NONCONVENTIONAL TECHNOLOGIES, EFFECTS OF CHANGES IN THE KNOWLEDGE-BASED ECONOMY

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Abstract

Humans are the expression of their thoughts, influenced by the specific risks of this society: conventional risks, such as the economic crisis, the pandemic, and military conflicts, or unconventional risks, such as cybercrime. The simultaneous or partial interactions between creative, critical, and unconventional thinking have led to the acquisition and development of knowledge necessary for the knowledge-based economy, including the development and implementation of unconventional technologies. The most important and valuable commodity in society is knowledge, especially new one, which can offer a competitive-adaptive advantage to the organizations that possess and intelligently capitalize on it in the market. Furthermore, it facilitates the development of business strategies, industrial and competitiveness policies, as well as social, educational, financial, military, health policies, etc., based on a real understanding of the technical-scientific creative process. Collaboration between these organizations has allowed the sharing, development, and multiplication of knowledge through digital technologies.

Keywords: *Unconventional Technologies, Unconventional Thinking, Unconventional Ideas, Unconventional Innovations, Knowledge-Based Economy*

1. Introduction

Industry 4.0 was introduced in 2011, being based on the unification of technological processes (as a corporate resource) with business processes (through the development of new models) to improve company performance. According to experts' studies, the most important skills needed in the age of Industry 4.0 are those related to workplace attitude and the ability to use technology. According to the Future of Jobs Report by the World Economic Forum 2020, by 2025 more than half of the workforce will need to acquire new skill sets, such as those presented in Table 1.

Almost 40% of people in the current labor market are affected annually by changes in the fundamental skills of the knowledge-based economy. In this context, education is no longer seen primarily as a way of providing socially valuable knowledge, but as a process in which value is determined by the number of direct benefits it brings to the student-consumer [2]. Another characteristic generated by the rapid changes in the knowledge-based economy is the need for 'just-in-time' learning.

Table No. 1. Industry 4.0 Specific Competencies [1]

No	Skill categories	Competences
1	Solving problems	Analytical thinking and innovation
		The ability to solve complex problems
		Critical thinking and analysis
		Creativity, originality and initiative
		Logical reasoning, high ability to solve problems and generate new ideas
2	Use and development of technology	Use, monitoring and control of technology
		Technological design and programming
3	Self-Management	Using active learning strategies
		Resilience, stress tolerance and flexibility
4	Working with people	Leadership and social influence

An important role is also played by new start-ups based on competence centers, which, alongside established companies, contribute to the development of new technologies, also making significant contributions to innovation, such as revolutionizing the plant-based protein market or using technology to simplify children's understanding of classical music [3].

Investors involved in such activities must focus on the main ideas (since strength comes from the exchange of ideas), be analytical, connect with as many potential investors as possible, and set priorities. To cope with bureaucracy, they rely on the skills of their partners, as decisions must be made based on their profiles. The most important skill of an investor is the ability to believe in the future.

On the other hand, large companies with offices in multiple countries implement changes based on an unconventional organizational design and increased autonomy in project development and implementation. This organizational design is based on the employees' ability to work in teams, coupled with an entrepreneurial mindset, so that each subsidiary, each project team, and each member of the organization can act like a start-up [4].

These changes have led to the emergence and implementation of highly efficient, unconventional innovations, based on new, much simpler approaches compared to traditional innovations, which rely on advanced technologies and decades of research and development [5][6]. These approaches have led to new innovations applicable in the primary locations where an individual operates: home and workplace. The need for unconventional thinking is driven by the challenge of finding solutions to implement new ideas in a limited timeframe. Unconventional thinking represents the driving force of technical-scientific progress, offering new perspectives and innovative solutions.

To explore the issues presented above, this paper is organized into six chapters as follows: Introduction; The Need for Unconventional Thinking; Study Programs Organized in the Field of Unconventional Technologies; Gig Workers, an Unconventional Category of Workers; The 'RO-NT-Gig Education' Platform – A Model for Developing Study Programs in the Field of Unconventional Technologies; Conclusions.

