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Review Paper

Academic Entrepreneurship at the Start of Industry 5.0 Era

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Abstract: *The economic theory has been once again looping to the role of the entrepreneur. The differences that we find are based on the changing role of the Universities as well as the expected shift to Industry 5.0. The focus of the paper is set on the successful entrepreneurs that have been "created" in the universities. Accordingly, the main hypothesis is: the Industry 5.0 instruments reveal a quite new world for academic entrepreneurs working in virtual open academic entrepreneurial centers. The structure of the paper is following: the first paragraph analyses the shift of the University role to support entrepreneurs based on 'business – academia' cooperation; the second paragraph presents the entrepreneurial knowledge that is important nowadays; the third paragraph gives a discussion on the digital instruments that stay behind the contemporary entrepreneurial training; and finally, some recommendations how virtual co-creation and co-working clubs should be organized will be given in conclusion.*

Keywords: *Academic Entrepreneurship, Industry 5.0, Co-working and Co-creation.*

JEL Classification L26

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1. INTRODUCTION TO ACADEMIC ENTREPRENEURSHIP

Focusing on the role of the "**entrepreneur**" and the process of entrepreneurship with/within the university/academia support, we could find four stages of understanding the common "academic entrepreneurship" (Jones & Wadhwani, 2006; Sterev & Penchev, 2023):

Firstly, the entrepreneurs were observed and described. For example, the very first explanation of the entrepreneur as a specific economic figure could be found in the 15th and 16th centuries in Venice, where the efficiency of the trade is explained by the personality of the trader and its accounting and managerial skills (see. Benetto Cotragli, 1573). Later, the very first definition of an entrepreneur was given by Richard Cantillion in the 18th century as a core figure of the market economy that "*brings the nation wealth and drives economic development*."

Secondly, entrepreneurship is a process that should be managed. For example, Josef Schumpeter states that "*the essence of entrepreneurial activity lay in the creation of "new combinations" that disrupted the competitive equilibrium of existing markets, products, processes and organizations*" (Schumpeter, 1947). Thus, numerous mechanisms for developing entrepreneurs were proposed in the 1950s and 1960s.

Thirdly, the development of behavioral management theories found the "opportunity" of university/academic training of entrepreneurs from the 1980s till the late 2000s. The "newly" proposed entrepreneurial study programs endeavor a personal development based on the knowledge that "*the entrepreneur is a person, not a team, committee or organization. .... Entrepreneurial actions are performed in all societies by individuals whose judgment differs from the norm*." (Hébert & Link, 1989).

Finally, entrepreneurs and entrepreneurship are set as the core of entrepreneurial economics as contemporary economic development is based on the strong figures of individual entrepreneurs: people who create high-tech companies (resp. start-ups) that push up technological and societal changes. In those terms, the role of Universities/academia is set as a starting point for any successful entrepreneur. Additionally, Huffman and Quigley (2002) found the role of the Universities not just in training entrepreneurial knowledge (third stage) but also in attracting high-tech entrepreneurs through entrepreneurial networks' development by instruments like: "network events," internships, business scholarships, and business incubators.

Following history, academic entrepreneurship as a process is not quite a new phenomenon, but it is trending nowadays as a result of seeking new economic and social opportunities. Therefore, focusing on the last, fourth stage of understanding entrepreneurs, we could set some of the latest definitions of "**academic entrepreneurs,**" meaning the entrepreneurs that start from their university/academia engagements. Additionally, "*academic entrepreneurship is the process by which an individual or group of individuals linked through their work to a university or research center use knowledge created in their research to set up business ventures or spin-offs*" (Miranda et al., 2017). Thus, Toole and Czarnitzki (2007) set that "*the common academic entrepreneurship is defined as a form of technology transfer.*" In that meaning, the academic entrepreneur is a researcher / scientific investigator who takes part in the commercialization of an originated technology. Verification of this is given by Feldman et al. (2002), who found a strong connection between the commercialization of the intellectual property of American Universities and equity instruments for technology transfer as a first step to fostering academic entrepreneurship within them.

