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Analysis of Innovation Activity in the Industrial Market of Kazakhstan

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Abstract

The growth of innovative potential is becoming the main driver of the competitiveness of the national economy. It is obvious that economic growth can be achieved only through the development of industrial and innovative achievements, the introduction of new technologies, and the use of modern computer technologies in production. Unfortunately, in Kazakhstan, the development of innovations is not sufficiently developed now. We see a small number of innovative developments and a small number of patents. Science is not related to business. All this confirms the fact that it is necessary to develop innovative potential in Kazakhstan and stimulate the demand and supply of innovations. Obviously, innovation is a key driver for the development of any enterprise. Only a wide assortment and high quality cannot ensure competitiveness; it is necessary to introduce innovations and new technologies. At the same time, innovative activity should be permanent and not be a one-time event. It is necessary to analyze the innovation market by conducting a regression analysis. Regression analysis is a method of modeling measured data and examining its properties. To analyze the influence of the main indicators of innovative activity, 7 variables were selected, and the data were considered in the context of 14 regions and two cities: Nur-Sultan (Astana) and Almaty.

Keywords: innovation, innovative potential, innovative activity, industrial market

Introduction

Industrial policy, as the core of the general economic policy of the state, should be associated, first, with the implementation of innovative restructuring of industrial production. In 2017, work was carried out to develop measures for the technological re-equipment of industry, including elements of the fourth industry of the revolution. On the ground, plans are being developed for the digitalization of regions with different implementation periods until 2025 (Ishchenko-Padukova & Movchan, 2017). To increase competitiveness, large, export-oriented domestic enterprises have begun to implement the technologies of the fourth industrial revolution in their industries. In general, it should be noted that the measures taken to stimulate the transition of industry to Industry 4.0 will contribute to an increase in the share of large and medium-sized enterprises that have introduced digital technologies to 11% in 2022. Measures have been developed that are aimed at creating the necessary ecosystem to support our enterprises' planning digitalization and stimulate more active adoption of digital technologies. These measures were included in the state program "Digital Kazakhstan".

Innovations in Kazakhstan are implemented within a complex dynamic system, the effectiveness of which depends on the use of internal capabilities. Many factors influence the innovative activity of enterprises. To form a strategy for the development of the innovative activity, it is necessary to understand what criteria exactly influence its activity. Such indicators as the number of enterprises with innovations, the level of activity in the field of innovations, the number of organizations that carried out R&D, and the volume of domestic costs have a significant impact on the level of innovation activity in the country. At the same time, it should be considered that for the proper development of innovative potential in the country, special attention should be paid to the growth in the number of employees who performed research and development, as well as the number of developed innovations. However, the importance of these factors and

the degree of their influence must be carefully researched and dependencies between these variables identified.

The transfer of the economy of Kazakhstan to an innovative path of development is one of the main priorities of state policy aimed at ensuring the sustainability of the national economy in the face of global competition (Bizikova & Pivovarova, 2017). The competitiveness of the national economy directly depends on the growth of innovative potential in society. This means that economic growth should be carried out mainly due to industrial and innovative achievements, the introduction of scientific and technological progress, the use of a computer, and resource-saving technologies (Bastl et al., 2012).

Objective. Now, the development of innovation processes in the country is at a low level. This is expressed by a small number of innovative developments of enterprises, weak patent activity, science is divorced from business, and functions within the framework of an industrial model. In Kazakhstan, for the development of innovative potential, it is necessary to carry out work on stimulation and supply and demand, to develop competitive market mechanisms (Almerekov & Kashkimbaeva, 2018). The innovative activity must be present in any manufacturing enterprise. This is because without modern technologies, increasing the range and improving the quality of products, the enterprise will not be able to increase its competitiveness in the markets. Moreover, to maintain competitiveness, it is necessary for innovation to become an ongoing process, rather than a one-off event. The common problem of low innovation activity is not only the lack of funding but also the general understanding of the infrastructure for the development of innovative potential. World practice shows that high budgets do not always become the key to success in innovation, and therefore it is important to study the factors that affect the level of innovation activity.

