СТОПАНСКА АКАДЕМИЯ „Д. А. ЦЕНОВ“ – СВИЩОВ

СЪЮЗ НА УЧЕНИТЕ В БЪЛГАРИЯ – КЛОН СВИЩОВ

Международна научна конференция

ПРОБЛЕМИ И ПРЕДИЗВИКАТЕЛСТВА ПРЕД ИКОНОМИЧЕСКИТЕ НАУКА И ОБРАЗОВАНИЕ ПРЕЗ XXI ВЕК

Свищов, 22 ноември 2024 г.

Сборник с доклади

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ИНОВАЦИИТЕ И ИНДУСТРИЯ 5.0: НЯКОИ ВРЪЗКИ И ВЪЗМОЖНОСТИ

Доц. д-р Искра Пантелеева[1]

Резюме: *Иновациите са двигател за развитието на икономиките. В съответствие с постиженията на науката и приложението им в практиката се реализират трансформации с различна степен на изменение. Тяхното абстракционализиране е в основата на концепциите за развитие на индустрията. Целта на доклада е да се представят основните връзки между иновациите и концепцията Индустрия 5.0, на чиято база да се очертават някои възможности за реализиране на ползи от инкорпорирането на иновациите в концепцията.*

Ключови думи: *иновации, Индустрия 5.0, трансформация, ползи, възможности.*
JEL: O1, O14, O25, O30, O31
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INNOVATION AND INDUSTRY 5.0: SOME CONNECTIONS AND OPPORTUNITIES

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Abstract: *Innovation is an engine for the development of economies. In accordance with the achievements of science and their application in practice, transformations with varying degrees of change are realized. Their abstraction is the basis of the concepts of industrial development. The purpose of the report is to present the main connections between innovations and the Industry 5.0 concept, on the basis of which to outline some opportunities for realizing benefits from the incorporation of innovations into the concept.*

Key words*: innovation, Industry 5.0, transformation, benefits, opportunities.*
JEL: O1, O14, O25, O30, O31
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1. Introduction

Innovations and innovative development are an attractive topic for the scientific sphere and business. Their importance for the achievement of multi-directional benefits provokes researchers to study their various aspects, to identify sources for the generation of added value, to propose various measures and tools to take advantage of the potential that innovations bring. For decades, scientists have

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been conceptualizing the main priorities for development, proposing ways to achieve them, looking for connections and regularities in order to achieve the desired goals.

In a historical context, defining different target positions in the concept of industrial business development, researchers gradually developed and shaped a series of versions Industry x.0 (Shterev, 2018; Psarommatis, May & Azamfirei, 2023;). At the end of the second decade of the 21st century, the last version of the concept was launched – Industry 5.0, the focus of which is quite different, compared to the previous versions. A person is placed at the centre of the concept, with all the concrete theses and goals arising from this specificity. Regardless of the evolutionary changes and the specific centre, in each of the versions, including in Industry 5.0, the transformations are based on the most important target orientations and tools for changing economies and society – innovation. On this basis, the aim of this report is to present the most important links between innovation and Industry 5.0, and to outline some possibilities for the realization of benefits from the incorporation of innovation into the concept.

2. Innovations and Industry 5.0 – specifics and main obligations

Innovation is one of the most powerful means of achieving growth and gaining competitive advantages. For decades, they have provoked the interest of researchers to study them and to identify specific mechanisms by which they can be stimulated, developed, implemented and successfully used for the development of economies and society. Scientists study their essential parameters and characteristics; the factor impacts; the structure of their organization; their forms of government; the indicators for their analysis and evaluation, etc. (Maddikunta et al., 2022; Choi et al., 2022; Ruppert et al., 2022; Minca et al., 2022; Wang et al., 2023; Caggiano et al., 2023; Psarommatis et al., 2023; Pang et al., 2023; Alabdulatif et al., 2024; Barata & Kayser, 2024; Moshood et al., 2024; Garrido et al., 2024; Rame et al., 2024; Murtaza et al., 2024; Rios et al., 2024;)The goal is to identify dependencies and working tools depending on the thematic and industry perspective.

