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## INNOVATIVE POTENTIAL OF SMALL AND MEDIUM BUSINESS \*

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Received 15 February 2020; accepted 30 October 2020; published 30 December 2020

**Abstract.** The article presents the results of the practical implementation of the methodology for assessing the innovative potential of small and medium-sized businesses of the Republic of Kazakhstan. To identify the level of development of innovative activity of SMEs in Kazakhstan the methods of correlation and regression analysis were implemented. The analysis conducted on the basis of available statistical materials discloses the impact of different factors on the innovative potential of small and medium-sized businesses. According to the author's approach to the evaluation of innovative potential, there are three groups of factors affecting the innovative potential – factors of general economic development, factors of development of small and medium-sized businesses and factors of development of research activities. The article also analyzes the main indicators of innovation activity of the considered enterprises and institutional features of their development. The results of the research allowed to identify both the advantages and disadvantages of innovative activity of national SMEs.

**Keywords:** innovative potential; innovative activity; small and medium-sized business; correlation method; statistical analysis; regression analysis

**Reference** to this paper should be made as follows: Kulmaganbetova, A., Dubina, I., Rakhmetulina, Zh., Tlessova, E., Tulegenova, Zh. 2020. Innovative potential of small and medium business. *Entrepreneurship and Sustainability Issues*, 8(2), 1286-1304. [http://doi.org/10.9770/jesi.2020.8.2\(76\)](http://doi.org/10.9770/jesi.2020.8.2(76))

**JEL Classifications:** M21, O31

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\* The article was prepared based on the results of an intermediate stage of research "Development of a systematic regulation mechanism for financial and credit organizations to support the innovation sector in the context of sustainable macroeconomic effects", carried out under grant funding of the Ministry of Education and Science of the Republic of Kazakhstan Grant Agreement Number 0118PK01143

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## 1. Introduction

In all developed countries of the world, small and medium-sized entrepreneurship (SME) is a powerful engine of innovative development. SME is often the main subject of innovation, being the source and generator of new ideas and innovations. This is facilitated by characteristic features of small and medium-sized businesses such as flexibility in relation to the constantly changing conditions of the external environment, high mobility of resources, efficiency and return of financial resources and a propensity for risk.

In recent decades, research has shown that innovation is a key factor in improving the competitive position of firms. Their innovative ability significantly affects competitiveness, which is based on qualitatively new skills and abilities. The innovation potential for achieving much higher competitiveness means providing less expensive products and services of better quality than those provided by competitors. Therefore, the measurement of innovation potential remains one of the main problems studied by scientists, senior and middle managers.

Particularly for small and medium-sized enterprises, the adoption of best practices in innovation management has played a fundamental role in the growth and progress of these firms, creating new sources of competitive advantages compared to their competitors. Since there are many approaches and methods for researching innovative activities and innovation potential of small and medium-sized enterprises, it is necessary to build the logic of research of the development problem of small and medium-sized enterprises' innovation potential.

## 2. Literature review

In order to disclose the nature of the given problem and the validity of the studies, an important stage is to review the literature and analyze various view points regarding the concept of "innovation potential of small and medium-sized enterprises". A significant contribution to the development of the modern theory of innovation introduced by Rosenbusch, Brinckmann, Bausch (2011), Dewangan, Godse (2017), Cocca, Alberti (2018), Carpinetti, Gerolamo, Cardoza, Galdamez (2017), Calantone, Cavusgil, Zhao (2018), Xiong, Ye, Wang (2019), Kumar (2019), Mazzoni, (2020) and others who have elaborated on theory of innovative management. The problem of the innovation potential of small and medium-sized enterprises was studied by scientists Zawislak (2018), Hoq, Ha (2019), Maravelakis, Bilalis, Antoniadis, Jones, Moustakis (2016), Manjon, Mompo, Redoli (2016), Leskovar, Baggia, Metlikovič (2018) and others.

The works of scientists Baizholova (2014), Ismailova (2016), Kenzhebayeva (2014), Kurmanov (2015) are devoted to the problem of formation of innovative potential, as well as the assessment of the impact of various factors on its development.

According to the definition of Zawislak (2018) "innovation opportunity" is defined as a process of studying technology, turning into technological development and operational capabilities, and management and transactional procedures.

Moreover, the approach of Hoq, Ha (2019) is also interesting in terms of innovation efficiency for small and medium-sized businesses, according to which the innovation potential of small and medium-sized enterprises includes the following three areas:

1) orientation to social capital, which is a positive attitude and participation of human and social capital in innovation;

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- 2) market orientation, including the ability to respond to market conditions, as well as adapting innovation to changing environmental conditions;
- 3) entrepreneurial orientation, which includes a proactive attitude of the company to risk and competition.

In the work of Maravelakis, the innovation potential of small business is explained as the ability of the company to identify and perceive business opportunities and effectively implement market innovations (Maravelakis et al., 2016).

Based on a comprehensive analysis of various theoretical approaches, Manjon, Mompo, Redoli formulated the following definition: innovation is a process that is stimulated through the promotion of research and development, the acquisition of technology, human or financial resources that lead to results in the form of product and process innovations or and both of them, i.e. companies engaged in product and process innovation achieve greater efficiency, sales growth, profit and market expansion than companies that do not innovate. (Manjon et al., 2016).

In the work of Glazunova, the innovation potential is explained as the ability and readiness of the organization to use production, labor, intellectual, scientific-technological, marketing, material-energy, infrastructure, financial-economic and managerial resources to implement the innovative development of the organization, ensure its innovative activities and achieve innovative goals. According to this definition, the organization's innovation potential can be represented as a dependence on the potentials of its subsystems (Glazunova 2016):

$$IP = \mathbf{f}(P_p; P_l; P_{mar}; P_r; P_{int}; P_{st}; P_{fe}; P_{inv}; P_{man}) \quad (1)$$

Where:

- $P_p$  - production potential;
- $P_l$  - labor potential;
- $P_{mar}$  - marketing potential;
- $P_r$  - resource potential;
- $P_{int}$  - intellectual potential;
- $P_{st}$  - scientific and technical potential;
- $P_{fe}$  - financial and economic potential;
- $P_{inv}$  - investment potential;
- $P_{man}$  - management potential.