2. The need for unconventional thinking

The greatest impediment to the development of unconventional technologies is the certainty of what is impossible. Fortunately, for 'unconventionalist' specialists, the impossible becomes possible through innovation and creativity. The words 'thinking,' 'vision,' 'research,' and 'possibility' are just a few that have led to overcoming certain limits that seemed insurmountable, driven by the emergence of smart materials and the increasing complexity of customer technical specifications in advanced industries such as aerospace, energy, or the military.

Individual testing, followed by the intelligent use of combinations of unconventional technologies, continues to offer significant development opportunities. The success of these

unconventional games and combinations is essential in meeting the specific demands of the knowledge-based economy [7].

Unconventional technologies and new industrial concepts might be the easiest frontiers to overcome, as today's research is supported by artificial intelligence, the most important achievement of the knowledge-based economy. AI-supported innovation has led to the implementation of new ideas, resulting in numerous positive changes, such as the development of new products and services, as well as the improvement of existing ones.

A book or a computer: which symbolizes innovation more?

The book is a source of wisdom – We are what we read, according to Robert DiYanni [8]:

- The content of a book can delight and/or move us;
- We can read to educate (instruct) ourselves or to find a source of inspiration;
- By reading, we discover ourselves and gain access to the lives of others;
- By reading, we understand the world we live in.

On the other hand, what represents innovation more than 'Apple' and the 'Bicycle for the Mind' (a computer for everyone)?

Bridges have posed real challenges for those who carried out infrastructure projects, although they sometimes seemed impossible to build. On October 18th, 2018, Chinese President Xi Jinping inaugurated the world's longest road and sea bridge, connecting Hong Kong, Macau, and the Chinese city of Zhuhai, with a length of 55 km and a 6.7 km tunnel. The construction of the bridge took seven years and relied on the expertise of specialists from five countries: the United Kingdom, the United States, Switzerland, Japan, and the Netherlands. As a result, the old distance (460 km) was reduced by 180 km [9].

The French Millau Viaduct in the Tarn Valley (considered a symbol of modern engineering, similar to the Eiffel Tower, with a length of 2.46 km and a width of 32.05 m), designed to last 120 years, was built in 39 months starting on December 14th, 2001. It is a true electromechanical conglomerate (Figure 1) [10]:

- Anemometers, accelerometers, inclinometers, temperature sensors, optical and electronic extensometers;
- Sensors that measure wind speed and structural deformations;
- Sensors that measure the roadway and its deformations;
- Sensors that detect traffic, estimating the weight of each vehicle and the total sum of vehicles on the bridge;
- All data is processed automatically and transmitted to the control center at the headquarters of the company - Compagnie Eiffage du Viaduc de Millau (CEVM).

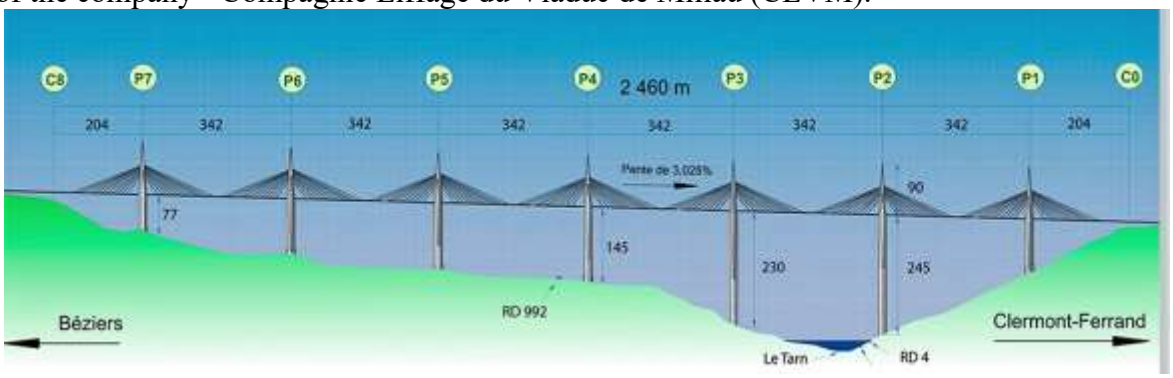

Figure No.1. Millau Viaduct in France [10]