For at least several centuries, the evolutionary/revolutionary development of industrial business and the changes occurring as a result of the use of various driving forces, tools and means in the implementation of production processes and the creation of products have been traced, in an effort to achieve good economic indicators and market projections (European Commission, 2022; Wang et al., 2022; Tóth et al., 2023; Rios et al., 2023; Jahid et al., 2023; Yang et al., 2024; Zafar et al., 2024; Zeb et al., 2024;). In all versions of the Industry x.0 concept, innovations have an important place and are the basis of the target orientations and priority areas for development. Innovative changes have an impact on the organization and structuring of units, activities and processes; the scope and type of resource combination/use; the maintenance of systems and their improvement in multi-component and multi-functional interaction (see Fig. 1).

According to the definition of the European Commission (EC), the centre of the Industry 5.0 is the person, his well-being, the role and contribution of

industrial business to the well-being of society, achieved through innovative technologies, efficiency and productivity, but also through "prosperity beyond jobs and growth" based on the "production capabilities of the planet", i.e. through digital and green transitions. The goal is a transition from Industry 4.0 to Industry 5.0, in which research and innovation are a tool for transformation towards a sustainable, human-centric and resilient European industry (research-and-innovation.ec.europa.eu; Digitalk Report, February 2022).

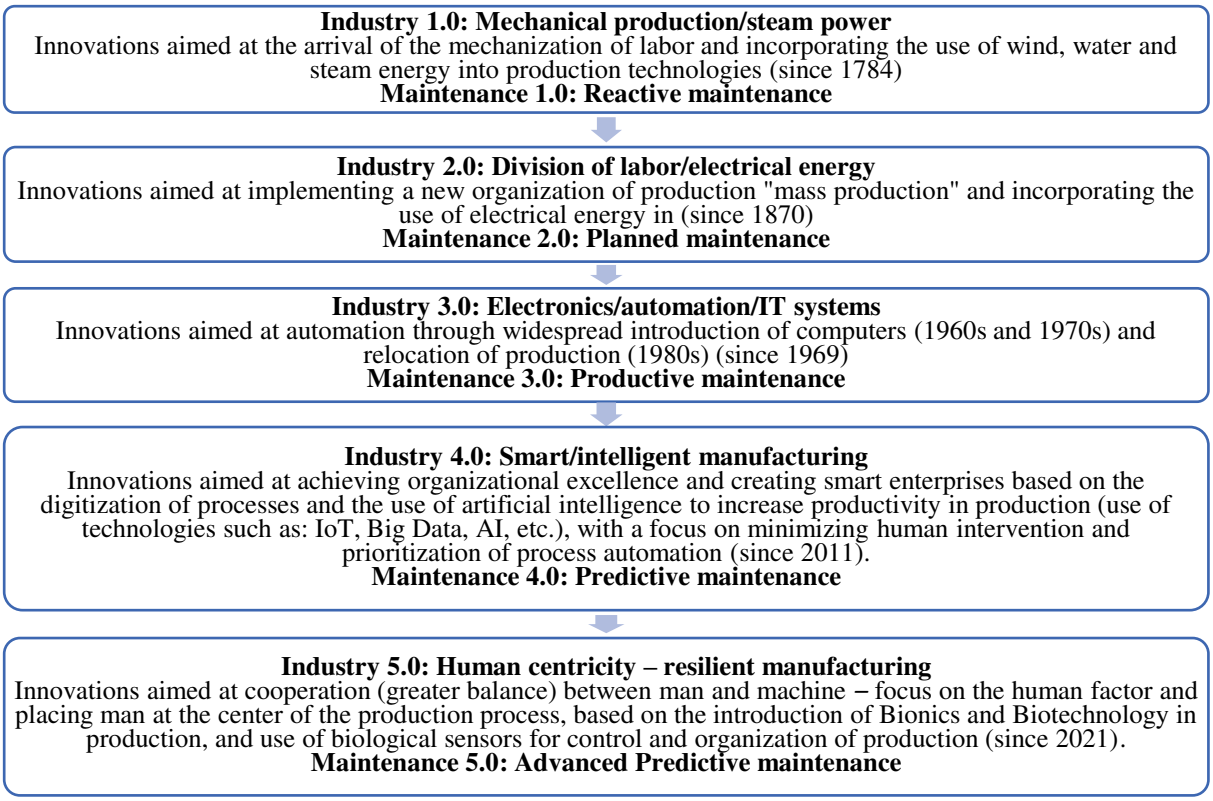

Figure 1. Stages of industrialization and versions of the concept "Industry 1.0 – 5.0" and "Maintenance 1.0 – 5.0"

Source: Revised on: (Shterev, 2018, 16; Psarommatis, May & Azamfirei, 2023, 68, 377)

The following can be mentioned as the **main functions** of Industry 5.0 (*Revised on:* akcent.bg, 12.01.2024):

