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**The Perspective of the Development of the Industry
of the Future in Romania in the Context of Big Data
and Digitalization**

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Abstract

Industry is still the main branch that contributes to the formation and growth of GDP.

The Romanian industry has lost its supremacy in a series of fields, in which it was once even among the countries with a pronounced industrial accent. Given the resilience and development of the smart economy, we can no longer talk about reindustrialization, but about the development of the Romanian industry on multiple levels, taking into account the possibilities created by robotics, biotechnology, nanotechnology development, artificial intelligence, information technology, digitization of activities in society and so on.

The objective of this article is to identify the possibilities and perspectives of Romania's evolution in the current context, in a double sense: to bring the industry back to the level of European and global competitiveness, and on the other hand to find the formulas, even though the process of resilience, so as to maintain the priority role of this branch.

In the research conducted for writing of this article, we used a whole range of statistical-econometric methods. Thus, we used the index method, the structural analysis method, the dynamic series and the comparative analysis. These methods and others (correlation method, regression model, etc.) were used to process, compare and highlight the trend for the data used in the analysis.

This article has as final objective the identification of the possibilities available to Romania to align with the restructuring of the industry at the level required by the Member States of the European Union.

Keywords: industry, resilience, robotics, digitization, Big Data.

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1. Introduction

The article *The perspective of the development of the future industry in Romania in the context of Big Data and digitalization* aims to analyse the perspective of the evolution of the Romanian industry in the next period in the context of Big Data and the process of modernization and digitalization.

Based on an analysis of the way in which the Romanian industry has evolved so far, this article tries to foreshadow the way in which it will evolve in the next period. However, a pertinent analysis cannot be carried out without taking into account the effects the recent effects of the health and financial-economic crisis, which not only Romania is facing, but of the entire humanity.

The development of the industry has a past and a solid foundation, which although affected in the process of free market introduction, privatization and especially our country's access to the European Union, there are still important elements to be considered in the next period for reorientation and reconsideration of the Romanian economy.

Within the national economy, an important number companies will still contribute to the achievements of the Romanian industry. Despite the fact that during the pandemic crisis and the economic-financial crisis a significant number of companies in the field of industry, especially in the field of small and medium enterprises, have decreased their activity, being in the process of restructuring or simply having ceased the activity, we must consider what is the perspective of the evolution of the Romanian industry.

At present, the extractive industry, manufacturing, energy and others have had a significant number of employees, and it is possible for new jobs to appear through investments, which represents an important contribution in the national economy.

An analysis is made of the structural evolution of the industry and the authors try to validate some areas that in the next period must be in the spotlight, so that by introducing modern methods, the achievements of science, research and innovation, to take this branch of the national economy to a higher net level. Thus, some branches, such as oil extraction, natural gas extraction, coal production extraction of other important ores, need to receive the necessary attention and through modernization, they should be able to follow a positive evolution in the next period.

We must keep in mind that the energy industry can be improved by applying other production methods, and thus produce an important qualitative leap in this field. The extractive and processing industry must acquire the importance it deserves in the structure, so as to ensure a positive evolution in the next period as well.

The development of the industry of the future in Romania will no longer be possible at the expense of the standard traditional technological level, but based on discoveries, and especially on the perspectives of the new conquests with a huge impact on the industry, which will further develop. In this context, the elements related to robotization must be studied and assimilated in substantiating the development of the industry of the future, the one that allows the endowment with advanced mechanical, computer or mixed systems, in other words with robots for advanced production processes.

The development of the industry must also be achieved on the basis of biotechnology, in the sense that the technical and production uses of microorganisms, plant cell cultures and others must take precedence. Particular attention must also be paid to nanotechnology, which is a modern technique that allows the manufacture of devices with molecular content and others. Attention must also be paid to the identification and development of branches or areas of activity based on artificial intelligence.

Last but not least, projects based on information and communication technology, known as IT or ITC, need to be developed. Information technology is necessary for the processing of information in particular through the use of computers. We must also not forget that the industry of the future will also develop towards the exploration, preparation and use of underwater industrial activities. We are overcoming the shortcoming in the decision taken following the exploration and exploitation of oil and gas in the Black Sea, but we still hope that this will become particularly important in the period ahead. The digitalization of activities in society will increase and change the current ways of management, funding, project management and research activities.

In the context presented, the authors concluded that the fields of finance, education, research, health, local or central government will have to be deeply digitized in order to meet the requirements of a modern economy.

