

# Conceptual Approaches of Industry 5.0. Correlative Elements with Supply Chain Management 5.0

Gheorghe MINCULETE<sup>1</sup>  
Ghiță BÂRSAN<sup>2</sup>  
Polixenia OLAR<sup>3</sup>

## Abstract

The continuous evolution of civilization in the world, has progressively determined the change of consumer options for different types of products in terms of complexity, which has progressively led to several industrial revolutions.

Therefore, in the current stage, the transition to a superior revolution of "Industry 4.0" takes place, where, from a digital point of view, the emphasis was on the devices related to the connection to the so-called Internet of Things.

In the conditions mentioned, both the industry and the logistics have developed in stages, revealing today projections and implementations adequate to the configurations of the digital level - 5.0. At this stage, a special emphasis will be systematically placed on research and innovation as essential factors in the process of making that European industry sustainable, resilient and focused on the human factor and interest.

The requirements of the information society, based on knowledge are obviously found in the specific coordinates of "Industry 5.0" and in the determining functions of "Supply Chain Management 5.0".

In this article we set out to briefly address the importance and role of the issue of "Industry 5.0", but also some correlations with "Supply Chain Management 5.0", given the current and future economic challenges.

**Keywords:** "Society 5.0"; "Industry 5.0"; "Industry 5.0" workers; "Supply Chain Management 5.0"; "Supply Chain Management 5.0 facilities".

**JEL classification:** D 20, D 30, M 10, M 21, M 31

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## 1. Introduction

The continuous socio-economic transformations in the information age, based on knowledge, determined the gradual, evolutionary transition of the society from one stage to another.

The concept of "Society 5.0" ("Super Smart Society") was promoted in 2016 by specialists from the Japanese government. A little earlier, initially in 2011,

<sup>1</sup> Gheorghe Minculete, "Nicolae Bălcescu" Land Forces Academy, Romania, e-mail: minculetegh@yahoo.com

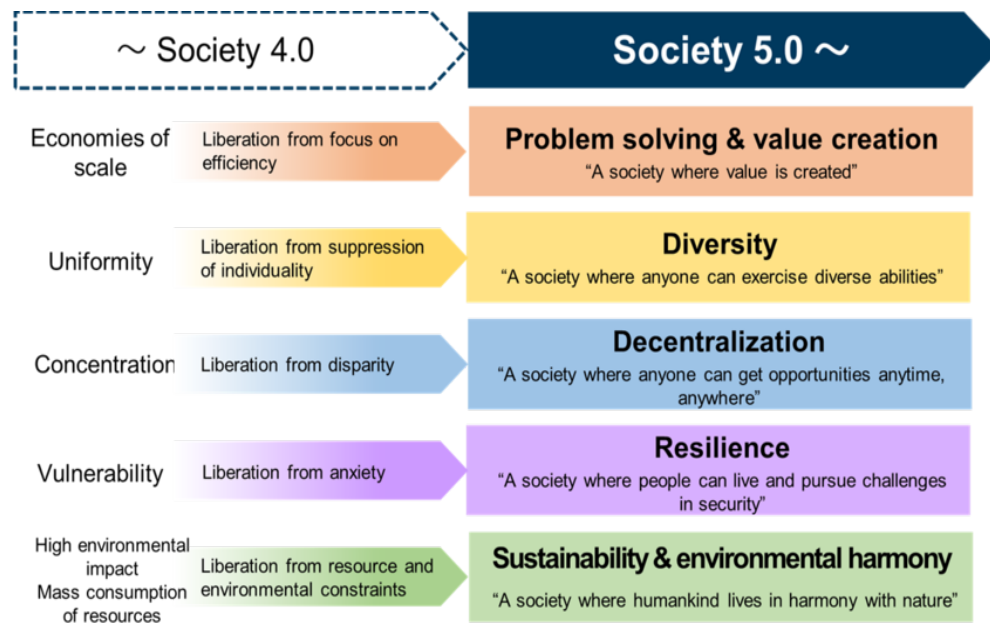
<sup>2</sup> Ghiță Bârsan, "Nicolae Bălcescu" Land Forces Academy, Romania, e-mail: ghbarsan@gmail.com

<sup>3</sup> Polixenia Olar "Carol I" National Defense University, Romania, e-mail: lisiolar@yahoo.com

then in 2013 (on the occasion of an industrial fair in Hanover), the concept of "Industry 4.0" was promoted, being the object of implementation, for this purpose, of Germany's national profile strategy (Guilherme, 2020).