In 2016, Switzerland inaugurated the world's longest railway tunnel, the Gotthard, which connects two European ports: Geneva and Rotterdam. The tunnel cuts through the Alps over a distance of 57.1 kilometers. Every day, 350 freight and passenger trains pass through it at speeds of up to 250 kilometers per hour. Its construction was decided based on a referendum, and the project took 17 years to complete, requiring the excavation of over 28 million tons of rock. Currently, the

Gotthard Tunnel is the longest railway tunnel in the world, being three kilometers longer than Japan's Seikan Tunnel and seven kilometers longer than the Channel Tunnel under the English Channel [11].

Unconventional ideas, different from what is considered conventional, have the capacity to revolutionize industries and redefine success. The knowledge-based economy is built on diversification and sophistication (increasing levels of complexity). Unconventional ideas are those that can transform complexity into opportunity and diversification into progress.

According to experts, to limit the excessive growth of complexity, the following steps should be followed [12]:

- defining objectives;
- selecting the necessary investments to achieve these objectives;
- developing an investment portfolio;
- balancing the investment portfolio by eliminating unnecessary investments.

The progress of unconventional technologies has been achieved through re-examining, reconsidering, and re-evaluating the interactions between existing technologies and the new specifications of clients, generated by socio-economic changes and the need to protect the environment.

Human-technology interactions have also become a subject of study for university students. For example, Wendy E. Mackay, Director of Research at Inria, is also a member of the 'Computer and Digital Sciences' chair at Collège de France, where she has been teaching the course 'Reimagining Our Interactions with the Digital World' since the second semester of the 2021-2022 academic year.

With the help of artificial intelligence, many such interactions have become human-machine partnerships (considered a duet, not a duel). These have been created to complement the working power of human operators, who have become 'digital conductors,' with technology becoming an extension of them. Understanding this shift represents a new constant, based on adopting a human approach to the members of the machine team [13]. The elements of change must be the subject of specific study programs, thus contributing to the creation of a new culture of collaboration.

3.Study programs organized in the field of unconventional technologies

The professional training of future researchers and specialists in the field of unconventional technologies is ensured through various disciplines studied in technical higher education. A few of these are listed below [14]:

- Engineering of Nanostructures and Unconventional Processes – National University of Science and Technology 'Politehnica' Bucharest;
- Unconventional Technologies and Equipment – University of Craiova and 'Lucian Blaga' University of Sibiu;
- European Master for Industry in Microwave Electronics and Photonics – University of Limoges, France*;
- Master of Science in Safe and Reliable Nuclear Applications – Institute Mines-Telecom, Palaiseau, France*;
- Interdisciplinarity in Materials for Energy Storage and Conversion – University of Picardie Jules Verne, Amiens, France*;
- Joint Master's in Nanomaterials for Green and Digital Transitions – University of Lorraine, Nancy Cedex, France*;
- Master in EuroPhotonics – University D'Aix Marseille, France*;
- European Master on Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors – University of Siegen, Germany*;
- Hydrogen Systems and Enabling Technologies – Polytechnic University of Turin, Italy*;
- Sustainable Biomass and Bioproducts Engineering – Wroclaw University of Science and Technology, Poland*;

- Large Scale Accelerators and Lasers – University of Paris-Saclay, France*.

All programs benefiting from an international curriculum (marked with *) operate in partnership (organized as a consortium) with two to eight universities from countries such as Italy, Spain, Poland, Finland, Germany, Slovenia, Lithuania, Greece, Portugal, The Netherlands, Norway, Hungary, Belgium, Sweden or France. The university associated with each program on the list above serves as the coordinator.

Graduates of these programs, through their industrial partners, gain access to local, regional, and global innovation networks, actively participating in the process of promoting leading brands in the field of unconventional technologies.

The promotion of new research in the field of unconventional technologies is carried out through numerous scientific publications and events specific to public relations activities, such as those presented in Table 2.