Literature Review

According to the research of innovative activity in Kazakhstan by such authors as Mamraeva (2017), Abylkasymova (2020), Seitzhanov (2020) in Kazakhstan there is a

progressive trend in the development of licensed trade in intellectual property, but, nevertheless, many enterprises are still characterized by low innovative activity, which is confirmed by the fact that only 3 to 6 percent of registered invention contracts in the country find their practical implementation. The share of innovative products in the country's gross domestic product is less than 1%. In the course of the literature review, it becomes obvious that in Kazakhstan there is a lack of empirical research, which is an assessment of the contribution of various factors to the development of innovative potential, their relationship with the volume of innovative activity, and research in the field of the behavior of innovative organizations. In this area, such well-known publications as Onyusheva (2017), Smirnova (2016), Tumalavičius et al. (2017), Tsaurkubule et al. (2020), Vigliarolo (2020) revealed the main problems.

As can be seen from Figure 1, the dynamics of changes in internal costs for innovation since 2011 have a positive trend. During this period, the cost of innovation has doubled from 33,466 thousand tenge in 2011 to 68,884 thousand tenge in 2018. However, they slightly decreased during the pandemic to 61,005.1 thousand tenge in 2021.

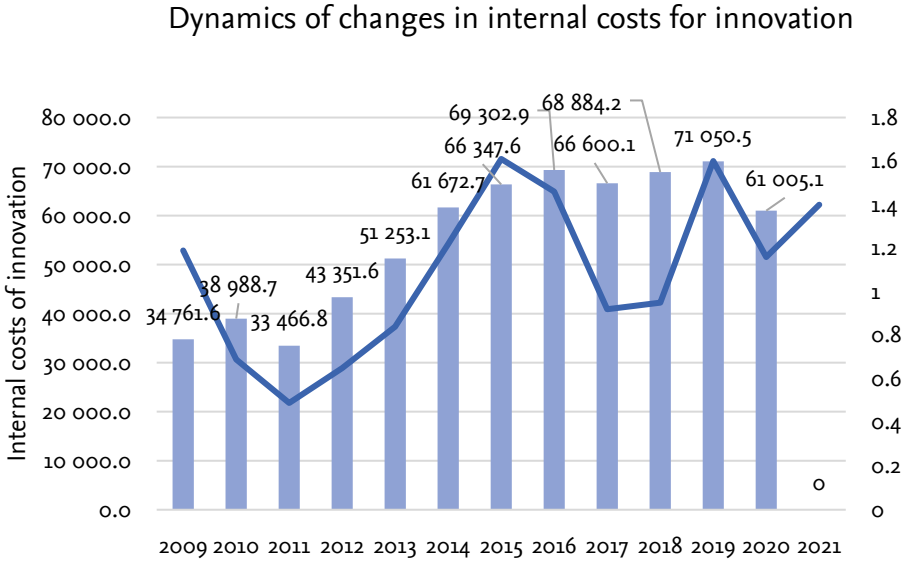

Figure 1. Dynamics of changes in internal costs for innovation, 2009-2021.
Source: Compiled by the author based on data from (Statgov, 2022)

The volumes and indices of industrial production in the regional aspect reveal that the indicators in some regions have a slight increase, therefore, in the case of the intensification of the use of innovative marketing in certain industrial sectors of the country, its results could be the stimulation of the general activity of local and regional industrial entities, an increase in competitiveness. individual large enterprises and sectors of the economy, and the intensification of the processes of participation of Kazakhstani brands in world commodity markets, in international spaces (Caurkubule et al., 2020).

Currently, the problems of modernization and innovative restructuring of the economy are key areas of socio-economic transformation Kazakhstan. Innovation processes in the Kazakh economy are significantly hampered by the institutional problems of the national innovation system. Commercialization and transfer of innovations have not experienced significant growth due to insufficient links between science, education, and business.

By 2017, the situation became more complicated, in which the seven leading countries of the world possess 46% of macro technologies and control more than 80% of the market for high technology products, incl. USA more than 20%, Japan - more than 14%, Germany - more than 10%. The position of Kazakhstan in the world market of innovative products in 2017 was insignificant: its share by type of activity ranges from 0.15 to 0.75%, while this indicator for the USA is 36%, Japan - 30%, China - 1% (Bozhko, 2010). The key indicator of innovation activity that characterizes the potential for technological modernization of the country is the activity of enterprises in the field of technological innovation. The level of innovation activity of the Kazakhstani economy lags far behind such innovatively developed countries as Germany - 70%, Canada - 65%, Denmark, Ireland, and Finland - 57%. This situation has arisen because in the enterprises of Kazakhstan, innovative activities, as a rule, are realized through the acquisition of technologies and equipment from foreign production, but their own innovations are not created Figure 2).