Following the latest definition of "(academic) entrepreneurship," some more pillars of 'academia – business' cooperation, as a basis of the Industry 5.0 boom, could be noted as follows:

- **Innovations** have kept their importance in economic development as well as entrepreneurial start-ups. However, scientific breakthroughs and scientific research innovations become a core idea for technological achievement /within Industry 5.0's technology development/ and a source for (academic) entrepreneurial endeavors (Klofsten & Jones-Evans, 2000; Siegel & Wright, 2015; Wood, 2011; Yordanova, 2019, 2021).
- **Innovation promotions** and **innovation commercialization** have become more and more expected results of the universities as the research universities were defined in the latest 2000s. As O'Shea et al. (2004) found, "*the commercial exploitation of new knowledge created in universities has become increasingly important to universities …*". All this is a final result of the Universities/Academia's role development not just a knowledge centers but a "leadership centers" that generate new (Industry 5.0 technology) knowledge to boost the new leadership and resource allocation approaches (Taylor, 2006).
- The **'academia–business' forms** are developing from industry-university research collaboration to intra-university forms (university-based incubator firms, start-ups by academicians) involving not just faculty staff but post-docs, students, or affiliated university personnel (Hayter et al., 2018). Following this, the typical Theory-to-Practice (T2P) University centers have "upgraded" to "open entrepreneurial centers" (Sterev et al., 2023).

Following the given key pillars of academic entrepreneurship, two approaches appear to be at the core of academic entrepreneurship: co-working and co-creation:

First, **co-creation** is set as a cooperative form of leadership creativity and new-technology development process. According to Sterev et al. (2023), Zuniga et al. (2021), and Hughes (2014) co-creation is "*the process of collaboration of two or more parties in building a new type of value for themselves or others*." The co-creation success in academic entrepreneurship is attributed to the group / social behavior of the people who become more successful, more motivated, and more creative when working in group cooperation (Li et al., 2022; Takahashi & Takahashi, 2022).

Second, **co-working** is the process of sharing a business environment, business processes, or staff with others. As a modern concept, co-working, especially within cloud-based Industry 5.0 technology for distance working, brings out flexibility, dynamics, and resilient design, which are favorable requirements for start-ups, freelancers, and creative industries (Kartika et al., 2019; Pan et al., 2022 and others). Additionally, according to Jackson et al. (2022), Mahlberg and Riemer (2017), and others, the co-working space in universities embodies **entrepreneurship**, **cutting-edge technologies, and transdisciplinary and collaborative working** as well as supports **matching students** with co-working members and gives interns access to developmental activities.

In summary, academic entrepreneurship is the core base of contemporary entrepreneurial economics, especially as a background for the development of the Industry 5.0 entrepreneurial system. It has not just supported new business decisions and new-born entrepreneurs' development but has set an appropriate environment for it through the rise of group (entrepreneurial) training and the establishment of innovative co-creation and (social) co-working networks.

2. ENTREPRENEURIAL KNOWLEDGE AND ENTREPRENEURIAL SKILLS

The main role of the Universities is to establish training. Thus, they have to train academic entrepreneurs to answer the needs of recent entrepreneurial economics covering fast change from

Industry 4.0 to Industry 5.0. The main question that any entrepreneur has always asked himself since the 15th century (from the beginning of entrepreneurial knowledge summarizing) is: Am I good enough to be a (successful) entrepreneur?

Notably, there has been no single answer to that question for more than five centuries. But, we are sure that successful entrepreneurs always believe in their "internal forces" to be entrepreneurs. Like any single entrepreneur, management science is looking for "(empirical) signs" that show the best entrepreneurial mindset!

From the very beginning (see. Cantillon, 1755 and others), the role and characteristics of the (trade) entrepreneur are essential for business development. Nowadays, the mechanism is still being kept, but the instruments for that are being improved. Thus, the practical instrument that the researchers and practitioners continue to look out for is based on the human-centric theories for **entrepreneurial profiles**.

