



## STATISTICAL ANALYSIS OF THE DEVELOPMENT OF INDUSTRIAL PRODUCTION MANAGEMENT IN THE REGION OF THE REPUBLIC OF KARAKALPAZISTAN

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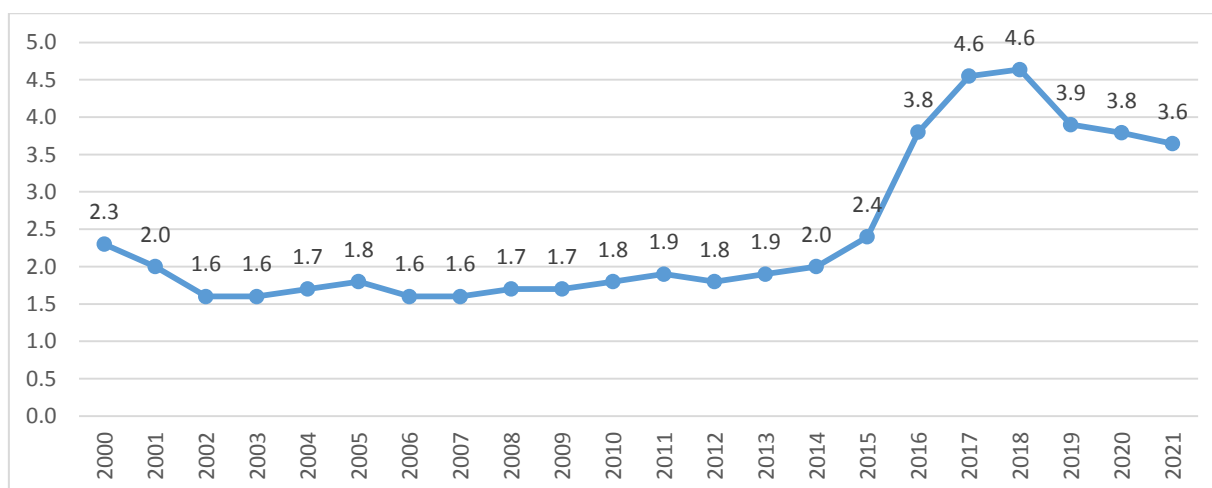
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**Abstract.** In the article, a statistical analysis of the results of the measures for the development of industrial production in the region of the Republic of Karakalpakstan was carried out on the basis of indicators representing their effectiveness, and the identification of existing problems identified important issues that should be paid attention to today. Also, the role and importance of management in the formation of statistical indicators was assessed using various quantitative methods.

**Key words.** Industrial production, investment, correlation analysis, activity level, viability ratio, management efficiency

The implementation of statistical analysis of the results of measures for the development of industrial production in the Republic of Karakalpakstan based on the indicators representing their effectiveness, and the identification of existing problems are among the important issues that should be paid attention to today. It is required to evaluate the role and importance of management in the formation of these indicators using various quantitative methods. Because the dynamics of cultivation of soy products and the results of its comparative analysis show that industrial production in the region had a tendency to decrease in the next period.

According to the dynamic results, the share of the Republic of Karakalpakstan in the total industrial production of the country has increased from 2.4% to 4.6% during 2016-2018, that is, it has almost doubled. It can be observed that this indicator will decrease to 3.6 percent by 2021, with a decrease in this indicator in the last three years.



**Figure 1. The dynamics of the share of the Republic of Karakalpakstan in the total industrial production of the country**

However, the region's share of industrial production remains high enough, despite the fact that the region will see a decline in the next three years. However, this decrease justifies the fact that the opportunities available in industrial production in the region are not fully used and shows that the growth rate of industrial production in the region was lower than in other regions in these years.

