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APPLICATION OF MODERN INFORMATION TECHNOLOGIES IN MANAGEMENT OF PRODUCTION PROCESSES

Abstract. *Current study examines business statistics of industrial enterprises activity of G20 members and indicators of activity of the Ukrainian machine building enterprises. Five of the G20 members - Japan, Brazil, South Africa (manufacturing only), the United States and the EU-28 - reported negative annual averages for 10 year period (2007-2017). Ukraine reported mostly negative trends of main indicators of machine-building for 2010-2013. The effect of direct investments from Ukraine into the economies of the countries of the world on the volume of products sold by machine-building enterprises was investigated in the paper. It was also investigated the impact of direct investment flows from Ukraine into economies of the world on the average salary of employees in the field of machine-building by tools of economic and mathematical modeling.*

Key words: *machine-building, correlation-regression analysis, simulation, direct investment, digital transformation.*

INTRODUCTION

Increasing of production costs, rising competition, quality requirements and nomenclature of the output of machine-building enterprises are all what production is facing in today's dynamic world economy. This, in turn, places increased demands on the flexibility of production and management in real time and the use of modern information technologies.

The problems of development of Ukrainian machine-building are revealed in the works of domestic scientists and economists.

Ilyash, O., Dzhadan, I., Ostasz, G. [1] determine scientific and methodological prerequisites for studying the influence of the industry's innovation potential indices on the industrial products' revenue of Ukraine. They offer mathematical model of correlation between the industrial products' revenue and the indices of the innovation potential development of the Ukrainian industry. Results of the study of macroeconomic indicators that influence the development of the Ukrainian industry is quiet actual and can be used in further researches of machinebuilding complex.

The paper of Iryna Bryzhan and Olesya Hryhoryeva [2] argues that Ukraine should change conventional concept of economic development, based on extensive consumption of natural resources and a large impact on the environment. The authors present how the concept of sustainable development might function to secure ecologically focused (continuous, crisis-free) industrial development. They state that the main prerequisites to sustainable development are innovations, as well as ecologically loyal institutional rules of business.

This paper corresponds the most vital issues of economic growth based on adequate and correct industrial development. For this purpose, data on the activity of machine-building enterprises of Ukraine for the period of 2010-2017 and statistics of

the activity of industrial enterprises of G20 members for the same period were analyzed.

Data concerning business statistics of industrial enterprises activity of G20 members are provided by the Eurostat Statistics. Indicators of activity of the Ukrainian machine building enterprises are provided by the State Statistics Service of Ukraine and analytical reports. All data cover the period of 2010-2017.

In five G20 members industrial output in 2017 had still not yet returned to pre-crisis levels. The impact of the financial and economic crisis on industrial activities and the subsequent recovery was substantial in several G20 members. Five of the G20 members - Japan, Brazil, South Africa (manufacturing only), the United States and the EU-28 - reported negative annual averages for 10 year period (2007-2017), indicating that in real terms the level of industrial output in 2017 had not yet returned to its pre-crisis level observed in 2007. Over the period studied, India (3.9%) and Indonesia (4.1%; manufacturing only) reported the third and second fastest annual average growth rates in industrial output among the G20 members, with the fastest growth in Saudi Arabia (6.0%; manufacturing only; 2010-2016). Looking at the latest annual rate of change, between 2016 and 2017, Turkey recorded the fastest growth in industrial production, up 6.3%, just over double the growth recorded in the EU-28 (3.1%). South Africa (manufacturing only) was the only G20 member for which data are available to report a fall in output in 2017 [3].

Table 1

Indicators of activity of machine-building enterprises for the period of 2010-2017 [5-7]

Year	Number of enterprises, units	Number of employees, thousand people	The average monthly nominal salary of employees, UAH	Volume of sales of machine-building enterprises, mln UAH	Direct investments from Ukraine into the economies of the countries of the world (US $ million)
2010	4736	482,3	2243	-	99270,5
2011	4791	499,4	2741	6424,8	130847,9
2012	4546	520,8	3042	6456,2	140539,3
2013	5103	488,8	3229	113926,6	6588,7
2014	4460	422,3	3336	101924,7	6702,9
2015	4483	370,4	4211	115261,7	6456,2
2016	4209	353,6	5344	131351,8	6315,2
2017	4481	358,8	7357	167649,3	6346,3

In 2017, the value of sold production covered by the sectors mining and quarrying and manufacturing amounted to 180 billion EUR. After the economic crisis in 2008, the value generated by EU production was reduced dramatically in 2009, with a sharp decrease of almost 18%. However, there was a turn-around between 2009 and 2011 when the value of sold production increased by more than 15% and remained stable in the following three years. The results of 2017 show the consolidation of the growth in production, after the full recovery and surpassing the 2008 level. This upwards trend of the EU's industrial production was mainly due to

the manufacturing of motor vehicles, trailers & semi-trailers, other transport equipment and machinery & equipment.