According to our assessment, the transition from "Industry 4.0" to the concept of "Industry 5.0" is not accidental, because in the societal plan it is obvious the adequate transition from "Society 4.0" to "Society 5.0".

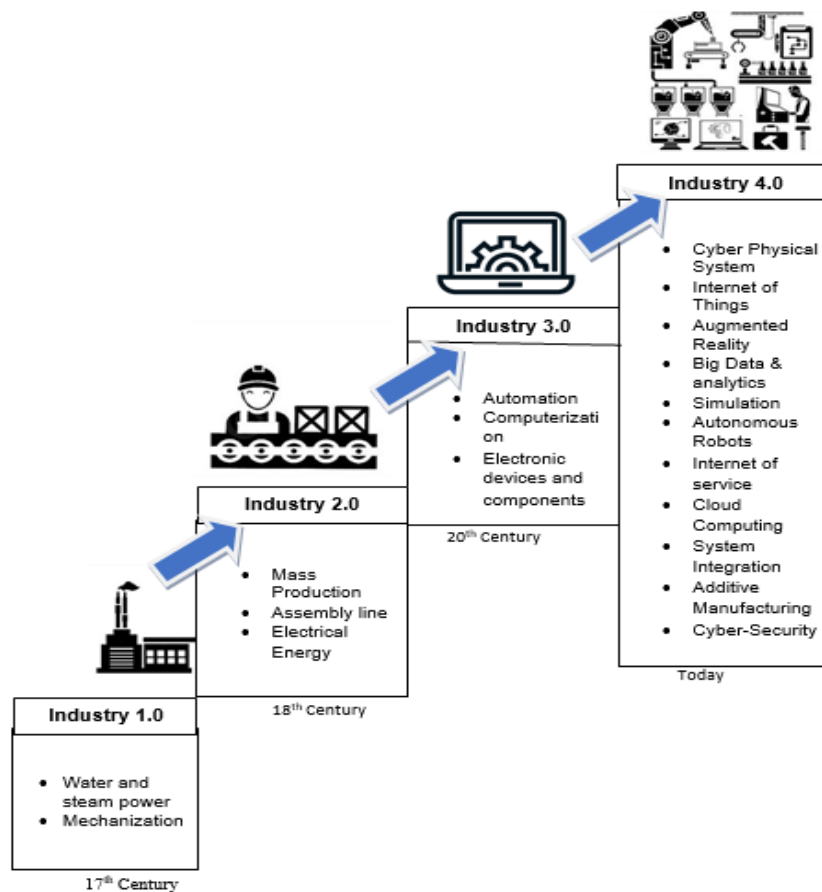
Between the industrial evolution and the evolution of the society there is, therefore, the obvious dependence and interdependence, because practically the first concept (of Industry) is integrated to the second (of Society). At the same time, both concepts highlight the fundamental changes of the national and global society and economy towards a new paradigm (ECD-GRID, 2021). In figure 1 we highlight elements of comparison between "Society 4.0" and "Society 5.0".



**Figure 1. Comparable aspects of Society 4.0 with Society 5.0**

Source: (Nakanishi, 2019)

In our approach to the eloquent presentation of the transition to a higher stage of industrial evolution, we appreciate that the engagement, combination and continuous evolution, especially in recent decades, of mechanisms related to the creation and capitalization of technological, informational and communication elements has led to premises and successful implementation of the characteristics of the industrial revolution, known as "Industry 4.0". (Strange and Zucchella, 2017). In figure 2 we present both the transition from one stage to another in the industrial evolution, as well as several essential facilities of "Industry 4.0".