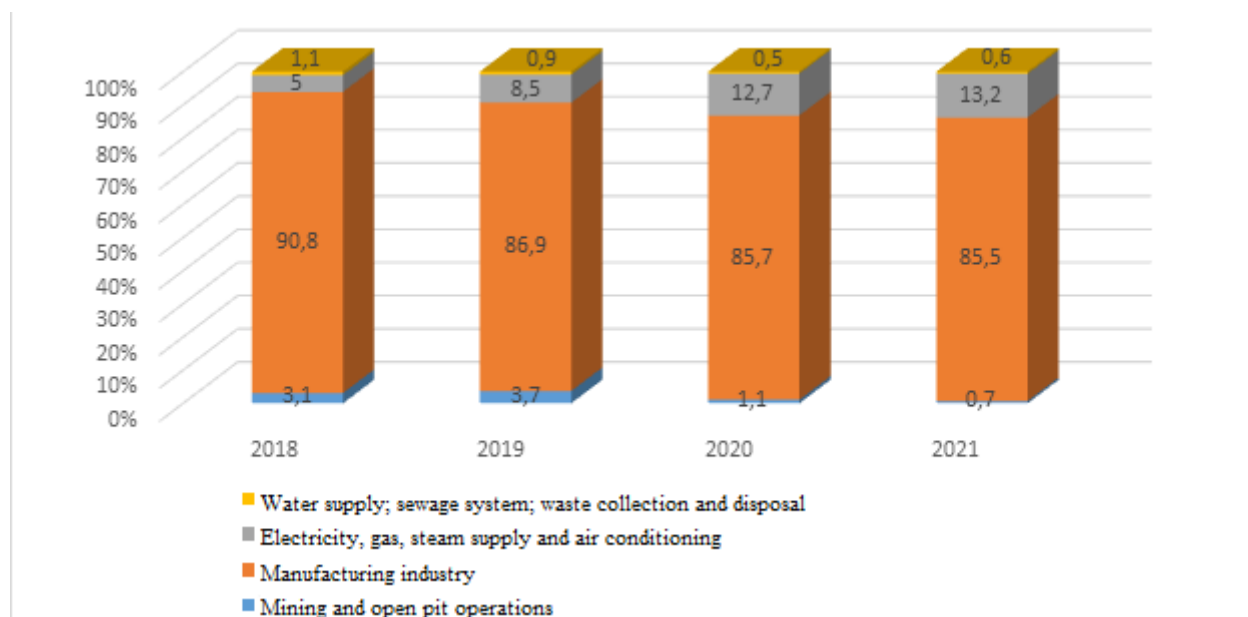
At the current stage of development, ensuring efficiency in any field and having high growth rates are directly related to the acceleration of innovative processes, in which the importance of digital technologies should be emphasized. However, both cases mentioned above are directly related to the volume of investments. Despite the fact that the share of the region in fixed capital investments in the country is quite large, the change in the production of industrial products has remained low. For example, in 2007, despite the fact that the share almost doubled, its share in industrial production increased by only 0.1%, a similar situation can be seen in the example of 2014-2015.

According to the results of the correlation analysis carried out to determine the relationship between the two indicators, the coefficient is -0.3 and it is justified that there is an inverse relationship. This does not correspond to economic laws. In addition, taking into account that the investments made in the fixed capital give their results during certain periods, when the relationship between the two indicators was modeled on different (lag) steps, it was confirmed that there is almost no relationship between them. For this reason, we would like to pay special

attention to the main directions and features of industrial development in the region.

The share of the Republic of Karakalpakstan in the total industrial production of the country reached its highest value in 2017 and 2018, and is observed to decrease in the next three years. The main decline came in 2019, from 4.6 percent to 3.9 percent, followed by slower declines in the following two years. The global pandemic at the end of 2019, as well as the introduction of various restrictions as a result of its consequences in 2020-2021, and economic fluctuations can be taken as the reason for the decline in the next two years. But researching the main reasons for the decline in 2019 remains one of the important challenges.

Taking into account the above, we would like to draw attention to the changes in the structure of industry in the region in the next four years. In the reports maintained by the Statistics Committee, industrial products grown are divided into four components (Figure 2).



**Figure 2. Dynamics of change of industrial structure in the Republic of Karakalpakstan**

The main share of the total industrial product corresponds to the contribution of the manufacturing industry, but a downward trend can be observed in its share during the researched period. In particular, in 2019, a sharp decrease compared to the previous year was observed, and in the next two years, the rate of decrease was observed. Mining industry and operation of open mines and water supply; In 2019,

the share of sewage system, waste collection and disposal decreased slightly compared to the previous year, but it can be observed that it increased in the next two years. As a result, it can be observed that the share of electricity, gas, steam supply and air conditioning in the total industry increased from 5 percent to 13.2 percent.