Entrepreneurial profiling helps to find data quality rules and requirements that will support data quality assessment of entrepreneurial success. Using entrepreneurial profiling alone, we can find some perceived defects and outliers in entrepreneurial training. Additionally, a lot of people use entrepreneurial profiles as the start and end point for their personal characteristics development, incl. competencies and assessment as results of profiling are:

- **Valued** in a balanced and correct way in comparison with other entrepreneurs;
- **Significant** to the (entrepreneurial) business success;
- **Reflect** the true extent of a particular entrepreneurial competence.

Moreover, the contemporary **entrepreneurial profile** emphasizes those human (capital) competencies (resp. entrepreneurial knowledge and entrepreneurial skills) that differentiate entrepreneurs from other people. These entrepreneurial skills and personal entrepreneurial experience do not make people great or better, but they summarize the needed preconditions for the success of entrepreneurs.

Looking at research evidence on what predicts entrepreneurial success, we fully agree with Krieger et al. (2022), who explains that early variety orientation of the entrepreneurial personality boosts their start in vocational entrepreneurial development. Thus, early entrepreneurial training does not follow boosting "millions of entrepreneurs" but gives an early bridge for entrepreneurial personalities to develop their **entrepreneurial skills.**

Additionally, entrepreneurial skills have recently been discussed in research on human capital. The lead hypothesis is that there is a strong positive relation between human capital – including education, experience, knowledge, and skills – and success (Unger et al., 2011). Therefore, entrepreneurial attitude and early-bird entrepreneurial training have a significantly positive effect on the success of entrepreneurs (Kassa & Mirete, 2022).

Looking for the "best entrepreneurial attitude," De Silva et al. (2023) propose that Universities should offer customized entrepreneurial training based on increasing (academic) motivation and better use of decision-making approaches in entrepreneurial causation.

Following Tam et al. (2021) and their analysis of blended entrepreneurial training on the pre-incubation stage for social entrepreneurship development, we could summarize four main entrepreneurial skills, very important for the human-centric approach of Industry 5.0 era:

- Team-working: despite the common belief that entrepreneurship is an individual path, the idea that shared dreams can lead to significantly more success is becoming increasingly popular. Thus, better teamwork skills will help young people understand themselves and be more successful in pursuing their (entrepreneurial) dreams.
- Risk-taking: As risk is essential for any entrepreneurial business, the knowledge of risk-taking will help young entrepreneurs "choose their (market) fights." Additionally, risk-taking skills are strongly connected to strategy set-up knowledge that forces entrepreneurial success.
- Creativity and innovations: The main hypothesis is that humans are creative themselves, but there is a need to bring these human characteristics to light. As education often opposes creativity to a technical mindset, it is a huge mistake as combining creativity and technical knowledge brings out successful innovations.
- Communication: Each entrepreneur should be able to speak in front of a lot of people and present the added value of their innovation. But there is no just speaking – that should be motivational speech that creates followers. Thus, pitching skills, resp. telling something important with fewer words and with pathos is part of common institutional entrepreneurship.

Proving the above results, Nieuwenhuizen and Groenewald (2008) and Da Silva Teles et al. (2021) found that essential entrepreneurial skills, at the start of the Industry 5.0 era[2], during entrepreneurial training for students could be summarized in three fields: innovativeness, pro-activeness, and risk-taking.

Following the EntreComp framework (Bacigalupo et al., 2016), three groups of essential entrepreneurial skills and knowledge are found:

First, ideas and opportunities include different skills that help the entrepreneur to understand his "deep wishes," such as creativity skills, visionary skills, valuable ideas generation skills, spotting opportunities skills, and sustainable thinking skills.

Second, resources include different knowledge and skills on how to use different resources efficiently, such as mobilizing different resources skills, mobilizing and motivating others skills, motivating themselves skills, self-awareness skills, financial literacy, and economic efficiency skills.

Third, into-action skills include different knowledge and skills that pull up entrepreneurial skills such as business planning knowledge, risk-taking knowledge and skills, team-working and team-leading skills, experience learning skills, and pro-activeness skills.

The (research) Universities have to develop preferred entrepreneurial competencies to foster entrepreneurial skills in their academic staff, students, and affiliates (Yordanova & Stoimenova, 2021). They are responsible for providing the necessary resources and supporting students in developing these skills. But how do we find the training content needed?

