Development’s Features of Industrial Production in the Region

G F Akhmedyanova1, A M Pishchukhin2, E A Semenov3

1Assistant professor, Aerospace Institute, Orenburg state University, Victory Avenue 13, 460018, Orenburg, Russia
2Professor, Aerospace Institute, Orenburg state University, Victory Avenue 13, 460018, Orenburg, Russia
3Researcher, Institute of the Steppe, Ural Branch of the Russian Academy of Sciences, Pionerskaya St., 11, Orenburg, Russia

E-mail: ahmedyanova@bk.ru, pishchukhin55@mail.ru, semenow@yandex.ru

Abstract. The work is devoted to the analysis of the regional industry level development in the Orenburg region. The state of the oil and gas industry, power industry, metallurgy, mechanical engineering and light industry has been considered. The analysis showed that since 2012, the region is characterized by multidirectional dynamics of the sectoral structure industry, in the face of fluctuations — either growth or production decline in individual sectors. There are positive moments. Orenburg region has successfully implemented its solar potential over the past 5 years. During this period, the region has earned 7 solar power plants with a total capacity of 200 MW. Further, the paper proposes a method for multidimensional assessment of the industry state. It consists in building a beam of coordinated development of industries and determining in the plane called the equal contributions plane of two parameters: distance and angle of rotation. The distance is estimated as the distance between the point representing the given moment and the point of intersection of the beam of coordinated development with the plane of equal contributions. The angle of rotation is determined between the line of intersection of the constant plane on the main type of production (oil production) with the plane of equal contributions and the line passing through the point of intersection of the beam of coordinated development with the plane of equal contributions and representing the point

1. Introduction
Industry - the main component of the Orenburg region economy. It produces 50-55% of the gross regional product and employs 25% of the economically active population. The coefficient of industry specialization of the Orenburg region exceeds the corresponding value on average in the Volga Federal District, which indicates a higher role of industrial production of the region among other regions. The basis of the industrial sector of the Orenburg region is determined by the oil and gas industry, ferrous and non-ferrous metallurgy, electric power, gas and petrochemistry.

Since 1992, the volume of industrial production in the region has declined on average for the year by 10-12%. Since 2000, industrial growth has begun, which averaged 10.5% by 2005, and from 2005 to 2012, the rate has decreased and amounted to 4.5% [1,2].
Since 2012, the multidirectional dynamics of the sectoral industry structure is typical, in the face of fluctuations — either growth or production decline in individual sectors. The core of the Orenburg industrial complex is changing: metallurgy loses its backbone functions, its place is occupied by oil refining and gas and petrochemistry.

The share of industries based on the natural resource potential of the region (fuel industry, electric power industry, ferrous and nonferrous metallurgy, gas and petrochemistry) in the structure of industrial production is constantly increasing and averages 80-85%.

2. Problem statement

2.1. Fuel and energy complex

The share of enterprises in this profile accounts for 45-50% of the total industrial output. Large reserves of oil and natural gas, a multicomponent composition of hydrocarbon raw materials, an advantageous geographical position, determined the development of oil and gas production complexes and the associated processing industry, as well as a powerful gas transmission network.

The region’s energy complex is characterized by a high degree of monopolization of production. Four well-known companies: Rosneft, Gazpromneft, Russneft and Gazprom Production Orenburg account for 95% of the total volume of gas-oil production and fuel processing. The activities of energy companies are clearly export-oriented. The share of the fuel and energy complex in the region’s export volume is 77%.

Oil production and refining ranks first in the structure of industrial production in the region. It accounts for 25-27% of the cost of industrial products. In terms of production, the oil-producing sector of Orenburg occupies the 4th place (4%) among the regions of Russia. Unlike the gas sector, the petroleum industry of the region has an impressive territorial coverage of distribution, including more than 190 fields in the main central and western parts of the region.

The total proven oil reserves for 2015 are more than 450 million tons, and potential reserves are about 900 million tons. The main deposits are located in the west and in the center of the region. Significant reserves are also found in the edges of the Orenburg gas-condensate field (110 million tons of explored and 230 million tons of potential). The development of proven reserves is 48.8%, the degree of exploration of the total potential reserves is 65.3%. For proven oil reserves, resource availability is 30-35 years [3].