• ***Implementing of specific contracts and individualized orders*:** the creation of products reflecting the specific needs of individuals and industrial market players is stimulated. Instead of making a huge number of different products, the focus shifts to designing and anchoring activities that create an enabling environment for identifying individual customer needs and transforming production processes to more easily customize and adapt to those needs.

• **Implementation of collaborative robots (Cobots):** the wide introduction of companion robots is initiated, creating an environment for direct interaction between a person and a robot within shared spaces. Synergy is sought from their simultaneous use, based on the advantages of joint activity. The creativity and

ingenuity of man, and the precision and speed of the manufacture of customized products by robots are used at the same time (maximum use of their advantages – fast installation and programming, flexible execution of heterogeneous tasks in different units, repeated manufacturing accuracy with constant quality).

• **Human Empowerment:** Coordinated "Human – Cobot" collaboration in a reasonable and efficient allocation of tasks so that unpleasant, unattractive, dangerous, boring, monotonously repetitive processes are outsourced to robots and humans are given the opportunity to direct their efforts to other tasks requiring creativity, innovation, inventive thinking, etc., or to avoid mechanical work dangerous to AI and robots. The goal is to use robots not as a substitute for a person, but to facilitate their work and stimulate their creativity.

• **Accelerate processes and maintain quality:** efforts are directed towards achieving operational excellence based on new technologies, production lines, robots and AI, while supporting the maintenance of desired quality through higher employee motivation and satisfaction to apply timely and responsible human intervention.

• **A sparing and responsible attitude towards nature and the environment:** the use of renewable energy sources and ecologically oriented logistics and production chains aimed at consuming less resources, producing limited harmful emissions, reducing the volume of waste and creating quality and – sustainable products.

In Figure 2 the main differences between Industry 4.0 and Industry 5.0 are presented.