At the end of the article, the authors focused on the conditions that the government strategy adapted to the new directions must be met and in line with the projects of the European Union. In this respect, the actions planned for each sector are inventoried, which differ according to the objectives pursued and the specific conditions, but most must be in line with the coordinates of the future industry development.

2. Literature Review

Akçomaka and ter Weel (2009) conducted a study analysing the correlation between social capital, innovation and per capita income growth in the European Union. The authors capitalized on the existing level of knowledge and extended the analysis on improving the correlation between factors of production. Anghel et al. (2019) highlighted the important contribution of the industry to the formation of the gross domestic product in Romania, while Anghelache and Burea (2018) directed their research towards the analysis of the evolution of this branch. The authors aimed to capitalize on the results of up-to-date research by proposing new ways / strategies for improvement in the future. Anghelache (2019) performed a complex analysis of the Romanian industrial activity, using in this sense statistical indicators and graphical representations that showed how the industry evolved as a whole, but also structurally. Barbosa and Faria (2011), as well as Buesaa et al. (2010) addressed a number of issues related to innovation and research policy in Europe. Dachs and Pyka (2010) studied issues related to the internationalization of innovation activities and presented the main drivers for the European Union. A similar topic is studied by Onetti et al. (2012). Erosa and Cabrillana (2008) analysed the differences in

productivity between industries. Grand et al. (2016) focused on anticipating the problems generated by a large part of renewable intermittent energies in electricity production. Hoberg and Phillips (2016) analysed the factors that determine the endogenous differentiation of products. Iacob and Dumbravă (2020) made an x-ray of the main elements that characterize the Romanian industry. Kahn and Mansur (2013) studied the correlation between local energy regulations and the geographical concentration of employment. Lee et al. (2016) studied the industries in which capital is invested. Pinto (2009) addressed an issue of innovation diversity in the EU. Srholec (2009) addressed notions of innovation cooperation.

3. Methodology, Data, Results and Discussions

The authors used data published by the profile institutions (National Institute of Statistics and Eurostat), processing them in order to highlight the aspects subject to analysis. Also, some statistical methods were used (data series, structural analysis and study in dynamics). At the same time, the index method was used.

The data submitted to the study were obtained from the data sources used, samples from some official documents and analyses / interpretations of the authors.

- ***The main mutations in the branch structure***

In line with the global trend of fragmentation, specialization and cooperation on product components, in the national space or between different countries, the Romanian industry has gone through a process of deep division of industrial giants.

Characterized by an excessive degree of concentration and integration of production, in the process of implementing the market economy, enterprises have been transformed, divided or disappeared. As a result of the changes during the transition and implementation of the competitive market economy, in accordance with the new legislation, the total number of enterprises, organized on the basis of the new principles, was 49,178, compared to 1989, when there were 2,102 industrial enterprises, with a high degree of concentration and integration of production.

Table 1. Distribution of enterprises in industry, by size classes, in 2019

	Total enterprises	of which: by size classes, by number of employees:			
		- micro – (0-9)	- small – (10-49)	- medium - (50 - 249)	- big – (250 and over)
Total industry	49 178	34 928	10 233	3 213	804
- extractive industry	1 072	760	241	51	20
- manufacturing industry	46 761	33 031	9 870	3 115	745
- electricity and heat, gas and water	1 345	1 137	122	47	39

Note: The grouping was performed according to Eurostat criteria.

Source: Statistical Yearbook of Romania, 2019, I.N.S. - data processed by the authors.

The existing small and medium enterprises in 2019 represented 31.1% of the total number of active industrial enterprises. Their share in the total number of employees, as well as in the volume of turnover per total industry were much lower. This

explains, to some extent, the relatively slow evolution of the private sector in this branch, as small and medium-sized enterprises, although wholly owned by the private sector, still make a modest contribution to the volume of production achieved by the total industry.

The process of privatization of state-owned companies and large industrial companies, together with the still low proportion in the total industry of the production of small and medium enterprises, made up the share of private sector production as a whole in the industrial activity as a whole.

Table 2. Share of small and medium active enterprises in the total number of enterprises in the industry, by number of staff and turnover in 2018 and 2019

	2018	2019
	by staff number	
Extractive industry	21.95%	22.76%
Manufacturing industry	50.53%	49.84%
Electricity and heat, gas and water	23.71%	23.28%
	by turnover	
Extractive industry	21.81%	43.76%
Manufacturing industry	38.89%	37.88%
Electricity and heat, gas and water	31.25%	33.34%

Source: Statistical Yearbook of Romania, 2019, I.N.S. - data processed by the authors.

The data in table number 2 are for the years 2018 and 2019. We did not bypass the year 2020, in which a significant number of small and medium enterprises have reduced their activity, went into insolvency or went bankrupt, disappearing from the market.