Currently, 85% of the total volume of work on the development of fields, production, transportation and sale of oil is carried out by Rosneft. Gazprom Neft accounts for 13% of regional oil production.

Since the beginning of the 90s, there has been a slight decrease in oil production. Since 2001, started a period of its steady growth. In 2013, oil production reached a maximum and increased 2.5 times compared to 2000. The sharp increase in oil production growth is associated with an unprecedented increase in world prices for oil and petroleum products. In addition, the cost of petroleum products in Russia is constantly growing, regardless of the situation in world prices for black gold.

The oil refining industry of the region is an asset of Russneft. The processing capacity of the Orsk refinery is 6.5 million tons of oil per year. The enterprise is supplied with raw materials from Western Siberia through the Western Siberia-Ishimbay (Bashkortostan) -Orsk oil pipeline system. Deliveries of oil from Kazakhstan through the Atyrau-Orsk pipeline, within the framework of a single customs area, allowing duty-free transportation of oil and petroleum products, are again becoming profitable. The plant’s products are sold not only on the intraregional market of petroleum products, but also go to other regions.

Prospects for the development of the oil region industry are associated with the development of a group of fields in the regions of the central part of the region, as well as with an increase in oil production from the rims of the Orenburg gas condensate field.
The share of the gas industry accounts for 17-18% of the cost of industrial products in the region. The operation of the industry is associated with a powerful raw material base of the Orenburg gas and condensate field, which is associated with about 87% of all natural gas resources and 98% of its production. The initial reserves of the field amounted to 1.9 trillion m³ and 120 million tons of condensate. Since the beginning of the development produced 1.15 trillion. m³ Gas resource availability at today's production volumes is 35-40 years [4,5]. Gazprom Dobycha Orenburg, which has been developing a unique Orenburg gas condensate field, characterized by a multi-component gas composition, which is processed at the largest gas processing plant in Europe and the only helium plant on the continent, has dominated the gas contour of the region. These enterprises produce more than 15 types of commercial products, the share of which in the all-Russian production is: helium and odorant - 100%, ethane - 78%, light hydrocarbon fractions - 28%, sulfur - 19%, liquefied gas - 8%, dry purified gas - 3%. From here, a wide fan diverge threads of pipelines. Here begins the kilometer zero of the famous gas pipeline "Soyuz". The recycled Orenburg and Kazakhstan gas is distributed through this branch throughout Russia and delivered to Europe [6]. Since the beginning of the 90s, the gas processing complex has been operating in a mode of shrinking gas production and processing. For the period from 1990-2017, natural gas production decreased 2.3 times. The deterioration of the mining and geological conditions of the development of a gas condensate field associated with an increase in the cost of drilling operations is a factor in further reducing the volume of produced gas. The Orenburg region has significant electric power potential. The total capacity of the power generating facilities is about 3.9 million kW. The power system of the region is excessive in terms of the ratio of production and consumption of electricity. More than 94% of electricity is generated in thermal power plants and combined heat and power plants. The key role in the regional electric power industry belongs to Iriklinskaya GRES, the largest thermal power plant in the Federal District with a capacity of 2,430 MW located in the east of the region. The station feeds not only enterprises and residential facilities of the Orenburg region, but also many neighbors in Bashkortostan, Kazakhstan and the Chelyabinsk region. On the territory of the region there are five thermal power plants, which are located near large industrial enterprises and cities. Orenburg region for 5 years successfully realizes its solar potential. A lot of light and a lot of space are ideal conditions for the development of solar energy. During this period, the region has earned 7 solar power plants with a total capacity of 200 MW. This is more than 5% of all electricity produced in the region and 27% of the total solar energy in Russia. The region has become the absolute leader in the development of alternative energy. Three running stations with a total capacity of 145 MW were the largest in Russia. Their capacity is sufficient to fully provide electricity to populated areas with a population of more than 80 thousand [7].

