etc.) and forms new models of consumers' needs.

Demand for diamonds is elastic in income, the degree of saturation of a particular market is determined, first of all, by the state of its economy, and by no means by the consumer properties of diamonds, what must be taken into account.

- Growing attractiveness of diamond products used as a means of saving.

To increase demand for diamond products used as a means of saving, long-term demand should be stimulated by:

- The organization of investment mechanisms in financial instruments, provided with diamonds.
- Promotion of the ideology of effective investment using financial instruments, provided with diamonds to consumer with the identification of the target audience.
- Integrated mix marketing of new instruments and mechanisms for using diamond products as a means of saving.
- The presence of unaccounted synthetic diamonds.

The presence of unrecorded synthetic diamonds among diamond products undermines consumer confidence in some diamonds products, especially small diamonds products. Diamond market participants actively solve these problems by toughening requirements for certification of brilliant, developing and implementing technology for detection of synthetic diamonds, introducing a system for identification and marking of diamonds, as well as toughening legal and regulatory frameworks for determining the use of synthetic diamonds.

- Reducing the profit margin of diamond producers.

The annual rise in the cost of material and energy resources in Russia contributes to the growth of costs of diamond producing companies. With a stable or strengthening ruble exchange rate, the preservation and growth of the achieved level of profitability of business in such circumstances is possible due to the introduction of innovative technologies and business processes that help reduce the costs of the total amount of basic resources of diamond processing industry.

- Impact of the consequences of the global financial crisis on the production of brilliants.

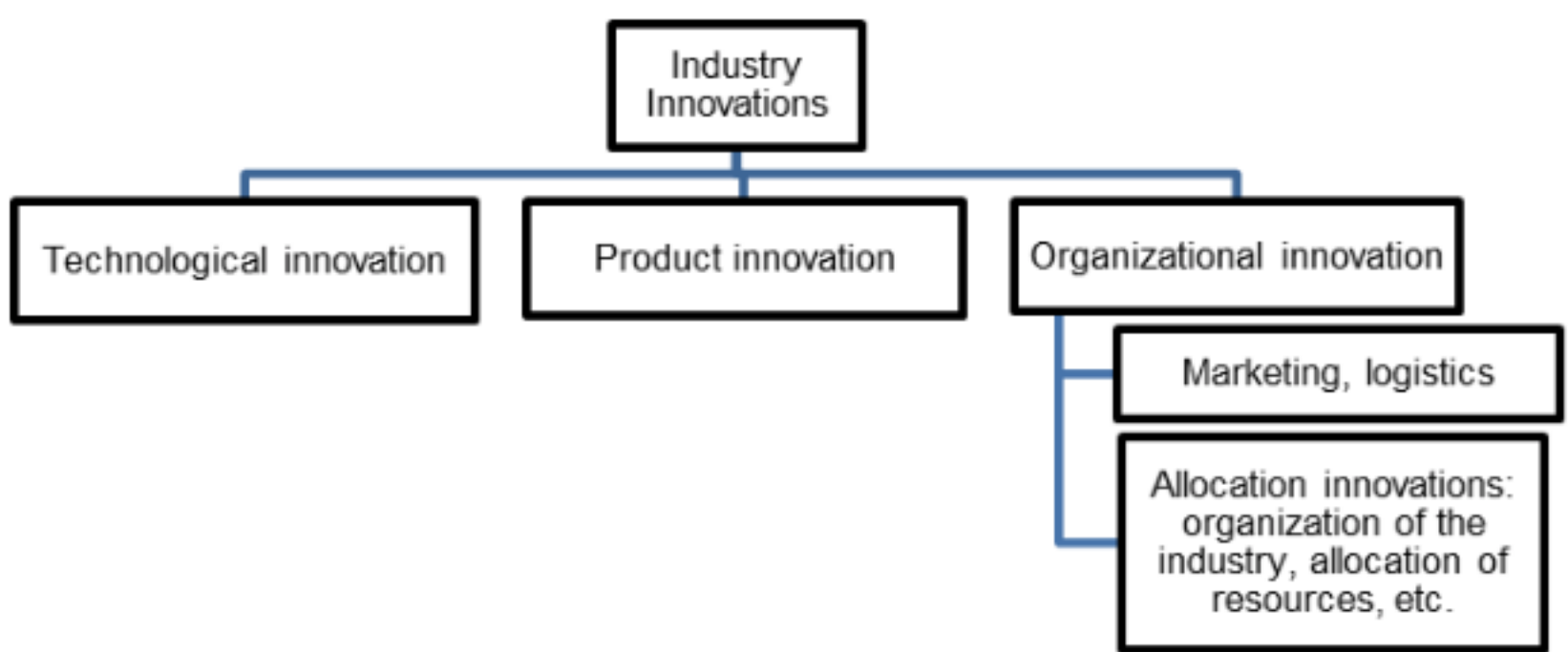
With the aggravation of the situation on the world diamond market, diamond processing companies reduce diamond production. At the same time, the obligatory redemption of rough diamonds according to the agreed volume of rough diamond, regulated by long-term contracts with PAO ALROSA, does not allow reacting to the changing situation on the world diamond market. The terms of the contract do not allow for a complete refusal to buy out a monthly batch of rough diamond, therefore, companies do not have the ability to timely respond to a change in the demand for the purchase of rough diamond, and are forced monthly to divert current assets for the purchase of rough diamond even in the absence of production needs in it.