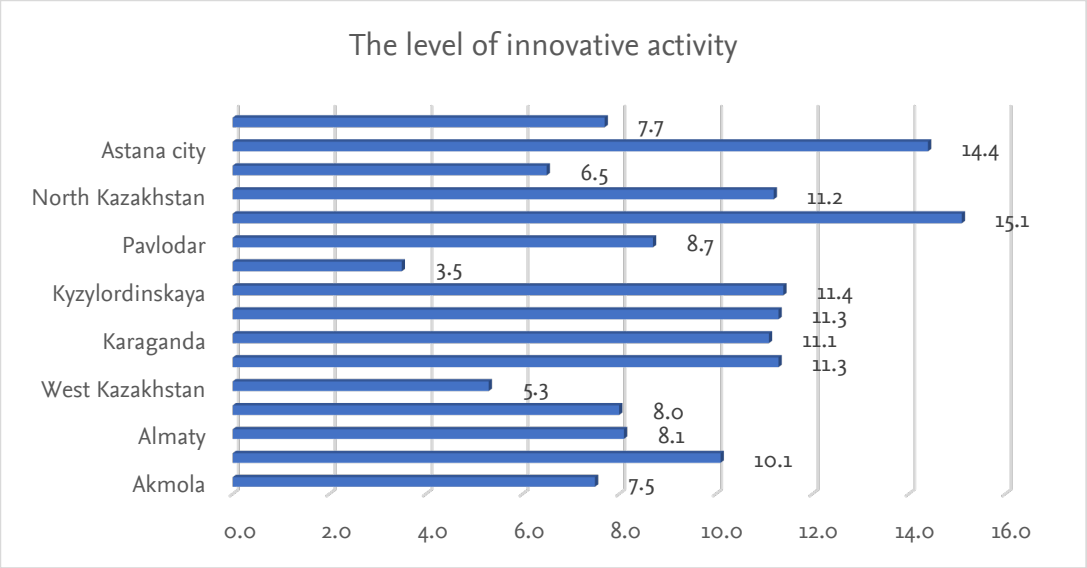

Figure 2. The level of innovative activity

Note: compiled by the author based on the source

In recent years, the main elements of the innovation infrastructure have been created in Kazakhstan, however, significant progress has not yet been achieved: innovation processes have little effect on the development of the economy (Maldynova, 2018).

Research Methodology and Design

Regression analysis was used to identify links between the factors of innovative activity. Regression analysis is a method of modeling measured data and examining its properties. Data consists of pairs of values for the dependent variable and the independent variable. The model of given regression is a function of the independent variable and parameters with an added random variable (Bengtsson, 2014). These variables were selected based on the experience of previous studies (Kravchenko & Marchenko, 2016) and are presented in the Table 1.

Table 1. Key indicators of innovation

Region	The volume of innovative products, million tenge	Enterprises with innovations	The level of activity in the field of innovations, in%	Number of organizations that carried out R&D	Internal costs, million tenge	The number of employees who performed research and development	Number of developed innovations
	Y	X1	X2	X3	X4	X5	X6
Akmola	15 721,9	98	7,5	11	898,2	678	24
Aktobe	39 442,0	116	10,1	16	839,1	362	32
Almaty	12 624,2	146	8,1	11	871,1	968	66
Atyrau	5 768,0	92	8,0	10	3 637,7	474	27
West Kazakhstan	18 122,1	49	5,3	8	298,5	323	11
Zhambyl	50 854,7	96	11,3	11	1 024,3	377	35
Karaganda	32 048,0	257	11,1	29	3 488,1	1 360	72
Kostanay	91 502,6	167	11,3	14	1 176,5	569	52
Kyzylordinskaya	5 505,8	89	11,4	8	506,3	229	23
Mangystau	294,9	40	3,5	6	8 043,5	696	13
Pavlodar	177 881,5	112	8,7	11	335,7	654	43
East Kazakhstan	80 472,0	303	15,1	34	5 000,5	2 325	76
North Kazakhstan	13 804,9	115	11,2	5	185,2	93	34
South Kazakhstan	125 231,6	162	6,5	19	924,2	1 090	113
Astana city	149 277,5	582	14,4	62	16 297,5	3 062	117