2.2. Metallurgical complex
No less important specialization of the region is the production of ferrous and non-ferrous metals. This industrial complex historically formed in the east of the region in the foothills of the Southern Urals. The presence of large reserves of non-ferrous and ferrous metals in East Orenburg, an advantageous transportation and geographical position, the proximity of large metal-intensive engineering centers, and the availability of labor resources contributed to the creation and deployment of a large metallurgical base in the region. At the same time, since 2013, the metallurgy of Orenburg is going through hard times. Due to the sharp fall in world prices for metals at the enterprises of the complex, the production volumes have significantly decreased, some production facilities have been stopped and mothballed. Combine "Ural Steel" is part of the metallurgical division of the company "Metalinvest" - the flagship of metallurgy of Orenburg. However, with its construction and development, a city with a population of about 100 thousand has grown. mankind. Like many metallurgical enterprises of the Urals, the plant was built on the basis of iron ore deposits, including the composition of the raw materials of natural-alloyed iron ore. At present, the reserves of local ores are almost exhausted, and
the plant uses mainly imported raw materials from the iron ore deposits of the Kursk Magnetic Anomaly and Northern Kazakhstan.

The production capacity of the plant allows producing up to 3.5 million tons of pig iron, 4.5 million tons of steel and 3.5 million tons of rolled products per year. The company supplies high-quality rolled products to the domestic and international markets, about 100 grades of high-quality alloy steel, the only natural chrome-nickel cast iron in the world [8,9].

Ural Steel is trying to correct the fall in prices by improving the quality characteristics of its products. Sheet tube billets (strips) for gas and oil pipelines are such a competitive product of the plant. Ural Steel is actively developing new technologies, new orders are being formed for its products, it is from its steel that modern metal structures are made for the construction of the most important object for Russia - the Kerch bridge in the Crimea.

Orenburg region is among the regions with developed non-ferrous metallurgy. In the region there are 5 enterprises of various industries, with the dominant role of the copper industry. This is due to the presence of large stocks of copper-containing raw materials (3rd place in the Russian Federation). The technological chain of non-ferrous metallurgy originates deep underground, where copper-zinc ore is mined at the Gay deposit (the largest in the Urals). The Mednogorsk Copper Sulfur Combine and the Ural Steel Novotroitsk Combine turn the enriched raw materials into initial products for mechanical engineering and metalworking.

At present, deposits of ore with low copper content remain in the deposit, which creates production and economic problems in its further exploitation. On the other hand, large reserves and high resource availability of the field, the presence of a developed transport infrastructure, proximity to markets gives certain prospects for its use.

The Mednogorsk Copper Sulfur Plant annually produces more than 40 thousand tons of blister copper and 500-700 tons of zinc sulphate. Currently, the company is working on copper concentrates of Gaysky and Buribaysky (Bashkortostan) mining and processing plants.

2.3 Machine-building complex

By the beginning of the 90s, mechanical engineering was one of the fields of specialization of the region. In the structure of industrial production at the cost of industrial products, it was only slightly inferior only to the fuel and energy complex. By the end of the 90s, the value of the industry has noticeably decreased. In an open market economy, many types of engineering products in the region could not compete with their foreign counterparts. Thus, its share in the structure of industry was reduced by more than three times. A small rise in the industry in the 2000s, in 2012-2017. it was again replaced by a reduction in production, and the once powerful Orenburg machine building industry shrank even more in relation to the previous level. In 2012-2017 the volume of output of engineering products fell by 25% [10].

In the region, the production of once-known types of machine-tool products (metal-cutting machine tools, presses), the electrical industry (refrigeration equipment, vacuum cleaners and washing machines) is almost completely suspended. Nevertheless, the engineering of the region undoubtedly has the potential for development, which is determined by the presence of a large metallurgical base, qualified personnel, production and technological capabilities of the engineering industry.

In Orenburg, a drilling equipment factory produces drilling rigs equipped with pipes of special strength, manufactured using a unique pressure welding technology, which are indispensable in geological exploration and tunneling works. Drilling rigs for exploration drilling for solid minerals are the company's own development, a vivid example of the implementation of the import substitution program.

Machine-building concern Ormeto-Yumz South-Ural Machine-Building Plant, located in Orsk, is the largest machine-building enterprise in the region, producing over 25% of the machine-building products of the region and about 40% of the total Russian volume of blast-furnace and steelmaking equipment. It manufactures metallurgical equipment for all technological stages of the production of
ferrous metals, as well as mining and handling equipment. The most famous are continuous casting 
machines for billets and converters with a volume of 320 thousand tons. 