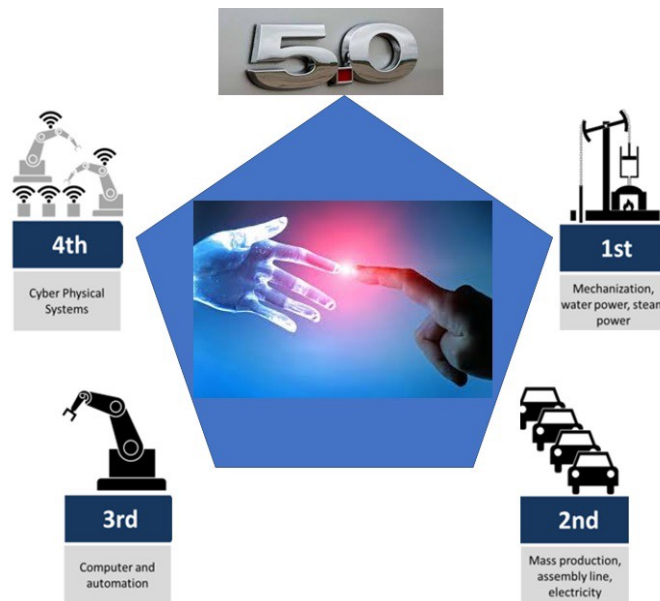
**Figure 2. Evolutionary presentation from Industry 1.0 to Industry 4.0**  
 Source: (Tay et.all. 2018)

According to our analysis, there were valuable evaluations and estimates converging to reach the stage of "Industry 5.0", a few years before moving to the implementation of this concept, made by both the specialists from the "McKinsey Global Institute" and the Czech specialist Michael Rada, from which we will briefly address below.

Since 2013, Mckinsey experts have estimated the economic potential impact, as a result of capitalizing on new technologies for 2025, given as variable (disruptive) growth factors: consumption; new income; gross domestic product etc. These determinations were based on the opportunities and facilities that the smart technologies of the future will offer to workers (of various professions). (Manyika et.all, 2013).

As we mentioned, another promoter of the evolutionary transition from "Industry 4.0" to the current (higher) stage of industrialization is the famous Czech expert Michael Rada, who, in 2015, showed the need to make the leap to

"Industry 5.0", as a result of the evaluation of the standard of living, of the creativity and of the requirements for the realization of the customized products of superior quality. Figure 3 shows the successive evolution of "Industry 5.0".



**Figure 3. The evolutionary leap to "Industry 5.0"**

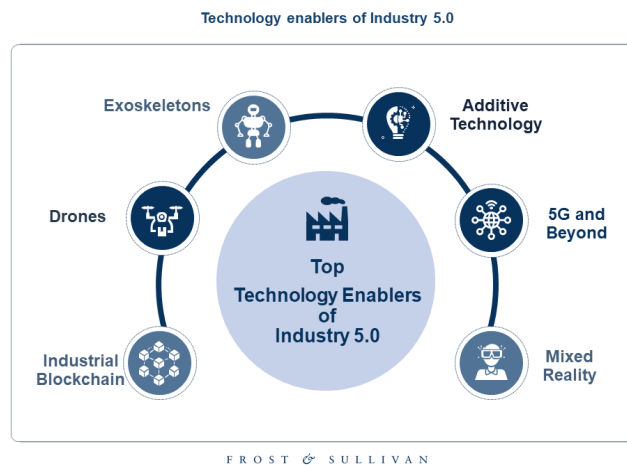
*Source: (Rada, 2018)*

Therefore, according to the assertions of the mentioned scholar researcher, in the stage "Industry 5.0" will be generalized (as much as possible), obviously, the set of processes involving human-machine interdependence in fully collaborative conditions by avoiding waste of resources (even zeroing) and industrial recycling of waste, for full effectiveness, efficiency and economic performance of companies, which will determine economic and social prosperity. This implies the continuous realization of a real synergistic mechanism that will continuously relate the highly qualified workforce to particularly intelligent machines.

In the ten years of operation of "Industry 4.0", the emphasis was on digitalization, increasing and efficient production flexibility and less on social fairness (Houston, 2020). The need for continuous efficiency, in the conditions of the new global economic challenges, determined the rapid evolution of the knowledge and technology adequate to the knowledge-based society towards a new stage, specific to "Industry 5.0".

Based on the profile analyzes, it results that this evolution (better expressed than revolution) is characterized mainly by the superiority of advances, technological advances and adequate collaborations in the direction of efficient continuation of digitization, automation, transparency, connectivity and availability of data and information necessary for the efficient operation of business and

development of economic processes in real time. Figure 4 shows elements of the technological potential in "Industry 5.0".