According to the nature of the share capital, out of the active industrial enterprises existing in 2019, over 80% were enterprises with a majority private property, the most of the being in the manufacturing industry. Out of the total number of active industrial enterprises, an important number of units were constituted with entirely foreign capital, most of them being in the manufacturing industry.

In general terms, regarding the number of active economic agents, private entrepreneurs are also taken into account, and their number in the industry activity was, in 2019, quite high.

The differentiated growth rates of the prices of industrial products in certain branches and in different periods exerted, together with the changes determined by the evolution of the physical volume of production, a significant influence on the structure of production on the main activities.

In the period 2010-2019, with the advancement of the process of restructuring industrial enterprises and setting prices on market criteria, it is found that the share by sectors of activity of industrial production was mainly determined by the evolution of the physical volume of production, reflected by a slight increase in the share of the manufacturing industry and a declining trend in the share of the extractive industry and the production of electricity and heat, gas and water.

• **The industry of the future** will no longer be able to rely on the traditional / standard technological level, but on discoveries and especially on the perspectives of new conquests, with a huge impact on the industries that will develop. In this context, they must be studied and assimilated in the substantiation and development of industries based on:

a) Robotization, which involves equipping production processes with mechanical, computer or mixed systems, in other words with robots. This will involve increasing productivity, replacing labour in profitable, sensitive or harmful operations. In a narrow view, this perspective could be interpreted as a replacement of the human factor, which would increase the number of unemployed population. This appreciation cannot be accepted in this way, because robotization will involve the development of activity in other fields such as research, innovation, invention and others. Under these conditions, it is necessary to restructure education, the development of research institutions, innovation, in other words, to improve the quality of the workforce.

b) Development of industries based on biotechnology, in the sense of the use in technique and production of microorganisms, plant and animal cell cultures for the production of useful substances. Thus, these crops of plant and animal substances can be used in agriculture, the food industry, pharmaceuticals or other *organic* products. And now there is the problem of developing *bio* industries, an aspect that will develop in the next period. Biotechnology is a young branch of the future of science that aims to help prevent the effects of food shortages, raw materials, energy sources, by studying the possibilities offered by the activity of enzymes in industrial processes. The emergence and development of biotechnology is related to the evolution of molecular biology, which allows understanding the links between molecular structure, morphology and the ability to function, growth and multiplication. These give biological systems unique features of computers with telecommunications, they are novelties that do not aim only at a straight extension of the machines of the industrial era, but at the leap to biosynthesis and biotechnologies in the pure sense.

c) Paying more attention to the development of nanotechnology, which is a modern technique allowing the manufacture of devices with molecular content, capable of manipulating structural matter, atom by atom. Nanotechnology will evolve and impose development, as a result of research into new industries.

d) Development of branches or fields of activity using artificial intelligence, closely related to the IT system, based on information technology. Romania has an international IT school, and the problem that arises, first of all, is the development of this activity based on natural intelligence, which is developing towards artificial intelligence.

e) At present, a number of projects are known and developed based on information and communication technology, abbreviated IT or ITC. This information technology is necessary for the processing (procurement, processing, storage, conversion and transmission) of information, in particular through the use of computers. Information technology is a field, a link between classical electronics

and computer science. Information technology, also known as computerization process, finds application on multiple levels related to data and information, namely: processors, computers, hardware and software, programming languages, system design and industrial activities. The occupations of specialists in these fields are quite varied and are evolving at an accelerated pace, and will be used in the industries of the future. In the last period of time, the scope of information technology has greatly expanded, including mobile phones, automation of automobiles, applications in sensitive industries, along with an increased demand for IT specialists on the labour market. In this regard, we must notice the improvement of higher education, research and innovation in this field. We specify that, in these fields (telecommunications, software and IT services, hardware and electronics), the number of employees has increased year by year. Thus, in the peak years, 49,800 people worked in these fields in telecommunications, 54,300 people in software and IT services and 20,000 people in hardware and electronics. We recall that an important number of people (specialists) in this field work with great results abroad. It becomes a priority that we must program the development of these industries of the future in order to keep in the country the Romanian specialists, who have a high standard of training.

f) The industry of the future will also move towards the exploration, preparation and use of underwater industrial activities. It is not just a statement, but we are referring to concrete facts. Thus, in the marine platform (Black Sea) of Romania there are important natural gas and oil resources. Marine platforms also contain other mineral resources, which will be the subject of research, exploration, exploitation and development of the industries of the future. Similarly, we can approach the exploration of the cosmos. Of course, these thoughts are for the development of the industries of the future. These could only be achieved through the development of research and innovation and especially through international cooperation.

g) The digitalization of activities in society will increase and change the current ways of management, financing, project management and activities. The fields of finance, education, research, health, local or central government will go through a deep process of digitization.