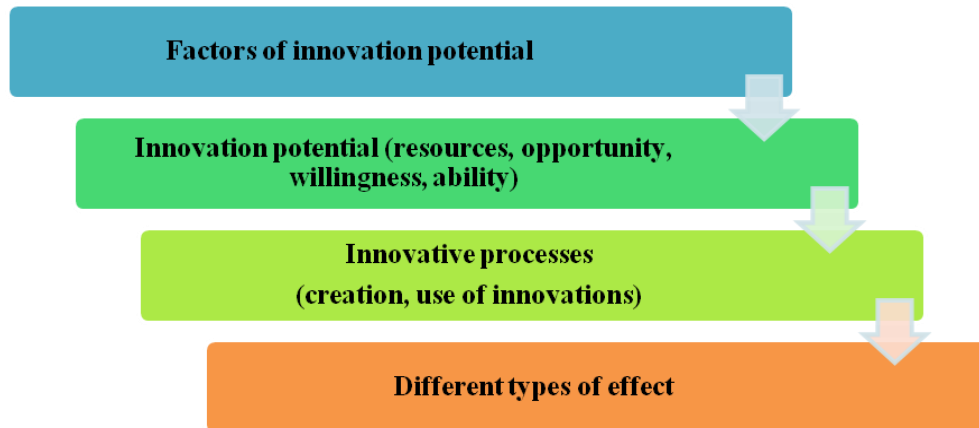
This approach considers the interaction of the organization's subsystems and the correct assessment of the innovation potential as part of the effective management of the organization's entire innovation activity.

A group of researchers from the Universities of Maribor (Slovenia) and Klagenfurt (Austria) considers the innovation potential of the company as the difference between the two states of the company: its goals and the actual state (Leskovar, Baggia, Metlikovič, 2008).

According to the author's approach of Kuzmina (2012), the innovation potential of the enterprise is one of the important resource components providing leadership in the competitive struggle. The author defines the innovation potential of the enterprise as the aggregate capabilities of the enterprise to achieve certain goals and solve problems of mastering new knowledge with the subsequent implementation process, resulting in new products, technology, process.

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In the work of Lapteva (2014), innovation potential is considered as an opportunity, readiness and the ability of an enterprise to create and use innovations with the available resources to obtain different types of effect (Figure 1).



**Figure 1.** Innovation potential of the enterprise by Lapteva (2014)  
*Source:* compiled by authors

The interpretation of Askarova (2016), based on the system approach, is also interesting. She proposes the definition of innovative capacity as the ability of the system to transform the actual order of things into a new state in order to meet existing or emerging needs, i.e. this is a kind of characteristic of the system's ability to change, improve, progress.

In general, the review of sources on this issue has shown that all approaches to the nature of innovation potential could be viewed from two aspects: first, innovation potential is a set of resource opportunities that enable the implementation of innovative projects; second, innovation potential as an indicator of the economic potential of the business entity.

Obviously, in order to identify the innovation potential of economic entities, taking into account all the significant indicators that characterize the various aspects of activity and the features of their innovation activities, it is necessary to determine the structure of the innovation potential of enterprises.

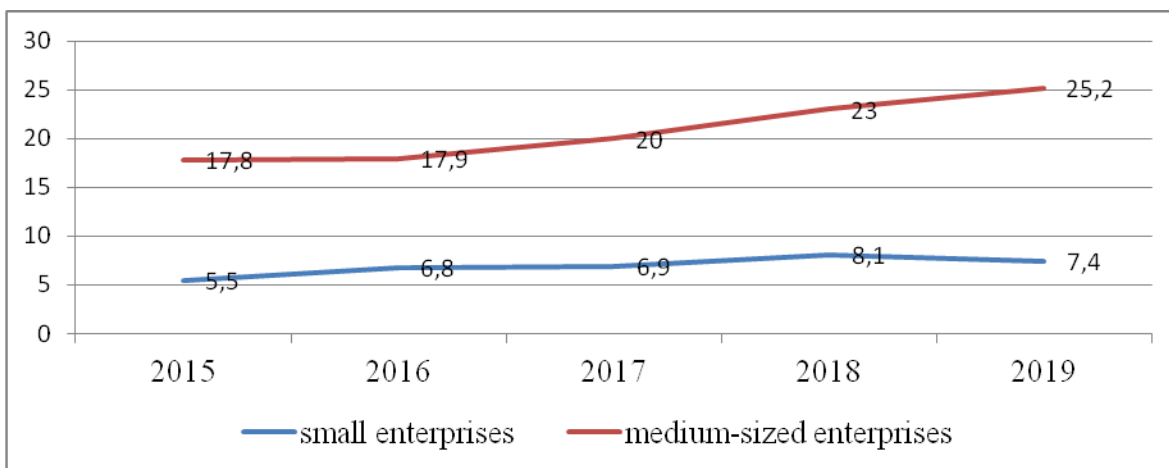
A review of the literature that, despite the existence of a wide range of definitions, the concept of “innovation potential of SMEs” does not have a well-developed and substantiated methodology for assessing innovation potential of SMEs. The authors of this study made an attempt to assess innovation potential of SMEs based on factors of influence on innovative products. Based on the set goal, the following tasks were set and solved in the research process: developed a conceptual model for the evaluation of innovation potential of SMEs, the analysis and the estimation of the innovation potential SMEs of Kazakhstan on the basis of three groups of factors: factors of SME development, factors of the General economic development of the country and factors of the development of research activities. On the basis of the results of the study, the identified factors influencing the final result of the innovative activity of SMEs were proposed Innovation activity characterizes the readiness to update the main elements of the innovation system - their knowledge, technological equipment, ICT and the conditions for their effective use, as well as sensitivity to everything new.