3.3. Vector of innovative development of the diamond industry

The goal of innovative development of the diamond mining and diamond processing industry is to provide support for "growth points" for bringing them to a globally competitive level by continuously improving the technological level of production.

The author proposes to apply the following instruments for the implementation of strategic goals in the implementation of innovations of various characters and contents. The classification of sectoral innovations is presented in Figure 1.

Figure 1
Classification of sectoral innovations



It is likely that the organization of the Diamond Exchange in the Far East will make its adjustments to the marketing policy of the Russian diamond mining companies. This will create conditions for the organization of a new Far Eastern diamond cluster with diamond production and jewelry production and a complex of infrastructure facilities (Nikolaev and Grigoryeva, 2016).

The implementation of investment projects during the stagnation of the national economy is determined by a group of risks associated primarily with the financing and operation of these projects. In order to minimize the impact of risks on the success of project implementation, it is recommended to get support from the relevant ministries and departments at the project preparation stage. When applying variants of the special economic zone (SEZ) and the Territories of Advanced Social and Economic Development, it is necessary to introduce significant changes in legal acts, which largely depends on state support for the diamond industry (Nikolaev and Grigoryeva, 2016).

The content of technological and product innovations is determined by the strategic planning documents of the industry enterprises (including PAO ALROSA, OAO SMOLENSK KRISTALL, etc.).

To equip production with advanced high-tech equipment, priority is given to the Israeli (SARIN) and Indian (HELIUM) production. At the same time, Russian analog systems (DIACOM Ltd.) are not competitive in terms of system functionality and scanning speed. In this regard, the system of priorities for innovative development of the industry raises the task of developing domestic production of high-tech equipment used in diamond processing. It is also necessary to intensify R&D related to the development and improvement of technology and a complex of diamond processing equipment to provide the industry with modern equipment of production.

Innovative economy, which optimizes the management systems of the industry and companies, is of great importance to modern economy (Mohtasham et al., 2017). The greatest increase of productivity is currently achieved through improved marketing, logistics, and management systems of production processes (Aletdinova, 2013). In the sales policy of companies and the industry as a whole, integrated mix marketing, organized in accordance with the information paradigm of economic development, should play a decisive role.

It should be borne in mind that innovation with the diamond shapes is a very complex and time-consuming process, since the diamond shapes do not change for a very long time. The volume of demand for innovative, fantasy diamonds is traditionally negligible. At the same time producing of fantasy and new multi-faceted shapes of diamonds, it is possible to maintain the initial mass of diamond to 70-75%, which saves expensive diamond materials and reduces production costs. Thus, one of the main directions of innovative activity is active (aggressive, "attacking") marketing and the organization of a new market and a new target audience of consumers of diamonds of non-traditional ("fantasy") shapes and design. This direction of development can generate the following factors that ensure the

development of the industry:

- Increase in labor productivity due to lower production costs that arise when saving expensive diamond materials (by keeping a greater weight of "rough" diamonds during processing and cutting).
- Stimulation of demand for innovative of diamonds shapes due to the increase in the level of consumption culture of fantasy diamond and market "routineization" of the innovative of diamond shapes.
- Increase the innovative activity of the industry by creating new trends in style, design of jewelry and luxury goods, creating studios for the design of diamond shapes, creating patents, copyrights for new of diamond shapes, etc.

Automation of measuring systems of energy consumption contributes to the improvement of the energy balance of the company, to increase the efficiency of accounting and planning of electric power consumption, to reduce the volume of actual electricity consumption for output.