Orsk Machine-Building Plant is the leading supplier of drilling locks for oil and gas sector pipes. Since 2007, in the city of Orenburg, the production division of the sowing and soil-cultivating equipment has been expanded by the production division of the American John Dear Agricultural and Industrial Corporation.

2.3. Light industry
At the beginning of the 90s, the light industry was at par with such industries as ferrous and non-
ferrous metallurgy. By the mid-2000s, in the context of an open economy and a market competitive 
environment, it had shrunk an average of 8–9 times and turned out to be one of the problematic 
branches of regional industry.

Most of the types of its products, due to the discrepancy between the price-quality ratio and the 
availability of cheaper Chinese and Vietnamese products on the market, do not find demand from 
consumers. The enterprise for the production of leather and felted shoes has practically ceased 
operation, the range of production of fabrics, knitwear and clothing has been reduced to a minimum. From 1990 to 2010, the share of light industry in the structure of industrial production decreased from 8.5% to 0.6%, which was evidence of its deep crisis and the lack of an effective regional policy in this 
industry. Only in recent years, positive trends and production growth in this consumer segment of the 
industrial structure of the region [11].

Of all, once a wide range of products of light industry in the region holds its position and remains 
relatively popular long-term regional brand - Orenburg shawl. Orenburg shawl does not lose its 
original authenticity. Its distinctive feature is not the fluff that is used, but the knitting that is 
transmitted through the generations and the characteristic pattern of patterns.

The main manufacturer of down knitting products is the Orenburg Downy Shawls Factory. This is 
a unique enterprise, which produces, in addition to the famous Orenburg downy shawls and cobwebs, 
also produces knitwear from downy yarn (vests, jackets, jumpers, hats, socks, mittens, etc.).

3. Research methods
The work is devoted to identifying the genesis of regional problems of the economy, identifying 
relationships between sectors, Developing a way to present and analyze information. In the 
multidimensional space, along the axes of which the levels of development of industries are deposited, 
it is possible to determine the locus of points for each of which the ratio between the coordinates 
specifying it is observed - this is a ray, let's call it a ray of consistent development [12]. It is given by 
the equation
\[ x_i = t x_{A_i} \]  
where \( x_{A_i} \) are the components of the radius of the vector defining the beam, \( t \) is an arbitrary parameter 
that allows you to run along this beam.

On the other hand, there exists a locus of points with an equal sum of coordinates - this is a 
hyperplane. The sum of the coordinates here plays the role of gross domestic product. Moving in this 
plane changes the mutual relations between the levels of development of industries with a fixed gross 
domestic product - let's call it the plane of equal contributions. This hyperplane is given by 
\[ \sum_{i=1}^{n} x_i + D = 0 \]  
In this hyperplane, you can find the distance from the representative point B, the coordinates of 
which are the levels of development of industries at the time in question and the point of intersection 
of this plane with the ray of consistent development - we call this parameter distance. It is determined 
by the formula
\[ \rho = \frac{\sum_{i=1}^{n} (x_{B_i} - \frac{D}{\sum_{i=1}^{n} x_{A_i}} x_{A_i})^2}{\sum_{i=1}^{n} x_{A_i}} \]  
The angle of rotation of the beam on the imaging point in the plane of equal contributions must be 
counted from some line. Let us take in this quality the line of intersection of the constant plane along
the reference product (which is considered the main one in this region) with the plane of equal contributions. The equation of this line is as follows.
\[
\begin{align*}
\sum_{i=1}^{n} x_i - \sum_{i=1}^{n} x_{Bi} &= 0 \\
x_i &= \text{const} = x_{c1}
\end{align*}
\] (4)

We accept that the direction vector \( \mathbf{a} \) of this line has unit coordinates and obeys the system of equations (4) from which its second coordinate can be found (one is zero due to the second equation of system (4))
\[
a_2 = \sum_{i=1}^{n} x_{Bi} - x_{c1} - n - 2
\] (5)

The ray on the image point has a vector representation.
\[
\mathbf{x}_{BC} = \mathbf{x}_C + t(\mathbf{x}_B - \mathbf{x}_C)
\] (6)

The angle between the straight lines is determined by the scalar product
\[
\cos \phi = \frac{|\mathbf{a} \cdot \mathbf{x}_{BC}|}{|\mathbf{a}| |\mathbf{x}_{BC}|}
\] (7)

From here
\[
\phi = \arccos \frac{|x_{Bi}x_{c1}+x_{Bi}^2(\sum_{i=1}^{n} x_{Bi} - x_{c1} - n - 1)+\sum_{i=2}^{n} (x_{Bi} - x_{ci})|}{\sqrt{\sum_{i=1}^{n} (x_{Bi} - x_{c1})^2 + n - 2 \sum_{i=2}^{n} (x_{Bi} - x_{ci})}}
\] (8)

Using this technique, the information of multidimensional space is integrated in only three indicators: gross domestic product, distance of the imaging point and the angle of rotation of the beam.