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### 3. Analysis of the current state

One of the important sectors for the implementation of the strategic objectives of innovative development of the economy of Kazakhstan is small and medium business, which serves as the foundation for ensuring the competitiveness of the economy and improving the welfare of the population of the country. The problem of using and enhancing the innovation potential of small and medium-sized businesses in Kazakhstan is becoming urgent due to the need to increase the role of small and medium business in the economy and the formation and development of innovative activities to increase the economic potential of the country as a whole. To identify the innovation potential of small and medium business in Kazakhstan, the level of their innovation activity in recent years will be analyzed. Innovation activity characterizes the readiness to update the main elements of the innovation system - their knowledge, technological equipment, ICT and the conditions for their effective use, as well as sensitivity to everything new.

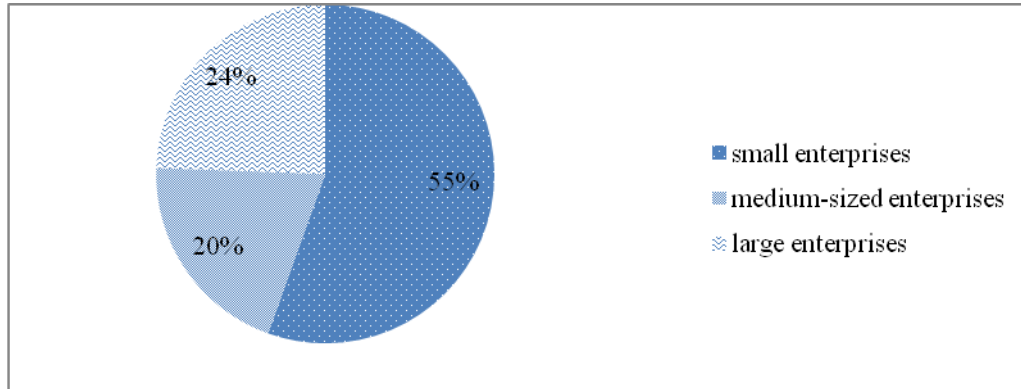
According to the Methodology, approved by order of the Chairman of the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan, the indicator of innovative activity is determined by the ratio of the number of innovatively active enterprises, that is engaged in any types of innovative activity, to the total number of existing enterprises and multiplying by 100 (Methodology for the formation of indicators of statistics of research and development works and innovations).



**Figure 2.** The level of innovation activities of small and medium-sized enterprises of the Republic of Kazakhstan, in %  
 Source: compiled by authors according to Methodology for the formation of indicators of statistics of research and development works and innovations

According to the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan, in 2019 the level of innovation activity of small and medium-sized enterprises increased in comparison with the indicator of five years ago, in particular for small enterprises by 1.9%, for medium-sized enterprises by 7.4%. Including the highest level of innovation activity of medium-sized enterprises (25,2%) rather than small (7,4%). An analysis of changes in the level of innovation activity of small and medium-sized enterprises over the past 5 years shows unstable dynamics (Figure 2).

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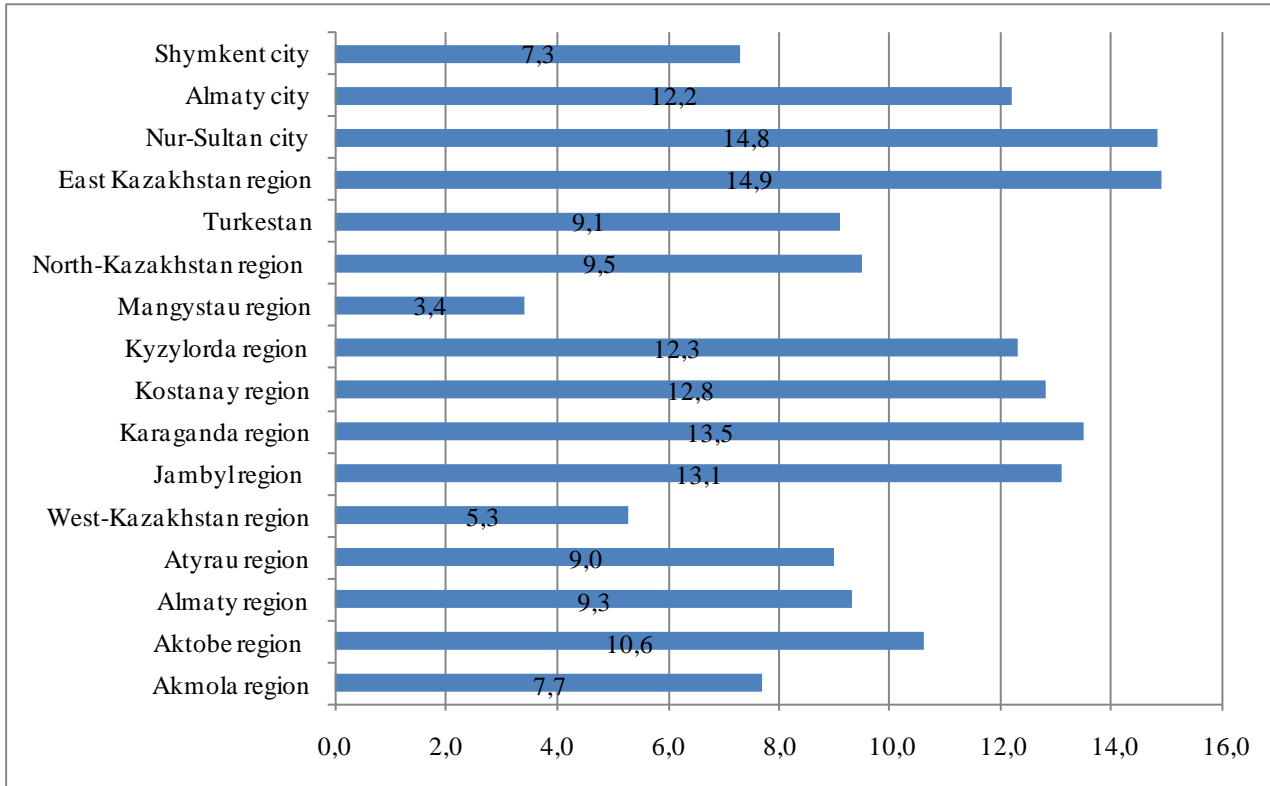
**Figure 3.** Structure of enterprises of the Republic of Kazakhstan, which have innovations in 2019, %