Over three-quarters of the EU-28's value of sold production (78%) was generated by six EU Member States. Germany recorded the highest value of EUR 1 160 billion, equivalent to 28% of the EU-28 total, followed by Italy (16 %), France (12%), the United Kingdom (9 %), Spain (8%) and Poland (5%). The other 22 EU Member States contributed with smaller shares (up to 3%) [4].

Tools of economic-mathematical modeling on the basis of correlation-regression analysis are used to determine the relationship between the main indicators of activity in the field of machine building.

Statistics show that the number of machine-building enterprises has increased in the period of 2010-2013, and since 2013 has fluctuated with a decreasing trend. Despite this, the volume of sales has been increasing slightly. Accordingly, the number of employees in the period of 2013-2017 has decreased. The average monthly nominal salary of machine building workers tends to increase in the analyzed period. Direct investments from Ukraine into the economies of the world in the period 2011-2014 tend to increase, and from 2015 - decrease.

According to the data presented in Table 1 the effect of direct investments from Ukraine into the economies of the countries of the world on the volume of products sold by machine-building enterprises was investigated. With this purpose the toolkit of economic and mathematical modeling based on correlation-regression analysis was used.

According to simulation the determination coefficient is 0.71 indicating the adequacy of the constructed model. The regression model of the impact of direct investment flows from Ukraine to economies of the world on the sales volume of machine-building enterprises will be:

$$y = 220070{,}3 - 2{,}12512x \quad (1)$$

Positive correlation coefficient indicates a direct link between Ukraine's investments into economies of the world and the sales volume, whereas the correlation-regression link being direct. That is, the increase of direct investment flows from Ukraine to the countries of the world will lead to increase of sales volume of machine-building enterprises.

It was also investigated the impact of direct investment flows from Ukraine into economies of the world on the average salary of employees in the field of machine-building by tools of economic and mathematical modeling.

The determination coefficient is **sufficiently** high and is 0.81, which indicates the adequacy of the constructed model. The correlation coefficient between indicators is also quite high and is 0.7, indicating a strong correlation between indicators. Positive correlation coefficient indicates a direct link, that is, if direct investments from Ukraine to other countries will grow, the average nominal salary of employees in the machine-building industry will also increase. This shows a clear relationship between key factors and activity results. Investing international projects allows to receive budget revenues, which in turn can lead to **increasing of machine-building staff salaries.** Correlation-regression equation of the degree of influence of direct investment flows from Ukraine to other countries will be:

$$y = 59997{,}66 - 8{,}53x \quad (2)$$

Application of tools of economic and mathematical modeling allows to reveal synergetic influence of dynamics of financial indices of machine-building industry and to explore possibility of influence and changes of dynamics of concrete indices. This will allow decisions to be made to improve the state of the national machine-building industry.

Monitoring and understanding of emerging market trends, deep studying and adapting to company needs, interacting with universities, industrial companies, the scientific community, mobilizing resources to find and implement innovative ideas in a company - this is what should determine the vector of machine-building companies of Ukraine.

A common trend in the development of individual manufacturing enterprises and states as well in the modern world is the digital transformation. However, this is not only a way of tracking data, cross-cutting analytics for strategy building, but also a way of integrating into a single ecosystem. It is necessary to change the types of customer interaction with the company, to introduce new digital systems, to personalize content. Creating R&D centers that would really liaise with university developments, applied research, venture investors, and implementing new data centers to support these R&D centers is important. The use of predictive analytics in business processes (production and sales) on the basis of new technologies is important factor for enterprise`s functioning in today's market environment. It is impossible not to mention the need for the introduction of procurement management subsystems (Smart Tender), which would increase transparency and reliability of information, reduce purchase prices for companies, avoid corruption schemes and abuse. This, in turn, would help attract investors as well as invest in foreign machine-building companies. However, while most digital technologies make it possible to increase the efficiency of production processes and survive in competition, polls show that the biggest concerns of industrial executives include the risks associated with digital transformation. The change in formation may be the beginning of the end for those enterprises that were not ready for it. Among the main reasons for this are the complexity of modifying work processes and the lack of intensity of innovation, insufficient study of consumers' opinions. Therefore, the approach to digitizing economic processes must be measured and balanced so that the decisions that support it would lead to a new impetus for business growth on an innovative basis, but not to the detriment of entire sectors of the economy and, ultimately, to excessive government control.

However, it should be noted that some of this is already being implemented at large private industrial enterprises of Ukraine. But not on the state ones. The implementation of these proposals requires the assistance of the authorities and political will.

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