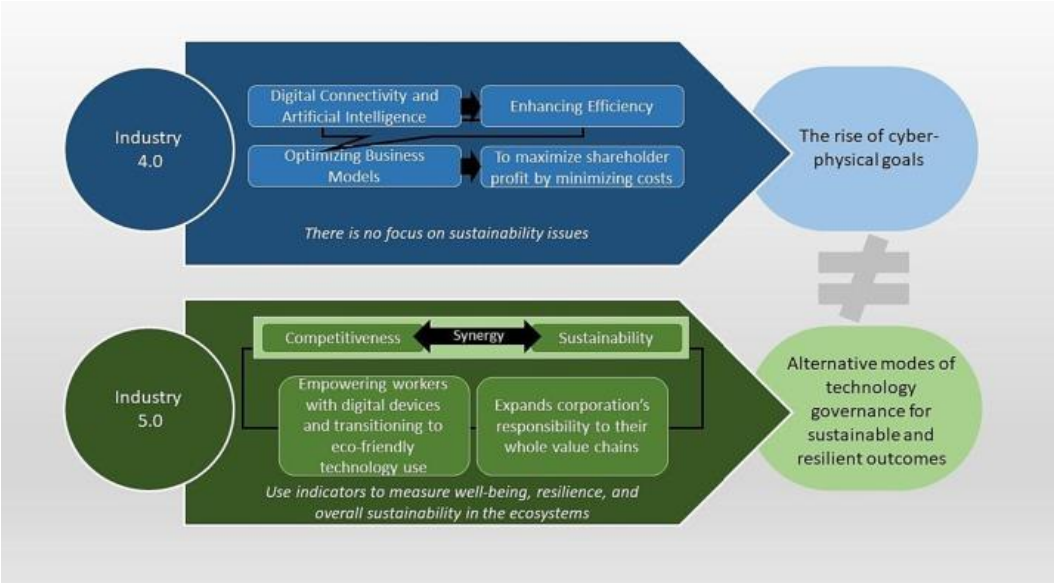

Figure 2. Differences between Industry 4.0 and Industry 5.0
Source: Garrido, Muniz Jr, & Ribeiro, 2024, 3; Based on Dixson-Decleve et al., 2022, 8-9.

Applying a comprehensive methodology to optimize human-machine interaction by conceptualizing knowledge creation and sharing to improve collaborative processes, including the development of artificial intelligence techniques for cross-checking with alternative feedback models, requires the inclusion of the architecture for collaboration Industry 5.0. The methodology of

the cyclical implementation of the innovation process within Industry 5.0 under collaboration architecture (I5arc) for creating shared knowledge covers six elements shown in Figure 3.

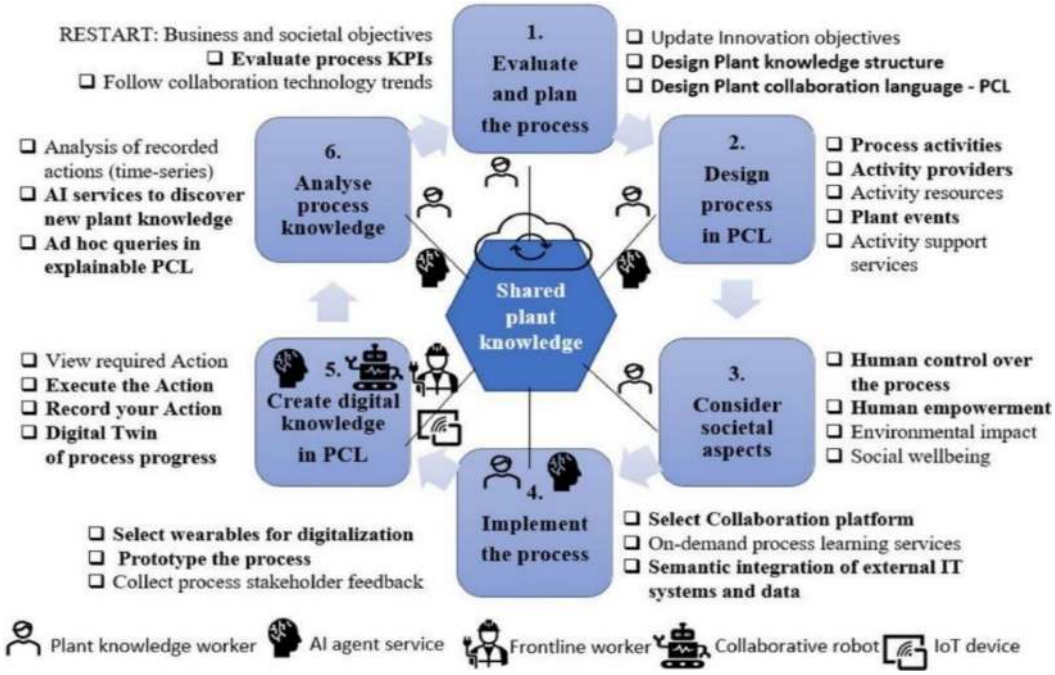

Figure 3. The methodology of the I5arc Process Innovation Cycle, that creates the Shared plant knowledge with the combination of the six elements
Source: Tóth, Nagy, Kennedy, Bohuš, Abonyi & Ruppert, 2023, p. 5.