Meetings between academic staff, industry specialists, and students from technical faculties are a source of new transformations and ideas for future research. At the same time, a bidirectional technological communication is created between the two groups (from education and industry). Through this, a continuous exchange of ideas, feedback, information, and knowledge specific to unconventional technologies is ensured, thus promoting innovation and development. At the end of events like those presented in Table 2, workshops and seminars can be organized in the "Ask Me Anything" (AMA) format, on various topics debated by the participants. Bidirectional communication helps organizations understand customer needs by increasing trust and credibility [15].

Table No.2. Specific events

No		The name of the event	Organizer
1		International Conference of Nonconventional Technologies	Faculty of Industrial Engineering and Robotics, Bucharest, Romania
2		International Congress on Neutron Capture Therapy	National Centre for Nuclear Research, Kraców, Poland
3		International Conference on Nuclear Cardiology and Cardiac CT	European Association of Cardiovascular Imaging, Seville, Spain
4		Unconventional Technologies 2024	Faculty of Mechanical Engineering, University of Žilina, Slovakia
5		International Conference on Neuromorphic Computing and Engineering	RWTH Aachen University, Germany
6		Central European Biomass Conference	Austrian Biomass Association
7		The Unconventional Resources Technology Conference	George R. Brown Convention Center, Houston, Texas, USA
8		International Conference on Unconventional Catalysis, Reactors and Applications	Warsaw University of Technology, Poland

For example, a company can use social networks (or other digital platforms) to gather feedback on a product launched on the market to continuously improve it (in this case, a product made with the help of unconventional technologies). Bidirectional communication helps organizations identify and solve problems that act as barriers to adopting new solutions, thus encouraging the faster adoption of unconventional innovations.

4.Gig workers, an unconventional category of workers

The last decade has seen an explosion in the 'gig' workforce, offering a wide variety of services to 'platform-based companies.' These companies contract individuals to perform specific categories of services but do not consider them employees in the traditional sense, such as those working for a company based in a fixed location. The largest increase in gig workers is in companies serving transport networks, allowing clients to move from one location to another (such as Bolt, Uber, and Blue) and various categories of goods to be moved to and from countries where numerous Romanian communities are active. Uber was listed on the New York Stock Exchange only seven years after its founding, in 2019, at that time valued at USD 82 billion. However, the gig economy has also expanded into other fields, such as freelancer platforms like Upwork or those dedicated to artisans on Etsy [16].

Since Uber's debut in 2012, the number of workers has grown by 5 million by 2021, comprising approximately 3% of the U.S. workforce, which represents almost 30% of the independent workforce in that country. A significant increase occurred during the Covid-19 pandemic, doubling the number of platform workers. According to 2021 statistics, 9% of the workforce performed activities for an online platform, leading to a fivefold increase in the revenue of these companies compared to 2017. Gig workers primarily appreciate the ability to have a flexible schedule, which can be adjusted through the platform. Most gig workers use this method to supplement their income, not as a primary source of earnings.

The lack of social protection and other benefits raises a series of issues that can be considered significant risks for these workers.

According to studies by J. Gruber, it was found that among workers active on Uber at the beginning of a quarter, 'only 22% worked 20 hours for four consecutive weeks; only 13% worked more than 30 hours for four consecutive weeks. Less than 5% of these workers worked over 20 hours each week in a quarter, and only 2% worked over 30 hours each week in a quarter.'

The use of this model can also be extended to the education system. Creating a "Gig Education" platform, accessible to all individuals and legal entities involved in unconventional technologies, could solve numerous problems, which will be presented in Chapter 5.

5.The 'RO-NT-Gig Education' platform – a model for developing study programs in the field of unconventional technologies

The gig economy refers to a specific sector or workers employed informally, working with short-term contracts and engaging in occasional jobs. The jobs considered in the gig economy include freelancers, online tutors, social media influencers, e-hailing services (person transport services organized through a platform), and p-hailing (goods transport services organized through a platform). Thanks to technological development, this workforce benefits from increasing mobility (working from anywhere and at any time). In times of economic uncertainty, such as during the Covid-19 pandemic, the gig economy has been a source of income and reduced unemployment, expanding by approximately 23% [17].

In recent years, the gig economy has expanded into many fields, including education. "Uber for Tutors" platforms and "Uber for Tutor" applications have changed the interactions between students and the academic environment, offering new opportunities and challenges for users [18].