**Figure 4. Technological potential in Industry 5.0**

Source: (Zutshi, 2019)

According to those expressed, it is obvious that the new concept ("Industry 5.0") involves highlighting the importance of research and innovation in order to adequately and long-term support the industry (national and multinational) by entrepreneurs and their subordinates within potential limits of the planet (OECD, 2019).

In the process of evaluating the experts, adequate to define the concept of "Industry 5.0", a series of important elements were taken into account, such as: the analysis of those rapid social evolutions, which took place on the European continent, but also on the whole world; continuous technological progress; the concretization of the increasingly sophisticated artificial intelligence; the related risks that require an adequate management s.a. (ECD-GRID, 2021).

## **2. Elements of intelligent and dynamic development appropriate to the evolution of "Industry 5.0"**

Seen as a natural evolution, "Industry 5.0" aims to implement human innovations appropriate to combine in the lucrative processes the activity of staff employed in production companies with those intelligent technological means that allow more precision and efficiency in the use of resources allocated, for obtaining production solutions, compared to the facilities of "Industry 4.0". These beneficial expectations through the implementation of the new concept of "Industry 5.0" require a number of specific tools (advanced and robotic technological systems; advanced applications; advanced software; complex automated platforms; advanced networking and digitization; intelligent supply chains), which will allow

and facilitate quickly the processes of realization, modernization, personalization and capitalization of different types of products at national and multinational levels (Kumar et.al, 2021).

Basically, the argumentation of entering the implementation stage of the new industrial revolution is highlighted by the report "*Industry 5.0*" presented to the European Commission, in early 2021, by Mariya Gabriel (Commissioner for Innovation, Research, Culture, Education and Youth). The rapporteur also showed the importance of the role of the document in the current situation dominated by the effects of the pandemic, when a whole series of European industrial fields were reinvented and adapted to the new demands, by using highly digitalized and ecological technologies for the proper functioning of the continental economy. At the same time, the mentioned personality highlighted "... it is time to make jobs more inclusive, to build stronger supply-delivery chains and to adopt more sustainable production methods" (DGRI/EC, 2021).

According to the specifications of the mentioned report, the following results: *the main elements of the need to materialize the concept "Industry 5.0"; the main facilities related to the employed personnel, but also to the industry as a whole; the importance of the research and innovation projects - in progress, as well as of the completed ones, necessary for the implementation of the new industrial revolution.*

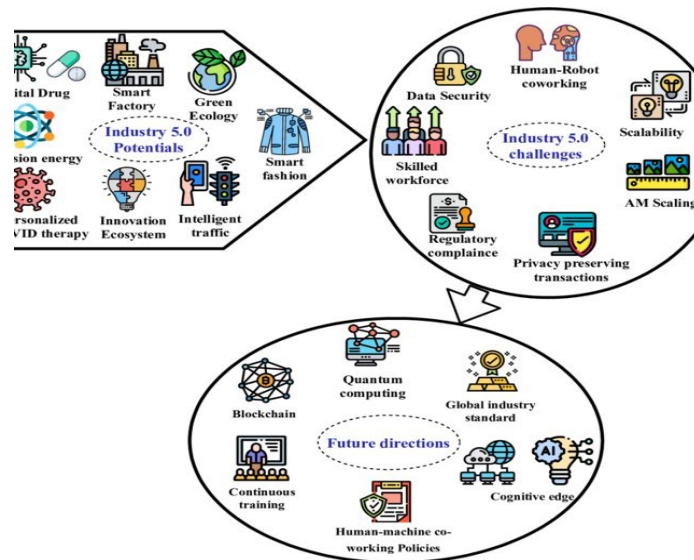
It is obvious that the "*Industry 5.0*" mechanism reveals the modern interactions between people and the evolved and high-performance technical systems. In this framework, the workers of "*Industry 5.0*" are integrated in intelligent production companies where they operate modern and fast automated systems, of high performance, fully associated with human intelligence (WHO, 2019).

From here, at present, it results that in the process of transition from "*Industry 4.0*" (high technology) to "*Industry 5.0*" it will not be applied the strategy of taking over all industrial activities by robots; the focus will be on specialized human labor, as a particularly important factor in modern automated and digitized production activities (WMF, 2019).