Possessing some / all of these entrepreneurial skills is found to be the difference between entrepreneurial success and entrepreneurial failure. So, based on Cooney (2012), Kutzhanova et al.

[2] Comparing the entrepreneurial skills from the Cantillon (1755) at the pre-Indystrial Era, passing by Schumpeter's (1947) entrepreneurial needs during the Industry 2.0 era, till Krieger et al. (2022) entrepreneurial success of Industry 5.0 we found a quite different (entrepreneurial) skills that are important for any recent Indutry x.0 era. Thus, we focus on those entrepreneurial skills, especially after Covid-19 pamdemic, that are found as a prequisition for new (Industry 5.0) innovation and technology development. – a.n.

(2009), and others, in order to personalize academic entrepreneurial training to meet the Industry 5.0 requirements, it is necessary to test each trainee's entrepreneurial skills individually to compare with the reference successful entrepreneurial set and to continuously monitor any changes in those individual skills.

Following Yordanov (2019, 2023) and Sterev (2023), three steps for understanding the academic entrepreneurial level within Industry 5.0 are needed:

The first step is to set the average entrepreneurial skills level. It differs in different societies as a result of existing personal knowledge and skills and societal group/personal understanding of entrepreneurial knowledge and skills. The main hypothesis is that all entrepreneurial skills are at the average level for the essential society.

The second step is to find out individual entrepreneurial knowledge and skills. They could differ by age, academic position (e.g., academic staff, students, affiliates), sex, and other social characteristics.

The third step is to discover the differences between individual and group entrepreneurial knowledge and skill levels. Accordingly, the hypothesis is that successful entrepreneurs prioritize exact entrepreneurial knowledge and skills and neglect others.

Accordingly, based on the methodology of EntreComp framework (Bacigalupo et al., 2016) application of the above three steps, the entrepreneurial profile and its Industry 5.0's context, resp. ideas, resources, and into-action, is visualized by profiling the entrepreneurial skills as follows (Figure 1.)

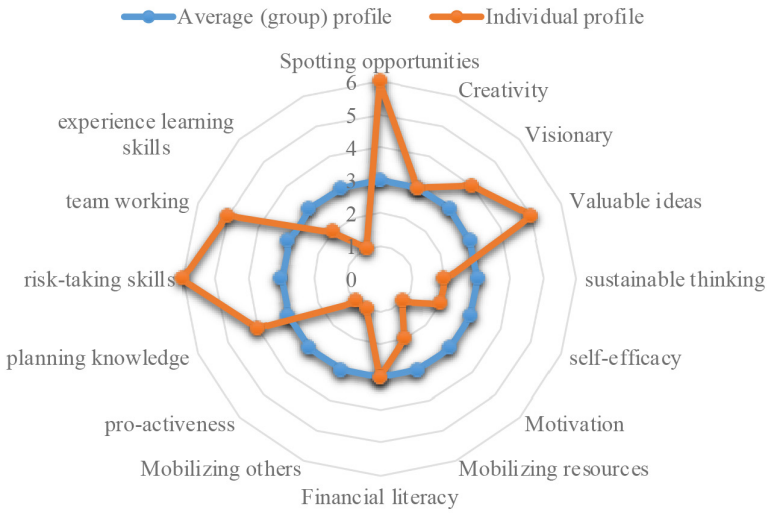

Figure 1. Entrepreneurial profiling
Source: Example of simple visualization based on methodology review of Bacigalupo et al. (2016)

3. ENTREPRENEURIAL TRAINING

Despite the academic debate on skills acknowledgment, entrepreneurial recognition could be done better at the time of training them as during the process of finding young people who intend to be entrepreneurs. As the tradition of the training of entrepreneurs in the USA is appointed backward

to the 1930s in Harvard Business School, entrepreneurial education in the (German-speaking) European universities became important in the mid-1990s (Franke & Luthje, 2004) and Bulgarian Universities as well – in the mid-1990s (Yordanov, 2019).

Although blended entrepreneurial training is done according to the personal entrepreneurial intention of the trainees, there is always a difference between entrepreneurial intention before and after the entrepreneurial training (resp. between the average values) (Figure 2).