*Source:* compiled by authors according to Internet resource of the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan

For completeness, the structure of enterprises that have innovations will be compared. According to the data of 2019, as shown in the diagram (Figure 3), the share of small and medium-sized enterprises that have innovations is lower than the share of large enterprises, which indicates that the main entities of innovation activity in Kazakhstan are mainly large enterprises.

In addition, the development of innovative activities of small and medium-sized businesses in Kazakhstan depends on regional innovation features. So, in the context of regions, small and medium-sized enterprises of Nur-Sultan (14.8%) and East Kazakhstan region (14.9%) are the most innovative, which level is 3.5% higher than the average for the republic. The least innovative are enterprises of West Kazakhstan (5.3%), Mangistau (3.4%) and Shymkent (7.3%) regions (Figure 4).

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**Figure 4.** Level of innovation activity of small and medium-sized enterprises in Kazakhstan in the regional section in 2019, %

*Source:* compiled by authors according to Internet resource of the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan

Moreover, in order to identify the innovation potential of small and medium-sized businesses in Kazakhstan, we analyzed the level of innovation activity for major types of innovations such as product and process over the past 3 years.

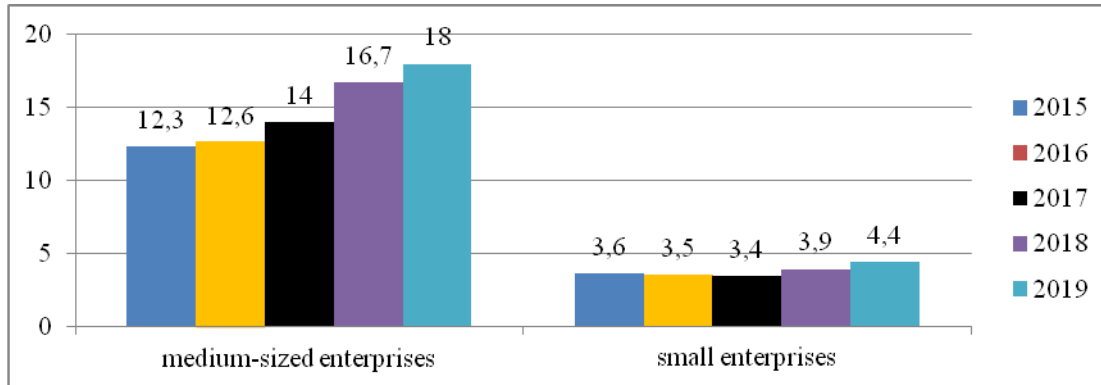
In domestic practice, the calculation of the indicator of innovative activity of enterprises is based on two types of innovations. According to the Methodology for the formation of indicators of statistics of scientific research and experimental design works and innovations (Order No. 232 of the Chairman of the Committee on Statistics of the Ministry of the National Economy of the Republic of Kazakhstan dated from 6 October 2016), the following definitions of product and process innovation are given:

- 1) product innovation – is the implementation of a product or service that is new or significantly improved in terms of the properties or methods of use, and also includes significant improvements in technical characteristics, components and materials, embedded software, user friendliness or other functional characteristics;
- 2) process innovation – is the implementation of a new or significantly improved method of production or delivery of the product and includes significant changes in technology, manufacturing equipment and (or) software.

Accordingly, the level of innovation activity is determined by the ratio of the number of enterprises carrying out product and process innovations to the entire number of functioning enterprises



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**Figure 5.** The level of innovation activities of small and medium-sized enterprises in the RK for process and product innovations in 2015-2019, %

*Source:* compiled by authors according to Internet resource of the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan

As Figure 5 shows, the level of innovation activity in product and process innovations of medium-sized enterprises is significantly higher than of small enterprises (by 4 times, according to 2019), which indicates that medium-sized enterprises, by virtue of their capabilities, have more innovation potential than small enterprises. As for the dynamics of the level of innovation activity in product and process innovations, there is also a positive tendency for medium-sized enterprises (an average increase of 1.42% per year), while for small enterprises a rise is observed by 1% in 2019 compared to 2017, and a decrease of 0.1% in comparison with 2015.

Summarizing the analysis of the level of innovation activities of small and medium-sized enterprises in Kazakhstan, several important points could be highlighted:

- The innovation potential of small and medium-sized enterprises is significantly lower compared to large enterprises, which indicates the need to formulate and implement a targeted innovation policy in the sphere of small and medium-sized businesses;
- in the context of the intra-sectoral structure, the level of innovation activity of small enterprises in comparison with medium-sized enterprises ought to be better, as evidenced by the data for the last three years, which mainly affects the competitiveness and efficiency of small enterprises as a whole;
- the uneven development of innovation activities of small and medium-sized enterprises by regions, which in turn determines the unevenness of economic development and the resource potential of the regions (the indicator of the region with the highest level of innovation activity (14.9%) is 4.4 times higher than the region with the lowest level (3.4%);
- a significantly low level of product and process innovation of small and medium-sized enterprises, which are basic in the innovation activity of economic entities, providing mainly improvements in the quality of products and raising the technical level of production.