4. Findings

Apply this method to the region in question, for which data is available summarized in four tables.

**Table 1.** Oil and natural gas production in the Orenburg region by years.

| Fuel types                        | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2015 | 2016 | 2017 |
|-----------------------------------|------|------|------|------|------|------|------|------|------|
| Oil, including gas condensate, mt | 10,1 | 8,7  | 9,1  | 17,5 | 22,2 | 22,9 | 21,8 | 20,8 | 20,5 |
| Natural gas, billion cubic meters| 40,1 | 32,4 | 25,9 | 21,0 | 21,1 | 20,5 | 19,4 | 18,3 | 17,2 |

**Table 2.** The total capacity of power plants in the Orenburg region by years.

| Types of power plants          | 2010 | 2015 | 2018 |
|--------------------------------|------|------|------|
| Total                          | 3680 | 3710 | 3880 |
| Incl. TPS and TPC              | 3650 | 3650 | 3650 |
| Hydr. power station            | 30   | 30   | 30   |
| HelioPS                        | -    | 30   | 0,8  |

**Table 3.** Steel production (thousand tons) in the Orenburg region by years.

| Total          | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|----------------|------|------|------|------|------|------|------|------|
| Incl. TPS and TPC | 2864 | 2548 | 2337 | 1519 | 1185 | 1095 | 1116 | 1467 |

Having averaged production by years 2010 - 2015, it is possible to build a beam of coordinated development. Then, substituting data for 2010 and 2018, we can determine trends in the regional industry at the moment. Calculations show: gross product in relative units fell from 5.667 to 4.768. The distance from the consistent development beam decreased from \( \rho = 0.629 \) to \( \rho = 0.55 \).

Finally, the angle of rotation has changed from \( \phi = 1.12 \) to \( \phi = 1.24 \), which means a small departure from the orientation of the industry to the predominance of the mining sector divide the text of the paper is optional and left as a decision for the author. Where the author wishes to divide the paper into sections the formatting shown in table 2 should be used.
Table 4. Production of the main types of products of the branches of the engineering complex of the Orenburg region.

| Types of products                       | 1990 | 2000 | 2005 | 2010 | 2012 | 2014 | 2015 |
|----------------------------------------|------|------|------|------|------|------|------|
| Metallurgical equipment, thousand tons | 21.6 | 7.6  | 10.5 | 11.4 | 10.8 | 13.0 | 12.8 |
| Forging machines, pcs.                 | 6091 | 222  | 274  | 616  | 885  | 387  | 194  |
| Metal-cutting machines, pcs.           | 2618 | 125  | 15   | --   | --   | --   | --   |
| Tractor trailers, pcs.                 | 23809| 1709 | 2412 | 1270 | 258  | 244  | 279  |
| Tractors for trucks, pcs.              | 300  | 389  | 217  | 63   | 110  | 32   | --   |
| Electric motors, thousand units        | 520  | 211  | 227  | 133  | 91   | 67   | 85   |
| Refrigerators and freezers, thousand units | 417.1| 57.2 | 48.6 | 42.3 | 47.2 | 44.6 | 82.5 |
| Vacuum cleaners, thousand units        | 272.1| 1.5  | --   | --   | --   | --   | --   |
| Washing machines, thou. pieces.        | 95.0 | 1.8  | --   | --   | --   | --   | --   |

5. Conclusion

Thus, the study of the features of the development of industrial production in the region allowed us to identify the main trends. The method of multidimensional analysis, based on the coordinates of the levels of development of industries, the beam of consistent development and the hyperplanes of equal contributions, has shown its efficiency and usefulness for the application and construction of economic forecasts.

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