Almaty city	26 183,3	550	7,7	131	25 357,8	8 821	240
Note: compiled by the author based on the source (Statgov, 2021)							

To analyze the influence of the main indicators of innovative activity, 7 variables were selected, and the data were considered in the context of 14 regions and two cities: Nur-Sultan (Astana) and Almaty. Data for the analysis were selected from statistical data published on the website www.egov.stat.kz. For the analysis, the dependent variable Y was determined - Volume of innovative products (goods, services), million tenge. The dependent variable (Y) is a variable that describes the process you are trying to predict or understand. In the regression equation, this variable is always to the left of the equal sign. While you can use regression to predict the dependent quantity, you always start with a set of well-known y-values and use them to calibrate the regression model. Known Y-values are often referred to as observables (Costa et al., 2012). The data for the selected variables are current for the current period, covering a period of 3 years.

The explanatory variables (X) are variables used to model or predict the values of the dependent variables. The dependent variable is a function of the independent variables. The following indicators were selected as independent variables:

X1 - Enterprises with innovations, and units.

X2 - The level of activity in the field of innovation, %.

X3 - Number of organizations carrying out R&D, units.

X4 - Internal costs, million tenge.

X5 - The number of employees who performed research and development, people.

X6 - Number of developed innovations, units.

The number of observations n = 18. The number of independent variables in the model is 6, and the number of regressors considering the unit vector is equal to the number of unknown coefficients (Industrialization, 2021). Considering the attribute

Y, the dimension of the matrix becomes equal to 8. The matrix of independent variables X has dimensions (Table 2).

Table 2. Matrix of paired correlation coefficients R

-	y	x_1	x_2	x_3	x_4	x_5	x_6
y	1	0.4284	0.4463	0.1913	0.1281	0.1323	0.3311
x_1	0.4284	1	0.5552	0.8873	0.8506	0.8316	0.8695
x_2	0.4463	0.5552	1	0.2642	0.1756	0.1843	0.309
x_3	0.1913	0.8873	0.2642	1	0.9338	0.987	0.9372
x_4	0.1281	0.8506	0.1756	0.9338	1	0.9251	0.8272
x_5	0.1323	0.8316	0.1843	0.987	0.9251	1	0.931
x_6	0.3311	0.8695	0.309	0.9372	0.8272	0.931	1
Note: compiled by the author when analyzing the data							

Findings

As a result of the calculations, the multiple regression equation was obtained:

Y = 5250.0463 + 335.6906X1-975.245X2-850.1251X3-11.5795X4-5.479X5 + 850.9919X6.

Multiple linear regression, which models the relationship between multiple input variables and an output dependent variable. The model remains linear because the output value is a linear combination of the input values.

As a result of the analysis, we can make the following economic interpretation of this model:

- an increase in X1 (Enterprises with innovations, units) by 1 unit of measure. leads to an increase in Y (Volume of innovative products, million tenge) by an average of 335.691 units;

- an increase in X2 (the level of activity in the field of innovation, in%) by 1 unit of measure. promotes reduces in Y by an average of 975.245 units;
- an increase in X3 (Number of organizations that carried out R&D, units) by 1 unit of measure. promotes reduces in Y by an average of 850.125 units;
- increase in X4 (Internal costs, million tenge) by 1 unit of measure. leads to a decrease in Y by an average of 11.58 units;
- an increase in X5 (the number of employees who performed research and development, people) by 1 unit of measure. leads to a decrease in Y by an average of 5.479 units;
- an increase in X6 (Number of developed innovations, units) by 1 unit of measure. Leads to an increase in Y by an average of 850.992 units.
- According to the maximum coefficient β1 = 1.008, we conclude that the factor X1 has the greatest influence on the result Y, that is, the more enterprises that have innovations, the greater the volume of innovative products. Figure 3 illustrates the dynamics of changes in the volume of innovative products for 2009-2018. Until 2015, there is an increase in the volume of innovative products, then within two years there is a decrease in volumes, which, according to the author, is associated with economic changes in the market, then in 2018 the volume of innovative products increased significantly (Sadyrova, Yusupov & Imanbekova, 2021).