Collaborative processes appropriate to intelligent production in "*Industry 5.0*" will cause multiple changes with an impact on the economy, ecology and the social world. All this will be beneficially influenced by the effective reduction of waste. This will be possible, precisely due to the new production mechanisms that will allow the reduction to zero of waste, as well as the expenses with their management (EC, 2019).

The explanation, therefore, of all the transformations imposed by the requirements of "*Industry 5.0*" is dependent on the social environment with implications determined by the human factor on production, economy and environment.

In figure 5 we present facilities of *Industry 5.0* in their dynamics, considering both the socio-economic challenges, but also the subsequent directions of evolution.



**Figure 5. Current and potential facilities of Industry 5.0**  
 Source: (Kumar et. all, 2021)

The “Industry 5.0” mechanism, characterized by the qualitative increase of the production and delivery of goods, as well as the superior provision of services, is meant to increase and consolidate the importance of superior industrial processes in society. Under these conditions, the management of companies will act in the direction of changing the value effort, fully attributed to a shareholder, at the value attributed to all those involved in the design and successful development of a smart business under the requirements of "Industry 5.0". This determines an adequate relationship of the worker's well-being with his evolved involvement in the modern production process: technologically superior; robotized, mechanized; sufficiently digitized (Kumar, 2021).

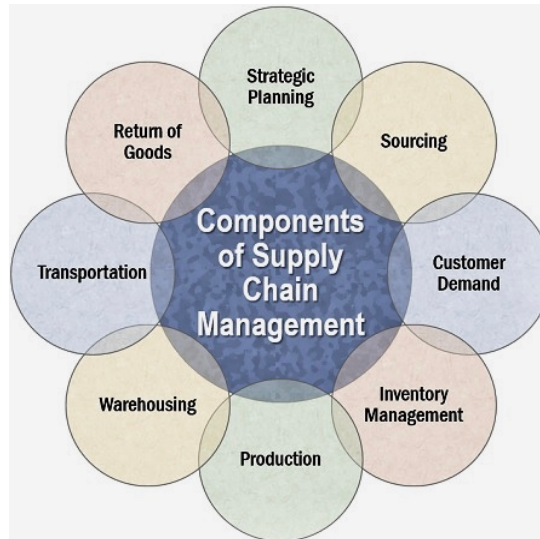
### 3. Smart Manufacturing and Smart Supply Chain. Efficient functional integration

In the conditions of the efficient evolution of the business processes, determined by the “*Industrial Revolution 5. 0*”, the experts reveal the efficient mutations in the implementation of the concepts “*Smart Manufacturing*” and “*Smart Supply Chain*”. (Lin et.all, 2016). Considering the first concept, ie "*Smart Manufacturing*", it determines the high-performance instrumentation of logistics processes, complementary to manufacturing systems within the intelligent production company 5.0, part of a modern and efficient supply-delivery chain.

The second concept, in "*Smart Supply Chain*", involves standards, procedures, technologies and advanced processes for real-time connection of all

partner companies and integrated into the functional business of a supply chain in a modernized system 5.0, to respond in time through its own “Sense and Response” system to the increasingly evolved and complex requirements of current and potential customers (consumers and/or users) (Germán, 2019).

Figure 6 shows the components of "Supply Chain Management" in the last two stages of the industrial revolution.



**Figure 6. Supply Chain Management components in Industry 5.0**

Source: (Prya, 2020)

Adequate functional integration of "Smart Supply Chain Management" with "Smart Manufacturing" will allow advanced and continuous monitoring of remote goods, ensuring optimal maintenance of manufacturing, traceability, transport and storage of goods and orders that are subject to effective transactions, based on evolved communication with both suppliers and customers, in real time. For this purpose, the modern logistics systems and processes - internal, external and collaborative - from the staff of each partner company and digitally, sufficient and efficient integrated in a "Smart Supply Chain Management" (Ryciuk, 2018) are very important. In figure 7 we highlight the transition of Supply Chain from traditional to digital.

Business models and economic achievements appropriate to "Industry 5.0", in beneficial conditions of productivity, competitiveness and compliance with agreed ecological values, will be dependent on intelligent supply-delivery chains, which will have to take care, in relation to digital marketing, of the requirements and needs of smart customers (individual and organizational).