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#### **4. Institutional framework for supporting innovation development**

An important aspect of supporting the innovative development of SMEs is the creation of specialized structures and institutions that form the infrastructure of innovation activity, among which, first of all, JSC National Innovation Fund (NIF) established in 2003 by the resolution of the Government of the Republic of Kazakhstan dated 30.05. 2003 with 100% state participation in the authorized capital, which was reorganized in 2012 in JSC "National Agency for Technological Development" (NATD - further Agency). The main goal of the activity is coordination of innovative development processes and provision of state information, analytical and investment support. For a relatively short period from the foundation of the Agency, significant results have been achieved, including:

- 1) the framework of investment support, the Agency provides financing for innovative projects and the creation of venture funds. At the end of 2018, the agency allocated 4.67 billion tenge to finance innovative projects and provide services.
- 2) the framework of information and analytical support, Agency developed normative documents and state programs. So in 2010, the Government approved the Program for the Development of Innovation and Assistance for Technological Modernization until 2014, and in 2012 the Law of the Republic of Kazakhstan "On State Support of Industrial Innovative Activities" was adopted. Proposals to the Tax Code were formed, according to which enterprises can reduce the taxable base by 50% of the cost of research and development (R & D).
- 3) the Agency's total investment portfolio as of 2018 is 2.36 billion tenge (\$13 million), which includes 5 project companies and 6 venture funds (3 domestic and 3 foreign).
- 4) the development of the system of commercialization of technologies in 2011, the Agency created 9 commercialization offices with the best research institutes and universities in Kazakhstan, which are the link between science and business in order to promote the results of research activities to the market.
- 5) in order to stimulate innovation activities, the Agency carries out activities to promote innovation and revitalize the rationalization movement. Annually there are an international innovation congress, competitions of innovative business projects and rationalization solutions, a contest of journalistic materials, as well as exhibitions of domestic innovative projects.
- 6) 8 regional technology parks and 3 design bureaus are created and are functioning in order to develop the innovation infrastructure, the free economic zone "Park of Innovative Technologies" is functioning on the territory where an innovation cluster on the principle of "education-science-technology-production" is planned to be created.
- 7) during the period between 2011 and 2015, the Agency set up five international technology transfer centers in Korea, China, the USA, Russia and France to implement and promote joint technology transfer projects. As a result, 15 Kazakh enterprises were assisted in the transfer of technology in the region of the mining and metallurgical complex, agriculture, power engineering and machine building, etc. (The development strategy of the joint stock company "National Agency for Technological Development" for 2014-2023).

In addition to the National Agency for Technological Development, in order to promote the development of priority, initiative, risk research and development work in 2006, JSC "Science Foundation" was established. According to the decision of the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan dated 21.04.2011, the priority areas of the investment activity of the Science Foundation are: energy, deep processing of raw materials and products, information and telecommunication technologies, life sciences, intellectual potential of the country. The Fund provides loans to scientists in the amount of 50 thousand to 2 million US dollars, planning to establish an enterprise or to realize the results of its research activities for 3-5 years. During the 10 years of its activity, the Fund has financed 22 research projects for a total amount of 242.2 million tenge (\$ 752,000) and provided innovative grants for financing 28 projects for 690.2 million tenge (\$ 2.1

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million). Another important player on the innovation field is the Development Bank of Kazakhstan, which was founded in 2001. The Bank renders financial support to the private sector and state organizations in the implementation of infrastructure projects and lending to industrial enterprises. In the framework of GPIFIR, the Bank participated in the implementation of 22 investment projects with a total value of more than 5.6 billion US dollars, of which 3.8 billion US dollars was allocated by the Bank. Among them there are strategically important projects such as Kazakhstan Electrolysis Plant, Kazakhstan Petrochemical Industries, Atyrau Oil Refinery and others.

Entrepreneurship Development Fund "Damu" was established in 1997 with the aim of financial and non-financial support the small and medium-sized enterprises (SMEs), as well as stimulating demand for their products. Initially, Damu was responsible for managing public funds received on credit from the Asian Development Bank (ADB) and the European Bank for Reconstruction and Development (EBRD). In 2002, the Fund began direct financing of SMEs at its own expense. Over the years of the foundation's work, they received financial support for a total of 1,505 billion tenge (\$ 4.6 billion) of about 31,000 SMEs. Most of these funds (approximately 70%) were used on stabilization programs to support enterprises affected by the financial crisis through interest rate subsidies, loan guarantees, charter capital, etc. Priority is given to regional support programs, financing of the real production sector, women's entrepreneurship, as well as leasing financing for SMEs. Since 2009, Damu also provides non-financial support, which includes training and consulting services, business plan preparation services, the creation of a nationwide network of business support centers.

The Investment Fund of Kazakhstan (IFK) was established in 2003 for private investments into share capital. IFK is engaged with investing in new and existing companies that deal with the processing of raw materials, using new technologies. The Fund also finances investment projects abroad in the framework of industrial cooperation between national and foreign companies (Kulmaganbetova, 2013).

## **5 Methodology**

The methodology of this study includes the study of theoretical approaches to the assessment of innovation potential, as well as the collection of necessary statistical data for its implementation. During the formulation of the problem in question, the task was set to identify the main groups of factors affecting the indicator of innovation potential of small and medium-sized businesses in the Republic of Kazakhstan, as an indicator of the volume of manufactured innovative products. The basis for this approach to the choice of the indicator of innovation potential of enterprises is the evolutionary theory of factors of production, according to which the produced product is considered as a function of the aggregate of resource (human, technical, technological, material, institutional, organizational and information) opportunities of production. In this paper, it is proposed to consider the volume of innovative products as a result of the implementation of the innovation potential (Inshakov, 2006).

Using the proposed methodology for evaluating innovation potential, there was a study conducted of the impact of factors on the volume of produced innovative products by small and medium-sized enterprises in Kazakhstan using statistical analysis applying the PSPP package. At the initial stage of the study, official statistical data for the period of 2010-2019 were collected and processed by the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan in the public domain.