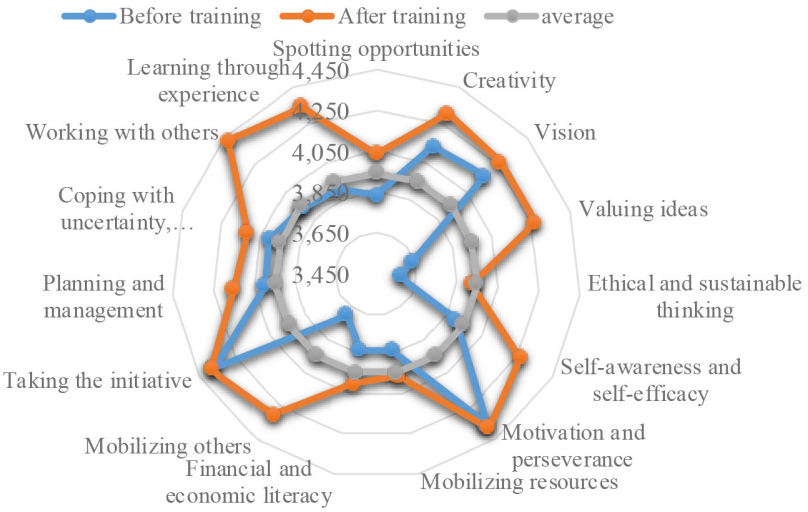

Figure 2. Entrepreneurial skills before and after entrepreneurial training
Source: Sterev, 2023

Additionally, blended entrepreneurial training could cover a wide range of topics, including business planning, marketing, financial management, and legal and regulatory affairs. This training can be particularly important for students considering starting their own business, as it can help prepare them for their challenges.

Sterev et al. (2021) state that entrepreneurial training covers at least one stage of the academic entrepreneurial roadmap (Figure 3).

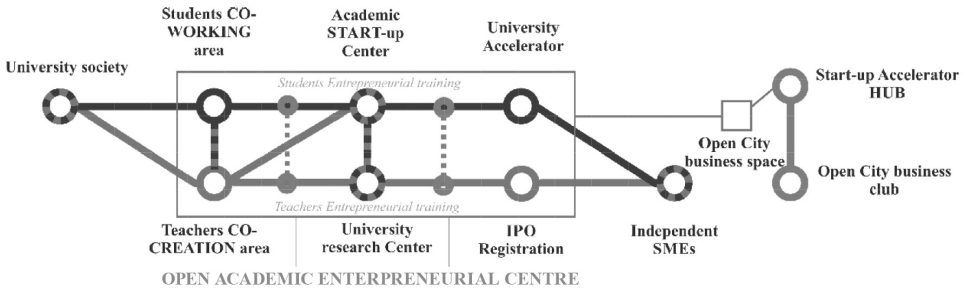

Figure 3. Road map of an academic entrepreneurship
Source: Sterev et al. (2021)

The latest research covering the COVID-19 effect found that the socialization of technology transfer could be the key point of the newest high-tech innovations and entrepreneurial development in

the near future. According to them, we are in a "group intelligence" boom as the starting point of the Industry 5.0 based on the "open business" and "open science" approaches. Following the latest technology development, entrepreneurial training could be done with the support of Industry 5.0 instruments (Table 1).

Table 1. Industry 5.0 and entrepreneurial training

INSTRUMENTS	CONTRIBUTION TO ENTREPRENEURIAL TRAINING
Big data	• Provides information for the entrepreneurial skills of a big group of end-users • Continuous change of the average level of entrepreneurial competencies based on the group knowledge and entrepreneurial success case studies
IoT	• Communication between devices on the Internet is needed to perform better business processes and activities. Allows better resource knowledge in real-time • Supports the fulfillment of the complex requirements of entrepreneurial economics • Extending the results of entrepreneurial training by detecting training errors and improving technical support for entrepreneurs
Block-chain	• Guarantees high levels of transparency in entrepreneurial chains and entrepreneurial networks • Ensures traceability, ethical sourcing, and more efficient material flows.
Machin learning	• Preparation of entrepreneurial forecasts with a high degree of accuracy • The reduction of human bias in testing and prototyping at the stage of early entrepreneurship
Computer Vision	• Automatic extraction, analysis, and understanding of useful information from an image or sequence of images that helps individualize the entrepreneurial training • Autonomous visual comprehension on entrepreneurial training