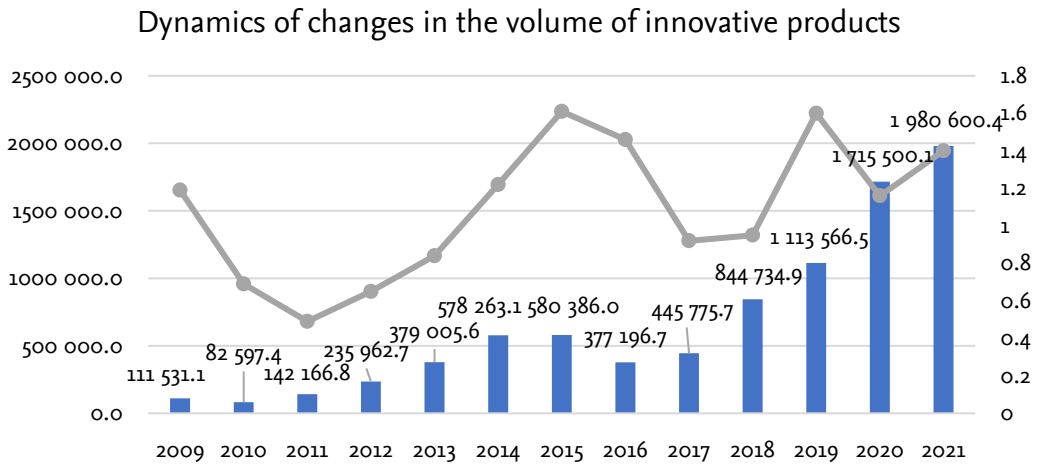

Figure 3. Dynamics of changes in the volume of innovative products, 2009-2021

For a deeper analysis of the main indicators of innovation activity in Kazakhstan, it is important to consider the data not only in the context of territorial regions, but also to analyze the innovation activity in time (Lisenkov, 2021).

Thus, a table of indicators of innovative activity in Kazakhstan was formed in the period from 2009 to 2021 (Table 3).

Table 3. Indicators of innovative activity in Kazakhstan

Year	Share of innovative products in GDP,%	Internal costs	Level of activity in the field of innovations, in%	Volume of innovative products	Number of organizations that carried out R&D
	Y	X1	X2	X3	X4
2009	1,19	34 761,6	2,1	111 531,1	421
2010	0,69	38 988,7	2,3	82 597,4	414
2011	0,49	33 466,8	3,4	142 166,8	424
2012	0,65	43 351,6	4,8	235 962,7	412
2013	0,84	51 253,1	4,8	379 005,6	345
2014	1,22	61 672,7	4,0	578 263,1	341
2015	1,61	66 347,6	4,0	580 386,0	392
2016	1,46	69 302,9	4,3	377 196,7	390
2017	0,92	66 600,1	5,7	445 775,7	383
2018	0,95	68 884,2	5,7	844 734,9	384
2019	1.6	71 050,5	10	1 113 566,5	386
2020	1.16	61 005,1	8.1	1 715 500,1	373
2021	1.4	75020.4	8.9	1 980 600,4	265

Note: compiled by the author based on data (Statgov, 2021)

As a dependent variable (Y) for this analysis, the indicator of the share of innovative products in GDP,% (Boldyrevskiy & Kistanova, 2014)

In this case, the independent variables are as follows:

X1 - Internal costs, million tenge.

X2 - The level of activity in the field of innovation, %.

X3 - Volume of innovative products, million tenge.

X4 - Number of organizations carrying out R&D, units.

The number of observations n = 12. The number of independent variables in the model is 4, and the number of regressors, considering the unit vector, is equal to the number of unknown coefficients. Considering the attribute Y, the dimension of the matrix becomes equal to 6. The matrix of independent variables X has dimensions (Table 4).

Table 4. Matrix of paired correlation coefficients R

-	y	x_1	x_2	x_3	x_4
y	1	0.862	0.5411	0.6587	0.7215
x_1	0.862	1	0.8464	0.8502	0.775
x_2	0.5411	0.8464	1	0.7836	0.6456
x_3	0.6587	0.8502	0.7836	1	0.4603
x_4	0.7215	0.775	0.6456	0.4603	1

Note: compiled by the author when analyzing the data

As a result of calculations, the multiple regression equation was obtained: Y = 0.193-5.1E-5X1-0.1921X2-4.0E-6X3-0.02519X4.