Considering the aspects presented above, in the current stage of Romania's development, it is necessary to reconsider the role of industry in the national economy, clearly establishing the modern development strategy of the country's industry. In this context, it is necessary, in the new conditions of sustainable economic development, to develop, in particular, those branches which are based on national resources and which have a tradition, as well as those which have significant production capacities, establishing, at the same time, the reduction of the levels at which the energy-consuming productions operate, which require imports of expensive raw materials and energy resources.

The creation of rational production capacities must be considered, avoiding the excessive degree of concentration, which would ensure their operation at maximum capacity, with high productivity and efficiency, with high value added and a high degree of competitiveness, capable of also meeting the requirements of external partners. Continuing to assign increasing importance to small and medium-sized

enterprises, they would develop in line with large industrial enterprises, contributing, horizontally, implicitly to obtaining their finished products.

• **The strategy must focus** on new elements of sustainable development, the priorities of industrial policy and the sectorial approach, including elements aimed at:

a) the priorities of the industrial policy as a whole, respectively the acceleration of the structural adjustment, the improvement of the business environment, the attraction of an increased volume of foreign investments and the attraction of community funds;

b) the priorities in the sectorial strategies: the accelerated restructuring of some industrial sectors - the steel and the defence industry; supporting the intense development of key sectors in the economy - telecommunications equipment, information technology; ensuring the food security of the population, which imposes the development of the industries of tractors and agricultural machines, of the production of fertilizers, of the food industry; ensuring the health of the population, which requires the development of the drug industry; development of industrial sectors related to the modernization of the necessary infrastructure and facilities (means of transport, equipment).

• **The actions envisaged for each sector** differ according to the objectives pursued and the specific conditions, but most of them must be part of several common coordinates:

a) selective restructuring of manufacturing nomenclatures by eliminating non-viable products and technologies;

b) promoting high-performance technologies and high value-added products;

c) modernization of technical infrastructure and technologies in order to reduce costs, improve product quality and reduce pollution potential;

d) deep restructuring (organizational, financial, managerial and commercial) of state-owned national companies, in order to increase their attractiveness for foreign investors;

e) resizing the production capacities in relation to the internal and external demand for products / services;

f) outsourcing of operations complementary to basic productive activities;

g) reduction of pollution caused by industrial activity, according to the relevant standards of the European Union;

h) increasing investments in special programs of education and training of the labour force, in order to increase its professionalism, mobility and flexibility, thus achieving a closer link between the development of physical capital and human capital;

i) the development of the industry due to the high intelligence potential that Romania has;

j) giving high priority to development, innovation and innovations for the restructuring of the entire industry based on advanced technologies so that the entire economy operates on the most modern basis;

k) intensifying the geological prospecting, in order to capitalize on the superior natural resources available to Romania, thus developing on modern technological bases of the economy;

l) use of Community funds and participation in European projects. Romania needs to reconsider some possibilities to become useful for European and world cooperation.

Acting in the spirit of the European Union strategy on industrial development, in order to harmonize Romania's industrial policy aimed at increasing the industrial production of the community as a whole, and of each Member State, the Romanian industry and companies must demonstrate their ability to adapt to international market requirements.

4. Conclusions

From the study carried out by the authors and from the interpretation of the data, which have reflected the evolution so far of the Romanian industry, some mainly theoretical conclusions can be drawn. Romania must move quickly to research. At present, the percentage of GDP devoted to research of about 0.48% is not inconclusive, but insignificant and can lead to other ways of interpreting this evolution.

Another conclusion is that in the field of research and cooperation Romania must align with European standards, participate in future projects on the development of European Union industry and more widely in Europe and worldwide.

Another conclusion is that the measures that will have to be taken in a vision regarding the future development of the Romanian economy must be based on a very deep analysis of the effects that the pandemic and financial-economic crisis had on the evolution of the Romanian industry at some point.

At the same time, Romania should focus and find a way to improve some areas of industrial development in which to have the supremacy in order to participate in the major European projects aimed at the European Union. Of course, we must not forget that this recovery and resilience program must be combined with the ideas contained in this article regarding the development of the industry of the future based on the most modern discoveries of research and innovation.

The authors consider that the objectives proposed in conducting this study have been met. Of course, this research can be developed / improved by expanding the study area.

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