In Romania, by using the site ro.gigexchange.com, we can obtain various information about gig economy services available at the national level (Figure 2) [19].

Figure No.2. Gigexchange Romania [19]

Building on the concept of 'Gig Development Opportunities,' we propose the implementation of a platform called 'RO-NT-Gig Education' (Figure 3), which would be accessible to all interested individuals and legal entities. This platform would offer a flexible program based on skills and interests, aimed at enhancing innovation and production capacity in unconventional technologies, as well as establishing new connections within the community [20].

The main benefits of this platform are as follows:

- Generation of specific national curricula;
- Establishment of a standardized model for each discipline in the field of unconventional technologies;
- Development of a practice schedule for students at partner companies;
- Designation of periods during which students can engage in part-time or volunteer activities within partner companies;
- Creation of interdisciplinary research themes and projects;
- Sharing of experimental results/technical sheets/videos on YouTube among interested parties;
- Sharing of technical specifications of the equipment available;
- Organization of workshops/seminars (in physical or online format) based on a clear schedule and with a well-defined target audience.

The main advantages for students involved in the gig economy are:

- Flexibility in accessing the platform (in terms of scheduling) to obtain new information or specific knowledge;
- Expansion of the range of accessible topics (niche subjects, highly specialized fields, etc.);
- Access to a wide market of information/knowledge at varying prices, depending on the source;
- Possibility to broaden the geographic coverage (contact with geographically dispersed specialists at the national level);
- Opportunity to initiate short-term personal projects, such as personal development activities. Example: 1-5 hours/week or 5-10 hours/week;
- Ability to view reviews made by previous users.

As shown in Figure 3, the menus of the proposed platform are:

- "Home" – allows viewing of the main page;
- "Universities" – contains the list of universities included in the "RO-NT-Gig Education" platform, as shown in Figure 4.

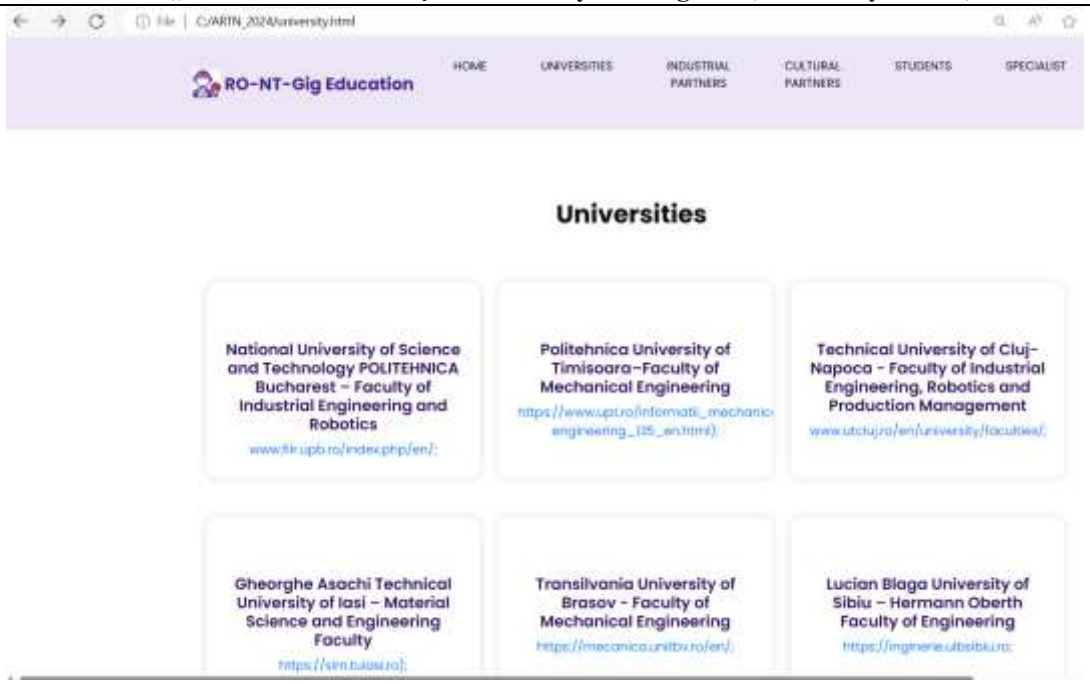

Figure No.4. Selective list of universities included in the "RO-NT-Gig Education" platform