According to the results of the analysis, the change of the industrial structure in the region is seen as one of the main reasons for the decrease in the share of the Republic of Karakalpakstan in the total industrial production of the country. The results of the correlation analysis based on the available data serve to confirm the above conclusion.

**Table 1**

**Correlation analysis results**

|           | <b>X1</b> | <b>X2</b> | <b>X3</b> | <b>X4</b> | <b>Y</b> |
|-----------|-----------|-----------|-----------|-----------|----------|
| <b>X1</b> | 1,00      |           |           |           |          |
| <b>X2</b> | 0,64      | 1,00      |           |           |          |
| <b>X3</b> | -0,85     | -0,95     | 1,00      |           |          |
| <b>X4</b> | 0,86      | 0,91      | -0,98     | 1,00      |          |
| <b>Y</b>  | 0,61      | 0,99      | -0,93     | 0,87      | 1,00     |

*Here:  $X_1$  – percentage of mining and open pit mining in total industrial output;  $X_2$  – share of manufacturing industry in total industrial product in percentage;  $X_3$  – percentage of electricity, gas, steam supply and air conditioning in total industrial output;  $X_4$  – water supply in the total industrial product; sewage system, waste collection and disposal percentage in percent;  $Y$  - The share of the Republic of Karakalpakstan in the total industrial production of the country is in percent.*

According to the results of the correlation analysis, there is a high positive correlation between the change in the share of the Republic of Karakalpakstan and the share of the manufacturing industry in the total industrial production of the country, which justifies the mutual influence of the decrease of both indicators. Water supply; despite the fact that the share of sewage system, waste collection and disposal in total industrial products is small and insignificant, it can be observed that it has a high correlation with the share of industrial products in the region.

There is a high and negative correlation between the share of electricity, gas, steam supply and air conditioning in the total industrial product and the share of the Republic of Karakalpakstan in the total industrial production of the country.

According to the obtained results, the decrease in the share of industrial production in the region in the next four years under study is considered to be the main factor in reducing the growth rate compared to other regions. In addition, according to the results of the correlational analysis, it was confirmed that the change in the structure of the industry has an effect on the decrease of the share. However, in 2019-2021, it can be observed that the growth rate of industrial products in the region is increasing, excluding 2020. The effect of each component in providing this growth rate was evaluated using factor analysis method (Table 2).

According to the results, the total growth in the industry in 2018, that is, 2.3 percent of the 4.1 percent was accounted for by the manufacturing industry, while the remaining 1.8 percent was distributed almost equally between the three components. Since 2019, there has been a sharp change in the impact of each component on the growth rate of total industrial production.

**Table 2**

**Results of the assessment of the impact of components on the growth rate of industrial production**

| <b>Years</b> | <b>Mining and open pit operations</b> | <b>Manufacturing industry</b> | <b>Electricity, gas, steam supply and air conditioning</b> | <b>Water supply; sewage system, waste collection and disposal</b> | <b>Total Growth</b> |
|--------------|---------------------------------------|-------------------------------|------------------------------------------------------------|-------------------------------------------------------------------|---------------------|
| <b>2018</b>  | 0,5                                   | 2,3                           | 0,7                                                        | 0,6                                                               | 4,1                 |
| <b>2019</b>  | -0,1                                  | 3,7                           | 1,6                                                        | -0,3                                                              | 5,0                 |
| <b>2020</b>  | -0,9                                  | 3,2                           | 1,9                                                        | -0,2                                                              | 4,1                 |
| <b>2021</b>  | 0,3                                   | 2,2                           | 5,0                                                        | -0,1                                                              | 7,4                 |

In particular, while the growth of total industrial products was 5.0 percent, 3.7 percent of the production industry accounted for 1.6 percent of electricity, gas, steam supply and air conditioning. As a result, the growth rate of the remaining two components has a negative value, which has caused a decrease in the overall growth rate. In 2020, the growth rate decreased from 5.0 percent to 4.1 percent, while the impact of the manufacturing industry on the growth of the previous

year's dependence-only industrial production was relatively reduced, while the impact of electricity, gas, steam supply and air conditioning increased relatively.

By 2022, providing a positive change in the growth rate of industrial production, the main share of the total growth was accounted for by electricity, gas, steam supply and air conditioning, that is, 5.0 percent of the total 7.1 percent growth was provided by this component. On the other hand, it is observed that the influence of the manufacturing industry has decreased.