Therefore, the new socio-economic challenges generated by the new risks and threats will make organizations and individuals build and capitalize intelligently, robustly and resiliently on plus-value by using new technologies and automated systems adjacent to "Industry 5.0" in each productive (national and / or



multinational )sector, as well as in the management of each integrated supply-delivery chain, for the beneficial capitalization (win-win) of products and services domestically and internationally (Müller, 2020).

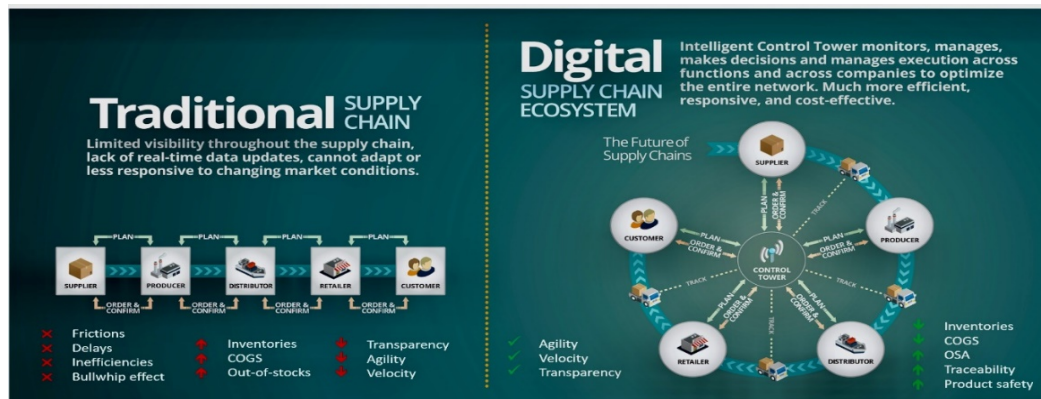


Figure 7. The evolutionary leap from traditional to digital adequate to “Supply Chain 5.0”  
 Source: (Annesley, 2019)

The dynamics of business change related to "Industry 5.0" determines transformations in the of the supply chain management, which is an important source of competitive advantage in market relations and transactions. According to Mckinsey's experts, it results that in the specific stage of functioning of "Industry 5.0" five trends with the role of modeling the management of the supply-delivery chain will be evident, respectively: • *implementation of innovations in the business of the future*; • *the existence of shorter and more complex business cycles in conditions of increased complexity*; • *increasing the number of customers (individual and organizational) for various types of products, as well as their requirements*; • *increase of salaries, but also of costs*; • *the evolution of Big data and related relationships* (Knut & Balaji, 2013). In figure 8 we reveal evolved aspects of "Smart Supply Chain Management", adequate to "Smart Manufacturing".

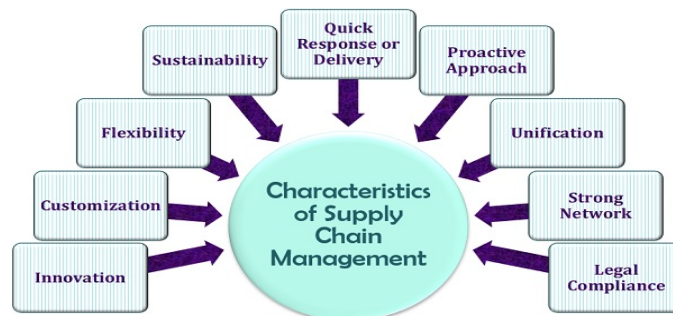


Figure 8. Characteristics of a Modern Supply Chain Management (5.0)  
 Source: Prya, 2020)

The proper functioning of the “*Industry 5.0*” systems will determine the clients (consumers) to become even more demanding, and in these conditions, the supply-delivery chains will involve some particularities regarding: *segmentation in order to ensure the timely capitalization of personalized offers; adequate guidance for attracting consumers (customers) interested in the immediate purchase of products (services) through digital marketing applied in social networks; innovative control on several levels, depending on the complexity; making them more viable through the agility, robustness and durability specific to each; interventions necessary to meet consumer requirements in certain periods of time, by providing (depending on requests) push, pull or mixed flows* (Knut, 2020). In figure 9 we briefly highlight, in correlation with those specified above, conceptual aspects and facilities of “*Supply Chain Management 5.0*”.