An empirical analysis of the available data allowed to develop a conceptual model of the connectivity of the innovation potential of small and medium-sized enterprises with the factors grouped as follows (Table 1):

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**Table 1.** Factors affecting the innovation potential of small and medium-sized enterprises

Name of group	Factors
Factors of development of small and medium-sized enterprises	<ol style="list-style-type: none"> <li>1. The number of SMEs</li> <li>2. The share of SMEs in GDP</li> <li>3. The level of employment in SMEs</li> <li>4. The volume of production of SMEs</li> <li>5. Fixed assets of small and medium-sized enterprises</li> </ol>
Factors of General economic development of the country	<ol style="list-style-type: none"> <li>1. Volume of GDP</li> <li>2. The share of innovative products produced in GDP</li> <li>3. Costs of production of innovative products</li> <li>4. The volume of production of industrial products</li> <li>5. Investments in fixed assets</li> <li>6. The inflow of foreign direct investment</li> </ol>
Factors in the development of research activities	<ol style="list-style-type: none"> <li>1. The number of employees performing R&amp;D</li> <li>2. Expenditures on R&amp;D</li> <li>3. The share of R&amp;D expenditure in GDP</li> <li>4. The number of organizations conducting R&amp;D</li> <li>5. The average monthly wage of employed R&amp;D</li> <li>6. The volume of produced innovation products</li> <li>7. The number of students and doctoral students of higher educational institutions</li> <li>8. The number of teaching staff of higher educational institutions</li> </ol>

*Source:* compiled by authors

A review of the literature on the problem under study showed that there is no unified methodology for assessing innovative potential that reveals the features of its development at all levels. Taking into account the above, the authors propose a grouping of factors influencing the innovative potential of SMEs at the macro, micro and meso levels.

1 group - the factors of small and medium-sized business development that determine the necessary conditions for the development of innovative activities of SMEs and include the number of SMEs, the share of SMEs in the country's GDP, the level of employment in SMEs, the volume of SMEs production, the availability of fixed assets of small and medium-sized enterprises;

2 group - factors of the country's overall economic development are considered as factors determining the potential of the national economy, an important part of which is small and medium business and provides effective innovation activities. Among these factors, there are the volume of GDP, the share of innovative products produced in GDP, the costs of production of innovative products, the volume of industrial production, investment in fixed assets, the inflow of foreign direct investment;

3 group - the factors of the development of research activities are factors determining the level of development of science and technology, which are the basis for the implementation of innovative activities at SMEs. It includes the number of employees performing R&D, R&D expenditures, the share of R&D expenditures in GDP, the number of R&D organizations, the level of wages of R&D workers, the volume of innovative products produced, the number of students in higher education institutions, the number of professors and instructors of higher education institutions, etc.

## 6. Results

For further evaluation, a correlation matrix was constructed that made it possible to determine the 13 variables associated with the volume of produced innovative products by small and medium-sized enterprises in Kazakhstan (Table 2).

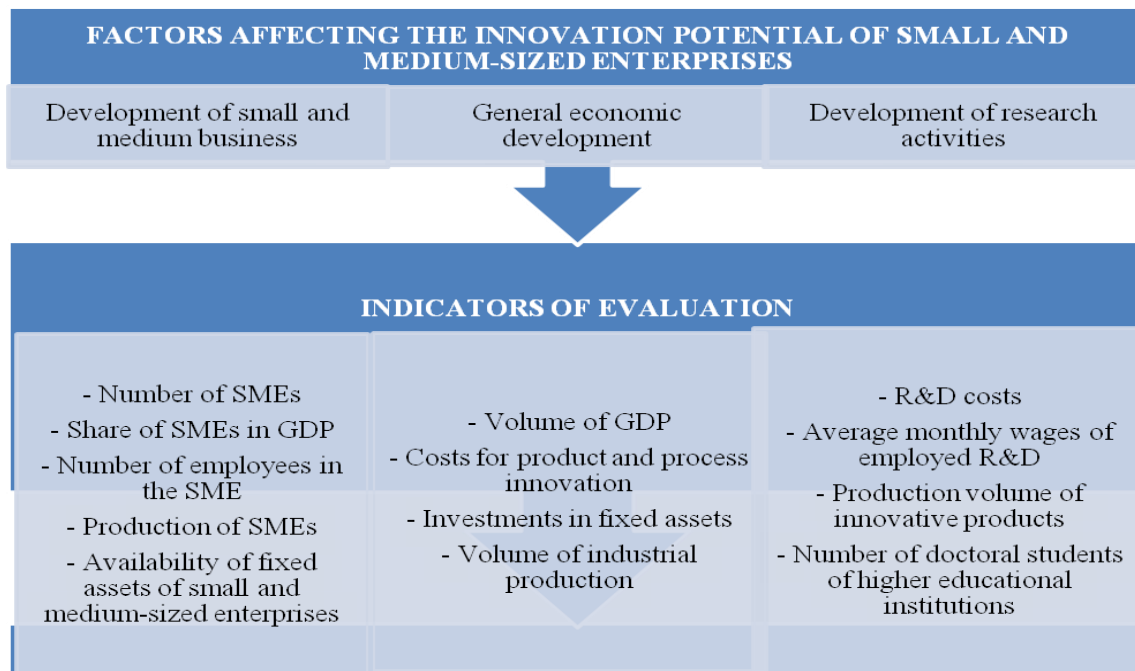
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**Table 2.** Variables associated with the volume of innovative products produced by SMEs in Kazakhstan

Indicators	Correlation coefficient
1. Number of SMEs	0,83
2. The share of SMEs in the country's GDP	0,77
3. Number of employees in the SME	0,82
4. Production of SMEs	0,93
5. Volume of GDP	0,94
6. Costs for product and process innovation	0,73
7. Volume of production of industrial products	0,83
8. Investments in fixed assets	0,92
9. Average monthly wage of employed R&D	0,92
10. Costs of R&D	0,7
11. Volume of produced innovation products	0,92
12. Number of doctoral students of higher educational institutions	0,95
13. Fixed assets of small and medium-sized enterprises	0,8

Source: compiled by authors

Based on the results of checking the coherence and consistency of statistical indicators using methods of measurement theory and correlation analysis, the authors developed a model for assessing the influence of factors on the innovation potential of small and medium-sized enterprises (Figure 6).