The main environmental problem of diamond processing production is the increased air contamination with diamond dust in production workshops. The specificity of diamond production leads to the fact that more than half of the diamond weight goes into irretrievable losses in the form of diamond dust deposited on the production areas of the workshop and inhaled by processors. It is necessary to improve ventilation systems and air removal from the processing area of production workshops.

3.4. Practical assignment industry innovation

Promising directions of innovative development of the diamond processing industry until 2030 according to the classification of sectoral innovations are possible in the following areas:

1. Technological innovations:

Equipment modernization of diamond processing companies with advanced technologies.

Increase of energy efficiency and clean production.

Conducting and implementing the results of research and development (R&D), including on improving the technological level of Russian analogue scanning systems and laser processing of diamonds, as well as the development of the Russian tool industry.

Implementation of technological plans in accordance with the current strategic programs of innovation development of companies of the diamond industry.

Implementation of modern systems for automation of the production process and information systems for decision support.

2. Product innovations:

Development of methods for preserving weight in the processing of rough diamonds.

Development of an effective system of supply of rough diamonds to diamond processing companies reacting to the world diamond market.

Improving the quality of diamond products.

Implementation of productive innovations in production, including: development and implementation of processing of fantasy diamond and new multi-faceted shapes of diamonds that allow to reduce irretrievable of diamond weight losses during processing.

Development of new types of luxury goods with diamond.

Use of alternative technologies for diamond processing.

Toughening requirements for certification of brilliance and tightening the legal and normative framework for identification of synthetic diamonds.

Development and implementation of technology for the detection of synthetic diamonds.

Implementation of the system of identification and marking of diamonds on the Russian diamond market.

3. Marketing innovations:

Implementation of promising events in the advertising activities of market participants, taking into account innovative technologies and marketing realities of Russian and foreign markets, including: cross-promotion; modern advertising technologies; creation of advertising alliances; integrated branding; formation of consumer awareness; positioning of products taking into account changes in market preferences, focus groups, etc.

Creation of a new unified commercial and information-presentation corporate Internet resource.

Launch of the program of specific marketing of brilliance.

Realization of promising ideas for increasing demand for diamond products as investments.

Creating conditions for promoting new product innovations in the consumer market.

4. Organizational innovations

Organization of production in the conditions of special economic zone (Territories of Advanced Social and Economic Development on the territory of the Republic of Sakha (Yakutia), Freeport of the Russian Island, etc.)

Use of venture financing instruments, attraction to the activity of Venture companies, Technoparks, funds, etc.

Improving the control system and stimulating the implementation of innovations in the activities of diamond processing companies.

Development and implementation of state support instrument for diamond market participants.

Carrying out an independent technological audit at least once every 5 years.

Optimization of depreciation policy.

Activities in the field of improving the organization of innovation and business processes.

Activities to establish and develop a research infrastructure.

Interaction with the innovation environment, incl. with universities in training and retraining of personnel, with research organizations, with innovative companies, with technological platforms and with innovative territorial clusters.

Activities in the field of international cooperation and foreign economic activity, incl. implementation of works and projects in the field of research and development, cooperation with foreign research and design centers, producers of innovative products, participation in international expert-analytical, presentation and educational activities with the purpose of sharing experience in the innovation field: international conferences and exhibitions.

Implementation of anti-crisis management technologies: finance, production, marketing, investments.

4. Conclusion

Thus, one of the most important components of strategic management of innovative development of the diamond processing industry is a combination of state support aimed at strengthening the integration of sectoral and national intersectoral research and development complexes. At the same time, it is necessary to optimize the financing system on the basis of project-oriented approaches, the use of public-private partnership mechanisms, the expansion of the list of state regulation instruments and the state support of the sectoral research and development complex.

Effective integration of the various components of the innovation system that ensure the growth of the innovative potential of the industry depends on the quality of the innovation infrastructure and the variety of relationships that "serve" innovation processes. From the point of view of the theory of state regulation of the economy, any infrastructure can't develop without active state intervention.

The developed innovative infrastructure influences the innovative activity of companies and

the industry as a whole. The innovative activity of the industry is determined by the ability of industry companies to finance research and development, including by transferring technologies in an innovative environment, in an innovation infrastructure "from producer to consumer". The innovation process, as a rule, has a long-term "life cycle" and consists of many fundamental and even more applied R&D. Therefore, the financing of the innovation process is of an investment aspect, regardless of the fundamental or applied importance of R&D.

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