The "Universities" menu displays the list of technical faculties from each university involved in developing complex educational programs in the field of unconventional technologies:

- "Industrial Partners" – contains the list of companies that wish to test unconventional ideas and solutions in their production processes, developed through collaboration among community members;
- "Cultural Partners" – facilitates the integration of these partners into various public relations activities organized by companies and/or universities. Interested individuals (students, professors, industrial specialists, etc.) can receive a cultural card, which provides discounts at events organized by cultural entities, other than those organized through the platform;
- "Students" – contains the database of students who wish to engage in the community's activities and undertake practical work at the industrial partners' locations. Access is granted based on credentials;
- "Specialist" – contains the database of specialists (professors, engineers, technicians, etc.) who wish to participate in the community's activities;
- "Proposed Master's Programs" – lists the master's programs proposed for development by community members. Access is granted based on credentials;
- "Master Programs Completed" – lists the completed and accepted master's programs. Access is granted based on credentials;
- "Public Relations" – includes specific activities organized through the platform: workshops, conferences, round tables, debates etc.

6.Conclusions

Network effects are crucial to the success and growth of platform-based business models. These effects occur when the value of a platform increases as more participants join and engage with it. The platform business model described in this paper leverages two primary types of network effects:

- Direct effects: Each new user who joins the platform contributes to the overall pool of knowledge, specifically in the realm of unconventional technologies. This aggregation of information enhances the platform's value by creating a richer resource for future users. As more users contribute their expertise and experiences, the platform becomes an increasingly valuable repository of knowledge. This directly benefits new users who gain access to a

broader range of insights and solutions, facilitating their ability to innovate and solve problems;

- Indirect effects: As the number of professionals and stakeholders engaging with the platform grows, its overall value to other participants increases. For instance, educational institutions, research and development organizations, and companies utilizing unconventional technologies find greater utility in a more populated and active platform. The increased participation enhances the platform's ability to connect users with relevant resources, collaborations, and opportunities, making it a more attractive and indispensable tool for all involved.

A market benefiting from network effects is also characterized by specific elements, such as:

- Unique Experiences: The platform provides distinctive experiences tailored to its specific field of activity. This specialization creates a niche environment where users can engage in activities and gain insights that are not readily available elsewhere. The unique nature of these experiences can drive user engagement and loyalty, as they offer value that is closely aligned with users' interests and needs;
- User Growth Impact: The expansion of the user base leads to a self-reinforcing cycle where the influx of new users results in increased information sharing and knowledge dissemination. Current users contribute valuable content and feedback, which, in turn, attracts more users. This growth is mutually beneficial, as it continuously enhances the platform's resources and relevance;
- Economic Perception: The platform is viewed by both suppliers and beneficiaries of unconventional technologies as either a cost center or a profit center. This perception is influenced by the platform's ability to provide valuable insights, innovative solutions, and opportunities that can either reduce costs or generate revenue. The economic impact of the platform's offerings makes it a crucial asset for its stakeholders;
- Expansion Opportunities: The platform offers numerous opportunities for expansion and growth. As the number of beneficiaries increases, driven by the diversification and growing complexity of unconventional technologies, the platform can broaden its reach and influence. This expansion is fueled by the continuous evolution of technology and the development of new products, which creates additional demand and engagement on the platform;
- Ease of Access: Simplicity in registration and participation is vital for attracting and retaining users. The platform's user-friendly design ensures that all stakeholders, regardless of their background or expertise, can easily join and benefit from its offerings. This accessibility helps to democratize knowledge and innovation, allowing a wide range of participants to engage with the platform.

In summary, the network effects of the platform not only enhance its value by expanding the pool of knowledge and increasing user engagement but also contribute to its economic significance and growth potential. The platform's design and functionality are key factors in leveraging these effects to achieve sustainable success and development.

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