**Figure 6.** The model for assessing the impact of factors on the innovation potential of SMEs

Source: compiled by authors

The grouping of variables into the appropriate groups was carried out on the basis of an assessment of the internal consistency (reliability, consistency) of the indicators included in the group. For this purpose, the Cronbach alpha

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coefficient was calculated in the PSPP program, which characterizes the internal consistency (homogeneity) of the variables (Dubina, 2010).

To form groups of internally consistent indicators, the following property of the alpha coefficient was used. If you exclude any indicator from the group, the alpha coefficient will change (decrease or increase). With the exclusion of indicators that do not contradict other indicators (in the sense that they are all aimed at measuring the general factor), the Cronbach alpha coefficient decreases. And, on the contrary, if you exclude indicators that do not agree with others, the value of the alpha coefficient will increase. The Cronbach alpha coefficient takes values in the range from 0 to 1. It is considered that the values of  $\alpha$  0.6 indicate a fairly acceptable measurement consistency, and the values  $\alpha$  0.8 characterize good consistency (Dubina, 2010).

Thus, it was possible to form three groups of variables corresponding to 3 factors (Figure 6). For variables (economic indicators) included in the first group (development of small and medium businesses), the alpha coefficient was 0.98. For the second group (general economic development) and the third group (Development of R&D), this figure is 0.95.

So, a model coordinated and collated by indicators has been constructed, it describes the relationship of the evaluation indicators to the main groups of factors affecting the innovation potential of small and medium-sized enterprises.

To determine the degree of influence of changes in independent variables (X) on the volume of innovative products produced (Y) by small and medium-sized enterprises in Kazakhstan, the pairwise linear regression method is applied (Table 3). Pairwise regression models were constructed, since the multiple regression models are statistically insignificant due to the multicollinearity effect (the connectivity of the attributes included in the model) (Dubina 2010).

In this study, the hypothesis is to determine the degree of influence of changes in factors on the final result of innovative activities of SMEs.

As a result of the simulation, the following equations of pair regression were obtained:

- 1)  $Y = -195347,79 + 0,37X_1 \pm 56150,48$ ;  $X_1$  – Number of SMEs
- 2)  $Y = -160363,33 + 14396,71X_2 \pm 63500$ ;  $X_2$  – The share of SMEs in GDP
- 3)  $Y = -423798,9 + 0,21X_3 \pm 57564,5$ ;  $X_3$  - Number of employees in the SME
- 4)  $Y = -43481,2 + 0,02X_4 \pm 37070,6$ ;  $X_4$  - Production of SMEs
- 5)  $Y = 12130,42 + 0,01X_5 \pm 60598,7$ ;  $X_5$  – Fixed assets of small and medium-sized enterprises
- 6)  $Y = -201343,92 + 0,01X_6 \pm 71508,3$ ;  $X_6$  – Costs of R&D
- 7)  $Y = -97887,83 + 7,48X_7 \pm 35241,46$ ;  $X_7$  – Volume of GDP
- 8)  $Y = -121063,74 + 1,81X_8 \pm 39283,88$ ;  $X_8$  – Average monthly wage of employed R&D
- 9)  $Y = -21573,91 + 0,46X_9 \pm 40086,65$ ;  $X_9$  – Volume of produced innovation products
- 10)  $Y = -31794,07 + 110,52X_{10} \pm 31448,93$ ;  $X_{10}$  – Number of doctoral students
- 11)  $Y = -230722 + 0,06X_{11} \pm 38791,36$ ;  $X_{11}$  – Investments in fixed assets
- 12)  $Y = -155274,34 + 0,02X_{12} \pm 55639,15$ ;  $X_{12}$  – Volume of production of industrial products
- 13)  $Y = 54932,69 + 0,16X_{13} \pm 68029,74$ ;  $X_{13}$  – Costs for product and process innovation

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**Table 3.** Parameters of the pair regression model

Variables	R square	B
1. Number of SMEs	0,69	0,37*
2. Share of SMEs in GDP, %	0,6	14396,71*
3. Availability of fixed assets of SMEs, mln. tg	0,63	0,01*
4. Gross domestic product, billion tg	0,88	7,48*
5. Number of employees in SMEs, pers	0,67	0,21*
6. Production of SMEs, mln tg	0,86	0,02*
7. Number of students in higher education institutions, pers	0,84	-1,02*
8. Number of doctoral students, pers.	0,9	110,52*
9. Investments in fixed assets, mln. tg	0,85	0,06*
10. Average monthly nominal wages of employed R&D, tenge	0,85	1,81*
11. Volume of innovative products produced, mln tg	0,84	0,46*
12. Volume of industrial production, mln tg	0,69	0,02*
13. Costs for product and process innovation, mln tg	0,54	0,16

\* - p- level of statistical significance < 0.01

Source: compiled by authors

The parameters of the constructed regression models allow us to compare the connectedness of the variability of the effective indicator (the volume of the innovative products produced) with the variability of the corresponding indicators. This connectivity could also be interpreted as the degree of influence of factor characteristics on the outcome. Thus, the emergence of each new enterprise in the SME will lead to an increase in the volume of innovative products by an average of 370 thousand tenge (\$ 1,1 thousand), an increase in the share of SMEs in GDP by 1% - by 14,396 billion tenge (\$ 44.7 million), an increase in the number of people employed in SMEs by 1 person - by 210 thousand tenge (\$ 652), an increase in R&D expenses by 1,000 tenge (\$ 3) - by 10,000 tenge (\$ 31), an increase in GDP by 1 billion tenge (\$ 3.1 million) - by 7.48 million tenge (\$ 23.2 thousand), an increase in the average monthly salary of employed R&D by 1,000 tenge (\$ 3) - by 1.81 million tenge (5,6 thousand dollars), an increase in the number of doctoral candidates by 1 person will lead to an increase in the volume of innovative products by an average of 110.52 million tenge (\$ 343.2 thousand).