Source: Modification on Biolcheva, 2018

Additionally, based on Saleh (2019), contemporary entrepreneurial training that focuses on Industry 5.0 Artificial Intelligence (AI) instruments increases entrepreneurial success as the AI is connected not to single human intelligence but to the collective intelligence of the society as follows:

- AI uses algorithms to discover entrepreneurial patterns from vast amounts of information;
- AI is capable of augmenting human intelligence, delivering insights, improving productivity, and increasing the entrepreneurial success rate;
- AI uses algorithms to construct analytical models that perform entrepreneurial training tasks through innumerable rounds of trial and error during the (virtual, augmented reality) training;
- AI is a tool that allows for integrating information from different sources and using it to make better entrepreneurial decisions.

4. CONCLUSION

As the role of the entrepreneur and entrepreneurship is in the core base of contemporary economics, training entrepreneurs is essential for the success of entrepreneurial economics. And, as the entrepreneurial approach stayed stable for more than 5 centuries, the instruments of finding and developing entrepreneurs differ. Nowadays, the boom of artificial intelligence and Industry 5.0 introduction leads university entrepreneurial training to the next level.

(Research) Universities play a crucial role in fostering entrepreneurial skills in academia (e.g., academic staff, students, and affiliates). They provide access to entrepreneurial mentoring and entrepreneurial networking opportunities, and they create and provide entrepreneurship education and training environment that fosters innovation and creativity. Fostering an entrepreneurial culture in the University could also be a powerful tool to promote entrepreneurship among students and faculty staff.

Accordingly, open entrepreneurial academic centers could increase the effect of social works provided by co-creation and co-working approaches in generating and using innovative entrepreneurial ideas. Such socialization of innovations is expected to be successful as unfolding the creativity of people from the academic community, resp. mostly students, but also teachers and researchers; expanding the scope of functional and technological innovations; developing the exact transversal skills and key competencies, such as problem-solving skills and entrepreneurial skills, needed for the innovation success.

Instruments of Industry 5.0 and AI could support open academic centers and convert them to virtual ones. Thus, entrepreneurial training becomes a continuous process, and future entrepreneurs can assess their success in real-time. But, it means a quite new entrepreneurial instrument to be developed, starting with big data – entrepreneurial assessment tools and finishing with blended entrepreneurial training via augmented reality and 3D computer visions.

The Universities have to organize Open Academic centers for entrepreneurial training and development that use successful entrepreneurial skills to establish and test single students/academic staff entrepreneurial intention /based on Industry 5.0 prequisitions and organize entrepreneurial training to boost the missing skills from the successfully referenced ones. Additionally, Universities must incorporate Industry 5.0 technologies, especially AI and cloud technology, to establish appropriate academic entrepreneurial profiles and intentions.

Finally, the Open academic center has to carry on innovative success as there are Industry5.0-based policy opportunities and requirements defining:

- Social infrastructure of the openness: Infrastructural, the functioning of such a center needs appropriate premises and a base. In accordance with the basic principles of the existence of this type of entrepreneurial center, with open doors, it follows that the center must be physically located in a building/premises with public access. Similarly, the center can also be located in the virtual space within existing Industry 5.0 technologies, and free access to the website/platform on which the center is presented is also required. Restriction of access to a physical/virtual center can only be done in relation to belonging to one or more interested groups through an access card/student card (for physical centers) or username and password (for virtual centers).
- Organizational team: the social structure needs the inclusion of different stakeholders as Academic entrepreneurs: students/academic teachers/researchers, Academic mentors, Academic tutors, and high-tech business mentors. Participation, especially by organizing virtual discussion rooms and AI discussion instruments, of all groups of stakeholders has to be ensured for better innovation success.

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