According to the conclusions obtained as a result of the method of correlation and factor analysis, one of the main reasons for the decrease in the production of industrial products in the region compared to the country can be seen as a change in the structural structure. Because, in 2018-2021, although the growth rate of industrial production in the region is high enough, the ratio has decreased, and the influence of electricity, gas, steam supply and air conditioning has increased in providing this growth. The results of the correlation analysis prove that there is a high inverse (-0.93) correlation between the increase in the share of this component in the industrial production and the share of the total industrial production in the region.

In order to ensure the stable development of industrial production in the Republic of Karakalpakstan and to maintain its place in the country's industrial production, it is required to ensure the optimal ratio between the components and ensure high growth rates of the manufacturing industry. In addition, full use of the opportunities created for the development of the industry is considered appropriate.

The level of activity of industrial enterprises and the coefficients of viability are important indicators in expressing the effectiveness of the organization of general management in industrial enterprises. In addition, we would like to pay attention to the dynamics of changes in the amount of products corresponding to each industrial enterprise in order to evaluate the production efficiency of each industrial enterprise.

In order to carry out a comparative analysis of the level of activity and the coefficient of viability, indicators were determined for the total enterprises and industrial enterprises in the region (Table 3).

Although the activity level of total and industrial enterprises in the region does not differ much during the research period, it can be observed that the activity level of industrial enterprises in the region was relatively low, except for 2019 and 2020. The highest difference was in 2014, despite the fact that in the following years positive results were achieved in reducing this difference, in the next two years, the difference will decrease again and the difference will increase. It can be seen that the effectiveness of management organization in industrial enterprises is relatively low.

**Table 3**

**Calculated activity level and viability coefficient for total and industrial enterprises in the Republic of Karakalpakstan**

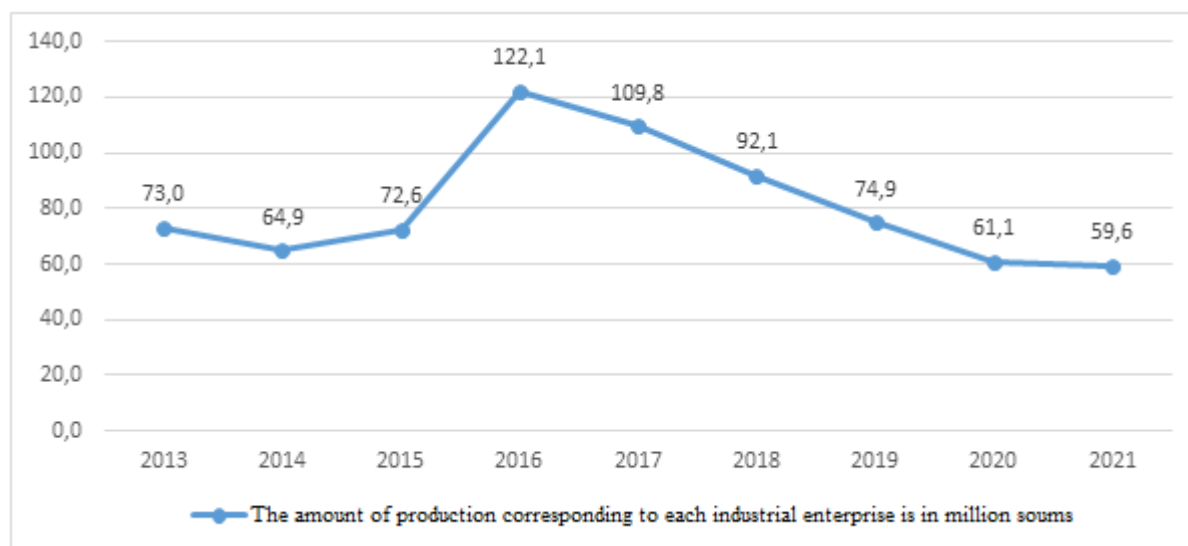
|      | Activity level    |                        | Survival rate     |                        |
|------|-------------------|------------------------|-------------------|------------------------|
|      | Total enterprises | Industrial enterprises | Total enterprises | Industrial enterprises |
| 2013 | 85,8              | 81,1                   | 19,6              | 38,0                   |
| 2014 | 89,9              | 87,6                   | 30,7              | 47,8                   |
| 2015 | 92,3              | 91,2                   | -1,1              | 4,9                    |
| 2016 | 94,4              | 94,0                   | 6,2               | 22,0                   |
| 2017 | 95,6              | 95,4                   | 35,5              | 73,6                   |
| 2018 | 97,2              | 97,3                   | 62,2              | 78,6                   |
| 2019 | 97,7              | 98,1                   | 72,6              | 82,2                   |
| 2020 | 96,9              | 96,5                   | 83,6              | 91,3                   |
| 2021 | 95,4              | 94,5                   | 48,4              | 54,9                   |