In order to analyze the influence of different groups of factors on the volume of produced innovative products, small and medium-sized enterprises calculated the aggregated indicators for each group of factors, the degree of correlation that is quite high with the volume of innovative products produced, which demonstrates the compatibility of integrated factors for characterizing the innovation activity of SMEs (Table 4).

Aggregated indices were calculated from the corresponding groups with high internal consistency (reliability), determined using the Cronbach alpha coefficient. Since the indicators in the group have different scale and dimension, they were reduced to a standard z-distribution with an average of 0 and a standard deviation of 1:

$$R_{nz} = \frac{R_c - m}{s},$$

Where:

$R_{nz}$  - is the z-normalized value of the indicator for the analyzed group;

$R_c$  - is the initial value of the indicator for the analyzed group;

$m$  - is the average value for the characteristic in the group;

$s$  - is the standard deviation for the characteristic in the group.



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With this transformation, the indicators with values less than the average for the group will have negative values, with large - positive.

As a result, sets of values of three indices corresponding to three groups of analyzed factors were obtained.

**Table 4.** Parameters of the degree of dependence of the volume of innovation products produced from different groups of factors

Group of factors	Alpha Cronbach (reliability)	Correlation with aggregated index	Closeness of the relationship between the aggregated indicator and the dependent variable
Factors of development of small and medium business	0,98	0,87	75,69%
Factors of General economic development of the country	0,95	0,88	77,44%
The factors in the development of research activities	0,95	0,93	86,49%

*Source:* compiled by authors

Correlation-regression analysis showed the presence of very high bonds of aggregated indices with the result of innovation activity of SMEs. Thus, the variability of the output of innovative products by small and medium-sized enterprises in Kazakhstan depends on 75.7% of the development factors of small and medium-sized businesses, by 77.44% of the factors of the general economic development, the highest degree of cohesiveness has been found with the factors of development of research activities (86.5%).

## 7. Conclusion

Based on the assessment, it was revealed that the closeness of the relationship of the aggregated indicator for micro-level factors was 86.49%, meso-level factors 75, 69% and macro-level factors 77.44%. This means that for the development of innovation potential of SME, the factors of development of research activities are of the greatest importance, and the factors of development of small and medium-sized businesses are of the least importance.

The conducted studies made it possible to conclude that in assessing the innovation potential of SMEs, the key point is the opportunities for innovative development of small and medium-sized enterprises, which ultimately are expressed by the volume of innovative products produced by them.

On the basis of the correlation-regression analysis of the influence of factors on the effectiveness of innovation activity of small and medium-sized businesses, it was possible to develop a conceptual model for assessing the innovation potential of SMEs in the Republic of Kazakhstan, which includes three main groups of indicators, namely, the group of "SME development indicators", indicators of the "general economic development of the country" and a group of "indicators of scientific and innovation activities". The conceptual model allows to integrate the results of innovation activities of enterprises and existing conditions for its development both at the macrolevel and at the sectoral level.

Also, during the research it was revealed that the volume of produced innovative products by SMEs in Kazakhstan is most influenced by factors such as the volume of GDP produced in the country (correlation coefficient - 0.94), the volume of products produced by SMEs (correlation coefficient - 0.93), the volume of



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innovative products produced in the economy in general (correlation coefficient - 0.92), the volume of investment in fixed assets (correlation coefficient - 0.92), and the level of wages engaged in R&D (correlation coefficient - 0.92).

In addition, as shown by the correlation analysis, there is a very weak relationship between the result of innovation activity of small and medium-sized enterprises with such factors as the number of workers performing R&D, the share of R&D expenditures in GDP, the number of organizations performing R&D, the share of innovative products produced in GDP, the teaching staff of higher education institutions, and the influx of foreign direct investment. As one of the main reasons for the low degree of coherence of the outcome indicator with factorial, the so-called "deferred effect" of the influence, which in innovation activities manifests itself after a certain period of time, is considered.

On the basis of the construction of the pair regression model, it has been established that SMEs, the share of SMEs in GDP, the number of people employed in SMEs, the cost of R&D, the volume of GDP, the average monthly salary of employed R&D, the number of doctoral candidates, have a significant impact on the volume of SMEs produced by innovative products. The degree of influence of the relevant factors is also determined.

Proceeding from the results of the assessment of the influence of factors on the results of innovation activity of SMEs subjects, the most important problems are identified, which need to be paid attention to further enhance their innovation potential:

- the need to increase the level of innovation activities of SMEs by encouraging the creation of innovative enterprises;
- the need to create conditions for the development of SMEs to increase the share of SMEs in the production of the country's GDP;
- increase in the level of employment in the SME, which is expressed by the increase of labor potential, which is an important component of the whole SME potential;
- stimulation of financing of research and development activities of small and medium-sized enterprises, designed for a long-term perspective of innovation;
- the solution of the most important issues in the staffing of innovation activities of SMEs, in particular the increase of wages of employed R&D, the provision of science personnel to SMEs.

The novelty of this study lies in the development of a system of factors affecting the innovation potential of SME and its assessment using the economic and statistical method.

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### ***Acknowledgements***

*The article was prepared based on the results of an intermediate stage of research "Development of a systematic regulation mechanism for financial and credit organizations to support the innovation sector in the context of sustainable macroeconomic effects", carried out under grant funding of the Ministry of Education and Science of the Republic of Kazakhstan Grant Agreement Number 0118PK01143*

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