**Figure 9. Conceptual elements and facilities of Supply Chain Management 5.0**  
 Source: (Guilherme, 2021)

Technological advances in “*Industry 4.0*” and even more so in “*Industry 5.0*” have allowed, and will further determine, the replacement of human labor with robots in operations within the supply-delivery chains, such as: *product handling (materials); storage of goods manufactured or purchased by different types of companies; taking over and packaging the finished products for storage and sale in conditions of speed and efficiency*. At the same time, the use of smart containers will be developed that allow a complex of specific use operations, such as: *establishing the goods to be transported; destination locations; waiting times for products (goods) at destination; automatic navigation in loading-unloading systems; optimal loads, according to the established options; continuous communications, included also in transit monitoring systems* (Guilherme, 2021).

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The advanced ideas at the 2019 Gartner Conference on "*Supply Chain Conference Trends, 2019*" anticipate, from our point of view, the digital demands of "*Society 5.0*" and "*Industry 5.0*". Therefore, the role and importance of digital platforms of companies, in the future, will be greatly increased given both the multitude of functional facilities, but also the increased requirements of products and services with high features and performance by consumers and users (individuals and / or legal) (Annesley, 2019).

In the same framework of the mentioned Conference, the importance and the role of the permissive and determinant digital and/or automated technologies of the business networks within "*Supply Chains Management*" were highlighted in order to obtain increased facilities within complex activities, such as: *design, planning and fast programming of business processes; efficient and high-performance communication within the integrated virtual communities of each "Supply Chains Management"; increasing the revenues of the partner companies integrated in a "Supply Chains Management", due to the efficient development of the manufacturing processes, of the fast deliveries/shipments of the ordered products; the continuous diminution of the existence in warehouses of their stocks of raw materials (materials), but also of those of finished products, etc.* (Annesley, 2019).

According to the conception of other specialists, digitized "*Supply Chains Management*" will have the potential to come to the aid of the beneficiaries by making available to them, in the market space, those products with special characteristics, while reducing costs and as such selling prices (wholesale and retail) accessible to current and potential customers. Therefore, digitalization will lead to changes in strategies and business models within the component companies of "*Supply Chains Management*", *as well as greater functional flexibility, risk reduction, but also adequate resilience.* These will allow, at the level of each Supply Chain Management, spectacular evolutions expressed through efficiency and performance adequate to the respective business profiles. (Raschke & Waterman, 2018).

#### **4. Conclusions**

Changes and transformations from one revolution to another focused primarily on manufacturing strategies and systems, in accordance with established performance requirements. It follows, therefore, that the transition to the *new*

*Revolution* (5.0, considered by experts - rather an evolution) requires the implementation of specific standardization and the use of advanced (intelligent) technological systems, as well as the timely realization of adequate infrastructure. In this sense, new robots and new intelligent automated technologies will be present in the modernized systems of supply-delivery chains.

All this will determine: the introduction of cheaper, viable, flexible, secure and much more efficient robotic systems; achieving intelligent and much more efficient manufacturing; effective reduction of production cycles for products requested by current and potential customers; the development of ecological effects in the realization of the manufacture, as well as in the commercialization and use by the clients (buyers) of the finished products; job creation (quite a lot) in the most representative fields of "*Industry 5.0*", such as technical and electronic intelligent systems, complex functions involving artificial intelligence and robotics, maintenance of new equipment (intelligent systems), education-training, planning-new programming and research in the field of robotics for modern manufacturing processes; development of hardware and software solutions related to the use of advanced robots and new intelligent systems, etc.

According to the analyzes and evaluations of the European Commission's experts, compared to "*Industry 4.0*", in "*Industry 5.0*" the emphasis will be on those projects that will allow the implementation of solutions to achieve more viable and resilient production, with the achievement of the parameters of long-term competitiveness. Under these conditions, emphasis will be placed on human skills and competencies appropriate to the challenges offered by new technologies and continuous digitization, so that human-machine interactions are beneficially achieved. Other projects focus on creating intelligent, autonomous factories, capable of rapid self-learning and self-adaptation to the challenges of the constantly evolving market environment through flexible, customized, efficient and ecological productions.

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