On the other hand, the high rate of viability in industrial enterprises indicates that the ratio of management in newly established industrial enterprises is effectively organized. It can be seen that both indicators give different results, i.e., the activity level indicates relatively low management efficiency in industrial enterprises, while the viability coefficient justifies a high one.

In order to clarify this problem, we focus on the amount of output corresponding to each industrial enterprise, which serves to express the overall

management efficiency. To calculate this indicator, the value of industrial products produced in the region was used, and in previous analyzes, this indicator was transferred to the prices of 2000, and its real values were determined. For this reason, the above indicators were used to ensure uniformity. That is, the year 2000 was used as a basis for determining the amount of products corresponding to each industrial enterprise.

According to the obtained results, the amount of output corresponding to each industrial enterprise is 122.1 million soums, reaching its maximum level by 2016. In the period after that, i.e. between 2017-2020, it is observed that this indicator has a steady downward trend. Only by 2021 was it found that the rate of decline slowed down a little.



**Figure 3. In the Republic of Karakalpakstan, the amount of production corresponding to each industrial enterprise is mln. in sum**

In the Republic of Karakalpakstan, the results obtained in terms of the amount of output per industrial enterprise indicate a decrease in management efficiency. This is also supported by the differences in the findings on the level of activity and the coefficient of viability, that is, a high coefficient of viability and a relatively low level of activity indicate that the necessary conditions for the establishment of industrial enterprises and their survival have been created, but there are problems with ensuring the continuation of its further activity. . It is this result that justifies the existence of sufficient opportunities for the development of the industry and the existence of problems in managing its further activity.

We evaluate the effect of all indicators used in the assessment of management efficiency on the share of the Republic of Karakalpakstan in the total industrial production of the country and their interaction using the regression analysis method.

$$SH = -9.25 + 0.02 * PRP + 0.11 * ACR + 0.01 * VR \quad (1)$$

Here. SH - The share of the Republic of Karakalpakstan in the total industrial production of the country, in percent; PRP - the amount of products corresponding to each industrial enterprise is mln. in sum; ACR – Activity level of industrial enterprises in the Republic of Karakalpakstan in percent; VR - The rate of viability of industrial enterprises in the Republic of Karakalpakstan is in percent.

We present the results of the developed model and the criteria necessary to justify the adequacy of the model as follows (Table 4).

**Table 4**  
**Regression analysis results**

Dependent variable: SH

|                    | <i>Coefficient</i> | <i>Std. Error</i> | <i>t-ratio</i>     | <i>p-value</i> |    |
|--------------------|--------------------|-------------------|--------------------|----------------|----|
| const              | −9.25301           | 2.40995           | −3.839             | 0.0121         | ** |
| PRP                | 0.0190282          | 0.00607036        | 3.135              | 0.0258         | ** |
| ACR                | 0.112280           | 0.0291609         | 3.850              | 0.0120         | ** |
| VR                 | 0.0124888          | 0.00534359        | 2.337              | 0.0666         | *  |
| Mean dependent var | 3.402760           |                   | S.D. dependent var | 1.041986       |    |
| Sum squared resid  | 0.608578           |                   | S.E. of regression | 0.348878       |    |
| R-squared          | 0.929935           |                   | Adjusted R-squared | 0.887896       |    |
| F(3, 5)            | 22.12070           |                   | P-value(F)         | 0.002580       |    |
| Log-likelihood     | −0.648102          |                   | Akaike criterion   | 9.296204       |    |
| Schwarz criterion  | 10.08510           |                   | Hannan-Quinn       | 7.593764       |    |
| rho                | −0.346769          |                   | Durbin-Watson      | 2.025087       |    |

According to the mentioned criteria, the developed model is adequate, and the results of the Student's criterion of the parameter representing only the effect of the viability coefficient on the results of the Student's criterion, which substantiates the adequacy of each coefficient, have a confidence interval of 90% and not 95%, and its probability level is equal to 0.07. The coefficient of determination is sufficiently high, justifying that the selected factors represent 93% of the variation in the resulting factor. The indicator determined by the Durbin-Watson criterion is

also at the standard level, which indicates that the selected factors can be used in one model.