Multiple linear regression, which models the relationship between multiple input variables and an output dependent variable (Jaakkola & Hakanen, 2013). The model remains linear because the output value is a linear combination of the input values.

According to the results of the analysis, the following economic interpretation arises:

– Increase in variable X1 (Internal costs, million tenge) by 1 unit of measure. leads to a decrease in Y by an average of 5.1E-5 units;

– Increase in X2 (the level of activity in the field of innovation, in%) by 1 unit of measure. leads to a decrease in Y by an average of 0.192 units;

– Increase in X3 (Volume of innovative products, million tenge) by 1 unit of measure. leads to a decrease in Y by an average of 4.0E-6 units;

– Increase X4 (Number of organizations that carried out R&D, units) by 1 unit of measure. leads to a decrease in Y by an average of 0.0252 units.

According to the maximum coefficient $\beta 1 = 1.387$, it can be concluded that the factor X1 has the greatest influence on the result Y (Volume of innovative products, million tenge). The statistical significance of the equation was tested using the coefficient of determination and Fisher's test. It was found that in the studied situation - 45883.62% of the total variability in Y is explained by a change in the factors Xj.

Discussion

The reasons for the low innovativeness also lie in the fact that the level of susceptibility of the republic's economy to innovations is low. Demand is not adapted to the use of advanced technologies (Vasilyev & Vasilyev, 2016). A feature of all post-Soviet innovation systems is a high share of the public sector of research and development with a small number of large science-intensive corporations and a relatively weak development of small innovative business (Kozhakhmet et al., 2020). As a result, the accumulated potential of scientific and technical solutions remains unclaimed, scientific institutes and scientists are limited in the possibility

of obtaining additional income for the development of research and can only rely on state funding (Spring & Araujo, 2014).

This study allows us to identify the main factors influencing the level of innovation activity, to determine the most important of them. The results of the study can be applied in the development of a strategy for the development of innovative potential. Of particular interest is the ability to study relationships on an annual basis and identify long-term relationships.

The problems of stimulating and developing innovation activity in the country have existed for several years. According to statistics, only a small part of innovations finds its practical implementation. For the period from 2009 to 2021, 4,531 license agreements and patent assignment agreements were registered. Among the reasons for the low level of commercialization of innovations are: the minimum demand for small innovative businesses; personnel problem; financial mechanisms for innovation; lack of accurate data on innovative enterprises; low motivation of researchers. Kazakhstan took only 50th place in the list of the most innovative states. Another rather serious reason for the low innovation susceptibility of the country's economy is the problem of the development of science in general in Kazakhstan, and fundamental.

Conclusion

The strategic necessity in the development of any enterprise in the industrial sector and the most reliable way to increase its competitiveness is the implementation of innovations to timely fulfill the needs of consumers, which is impossible without the implementation of the concept of servitization as a marketing strategy (Denyer & Tranfield, 2006). The continuous process of development and application of the most advanced technologies, the expansion of international cooperation require continuous improvement of nationwide statistical reporting forms and instructions for filling them out, as well as revision of the methodology for science and innovation statistics, studying the experience of other countries to ensure comparability of statistical data in the international arena (Bustinza et al., 2017). In

Kazakhstan, as in many countries, it is necessary to opportunities to increase the number of resources devoted to timely collection of relevant high quality scientific and technical data based on international methodology (Maldynova et al., 2018).

The purpose of the study was to identify the relationship between the level of innovation activity and the factors influencing it. As a result of the analysis, it was revealed that the volume of innovative products is mainly influenced by such factors as the level of innovative activity in each of the regions of Kazakhstan, the number of innovations developed, and the number of innovations developed at the enterprises of Kazakhstan as a whole. This study is widely used, so it can be applied to a separate enterprise if data are available. A repeated study on the same factors is of particular interest in the future, as it will allow us to establish the dynamics of changes in innovative activity and its causes. The innovative activity must be present in any manufacturing enterprise. This is since without modern technologies, increasing the range and improving the quality of products, the enterprise will not be able to increase its competitiveness in the markets. Moreover, to maintain competitiveness, it is necessary for innovation to become an ongoing process, rather than a one-off event.

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