The development of scientific thought and the efforts of business are likely to provide new scientific achievements that will find their practical dimension. On this basis, a further modification of key positions in the concept and a subsequent version of Industry x.0 is expected, much faster and perhaps even before the key moments of Industry 5.0 are realized.

3. Possibilities for realizing benefits from the incorporation of innovations in the Industry 5.0 concept

The benefits of Industry 5.0 provide opportunities to identify key areas for incorporating innovations into Industry 5.0 and generating additional benefits. They are based on the main pillars of the concept (Barata & Kayser, 2024, p. 5):

- *Human-centric*: Human health and safety, work assistance and error reduction, training, fair decision making (Wang et al., 2022; Ruppert et al., 2022; Choi et al.; 2022; Ignatius & Bahsoon, 2023; Pang et al., 2023; Wang et al., 2023);
- *Sustainability*: environmental protection, energy optimization, waste reduction (Choi et al., 2022; Guruswamy et al., 2022; Rios et al., 2023);
- *Resilience*: health monitoring and disaster prevention, supply chain continuity, manufacturing flexibility, secure data storage (Zhang et al., 2021; Choi et al., 2022; Minca et al., 2022; Dewangan & Chandrakar, 2023; Rios et al., 2023).

Future directions where potential benefits can be identified we would integrate in the following areas:

✓ ***Use of new business models*** that lead to cost optimization through the use of new technologies, collaboration between man and machine, creation of higher value jobs, etc.

✓ ***Implementation of ecologically oriented solutions*** related to optimal use of resources, consideration of climate changes, minimization of waste, compliance with climate changes and sparing of nature in general, etc.

✓ ***Taking into account individual needs***, offering customized packages of solutions, combining the innovation potential of science, human skills, and the precise robotic manufacturing of products, maximally useful, sparing nature and corresponding to specific requirements, etc.

✓ ***Maximum use of the creative charge of people*** in the direction of non-standard solutions, rationality and humanization, incorporating this charge into innovative solutions with multi-directional benefits, which leads to improved talent attraction and retention, improved design freedom for employees, greater employee satisfaction and loyalty, etc.

The realization of Industry 5.0 requires a change of worldview and the starting point for perceiving business and its functioning. The interaction of man and machine in the conditions of a digital environment gives rise to new educational needs and requires the acquisition of various knowledge, skills and competences, including extensive knowledge in the field of robotics or artificial intelligence.

4. Conclusion

Innovations are an imaginary feature of the modern world. They are a driving force, a source of benefits and a successful way of business development. Individual countries, regions and enterprises develop their own action strategies and define a vision to achieve their goals. The concept of industrial business development is an important guide for the direction of the desired transformations and an adequate tool for following the pulse of time. Its evolutionary development is related to the introduction of adequate guidelines and the identification of support points for maintaining the desired competitiveness. The changes find expression in the development of its various versions – from 1.0 to 5.0. At the core of each of them are the innovative achievements of science and business and the key indicative guidelines for future behaviour. There are tight links between innovation and concept, as well as strong dependencies between resource acquisition pathways, transformation process tools, and the scope for realizing multi-directional benefits, making the task of early prediction and rapid business realignment to imperatives complex and difficult. of the new realities. It depends on the company's management how promptly and adequately it will react to the surrounding challenges and take actions to align its production processes and mechanisms for interaction with the market. Taking into account the complex

interrelationships between individual systems, processes and activities on the one hand, and human-robot/technology interaction on the other, should be a priority.

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