Based on the aforementioned analysis, it should be noted that the development of industrial production in the region, in particular, the increase of the share of the Republic of Karakalpakstan in the total industrial production of the country, such as the amount of output per industrial enterprise, the level of activity of industrial enterprises, and the coefficient of viability have a positive effect. One of the main problems was to increase the level of activity of the existing industrial enterprises, because the impact of this indicator has a higher value compared to others.

An increase in the amount of output per industrial enterprise by one million soums serves to increase the output factor by 0.02 percent. This is a sufficiently high indicator, because one million soums is a rather small amount for the value of the product corresponding to each industrial product. On the other hand, the sharp decrease in output per industrial product in recent years remains one of the important problems, and this is to some extent related to the level of activity and the coefficient of viability. Because the growth of the survival rate and the decrease in the level of activity can be the main reason for this.

In order to clarify this problem, we will focus on the results of the model below. Taking into account the effect of the activity level and the viability coefficient after a certain period, steps (lags) were used to determine that any change in these indicators is reflected in the amount of output per industrial enterprise after one year.

$$PRP_t = -11.15 + 2.58 * ACR_{t-1} - 0.83 * VR_{t-1} \quad (2)$$

All the criteria justifying the adequacy of this model are mentioned in Table 5. We did not find it permissible to pay special attention to them, because it can be seen that the model and its coefficients are adequate according to all criteria, and the values determined according to the criteria are at the specified standard level.

**Table 5**

**Regression analysis results**

Model 22: OLS, using observations 2014-2021 (T = 8)

Dependent variable: PRP

HAC standard errors, bandwidth 1 (Bartlett kernel)

|                    | <i>Coefficient</i> | <i>Std. Error</i> | <i>t-ratio</i>     | <i>p-value</i> |     |
|--------------------|--------------------|-------------------|--------------------|----------------|-----|
| const              | -111.150           | 23.5968           | -4.710             | 0.0053         | *** |
| ACR_1              | 2.57903            | 0.256459          | 10.06              | 0.0002         | *** |
| VR_1               | -0.834443          | 0.0685548         | -12.17             | <0.0001        | *** |
| Mean dependent var | 82.12483           |                   | S.D. dependent var | 23.48506       |     |
| Sum squared resid  | 526.7397           |                   | S.E. of regression | 10.26391       |     |
| R-squared          | 0.863569           |                   | Adjusted R-squared | 0.808996       |     |
| F(2, 5)            | 190.5393           |                   | P-value(F)         | 0.000019       |     |
| Log-likelihood     | -28.10057          |                   | Akaike criterion   | 62.20114       |     |
| Schwarz criterion  | 62.43946           |                   | Hannan-Quinn       | 60.59373       |     |
| rho                | -0.073980          |                   | Durbin-Watson      | 2.134507       |     |

According to the results of the developed model, the level of activity has a positive effect on the management efficiency of industrial enterprises in the region, and the coefficient of viability has a negative effect. However, before drawing conclusions on these results, it is necessary to pay attention to the results of the above analysis. Because the viability coefficient has a negative effect, theoretically it is not suitable, but if the research object and the indicators underlying the management efficiency of industrial enterprises are based on the dynamics and results of previous analysis, the results obtained by the model are reliable and consistent with the previous conclusions.

Based on all the results of the analysis presented above, it can be concluded that the viability coefficient represents the creation of sufficient conditions for the development of industrial enterprises in the region. On the other hand, the decrease in the level of activity indicates the presence of problems in managing the activities of the enterprise after its establishment. Also, the decrease in the amount of products corresponding to each industrial enterprise serves to confirm our above opinion. As a result, the share of the region in the production of total industrial products is observed to decrease in the following years, besides, there are changes in the structural structure of the production of industrial products.

In our opinion, proper management of industrial enterprises of the region, providing them with qualified personnel will serve not only to develop the industry of the region, but also to ensure the effectiveness of the measures implemented to ensure industrial development.

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