Revista Pensamiento y Acción
eISSN 2619-3353
ISSN 0120-1190
Uptc Universidad Pedagógica y Tecnológica de Colombia

Entrepreneurship, Transfer and Technological Innovation in a Public University in Central Mexico

Cruz García-Lirios[1]
José-Alfonso Aguilar-Fuentes[2]

Recepción: marzo de 2024 **Aprobación:** abril de 2024

Abstract

The relationship between entrepreneurship, transfer and technological innovation has not been revealed in the literature from 2020 to 2023. Therefore, the objective of the study was to establish the entrepreneurship system that predicts transfer and innovation in a public university. An exploratory, cross-sectional and correlational work was carried out with a sample of 100 professional practitioners and social workers from a public university in central Mexico and in a strategic alliance with local micro-enterprises. The results show that technological innovation is a function of financial investment and technology transfer is predicted by sustainable responsibility. In relation to the literature that reports 10 dimensions of entrepreneurship, it's recommended to extend the study to a university corporate environment.

Keywords: scientific entrepreneurship; sustainable development; technological innovation; technology transfer.

[1] Universidad Autónoma de la Ciudad de México (Ciudad de México, México).
[2] Universidad Autónoma del Estado de México (Toluca, México).

ISSN 0120-1190 – eISSN 2619-3353
DOI: https://doi.org/10.19053/01201190.n36.2024.17414

Emprendimiento, transferencia e innovación tecnológica en una Universidad Pública del Centro de México

Resumen

La relación entre emprendimiento, transferencia e innovación tecnológica no ha sido revelada en la literatura del 2020 al 2023. Por lo tanto, el objetivo del estudio fue establecer el sistema de emprendimiento que predice la transferencia y la innovación en una universidad pública. Se realizó un trabajo exploratorio, transversal y correlacional con una muestra de 100 profesionales y trabajadores sociales de una universidad pública del centro de México y en alianza estratégica con microempresas locales. Los resultados muestran que la innovación tecnológica es función de la inversión financiera y la transferencia de tecnología está predicha por la responsabilidad sostenible. En relación con la literatura que reporta 10 dimensiones del emprendimiento, se recomienda extender el estudio a un entorno corporativo universitario.

Palabras clave: desarrollo sostenible; emprendimiento científico; innovación tecnológica; transferencia tecnológica.

Para citar este artículo:

García-Lirios, C., Aguilar-Fuentes, J.-.A. (2024). Entrepreneurship, Transfer and Technological Innovation in a Public University in Central Mexico. *Pensamiento y Acción*, *35*, 1-18. https://doi.org/10.19053/01201190.n36.2024.17414

Introduction

The history of scientific and technological entrepreneurship is intertwined with advances in science and technology over time (Ezeudu, Ofoegbu & Anyaegbunnam, 2013). The most important milestones by historical period are:

- Industrial Revolution (18th-19th century): The Industrial Revolution ushered in an era of technological and business innovation (Hameed et al., 2016). New machines and processes transformed production and transportation, leading to the creation of factories and economic expansion.
- 19th-20th century: The expansion of electricity and communications fueled innovation in areas such as telegraphy, telephony, and radio. Inventors and entrepreneurs such as Thomas Edison and Nikola Tesla played a pivotal role in commercializing new technologies (Fayolle et al., 2021).
- 20th century: World War II and the Cold War boosted investment in research and development, leading to technological advances such as computing and space exploration (Etzkowitz, 2011). The brainchild of Silicon Valley in California became an epicenter of technological innovation, with companies like IBM, Hewlett-Packard, and later technology companies emerging.
- 70s and 80s: The rise of personal computing led to the creation of companies such as Apple and Microsoft, founded by Steve Jobs and Bill Gates, respectively (Kuschel et al., 2020). The biotechnology industry began to take shape, with the founding of Genentech in 1976.
- 90s: The explosion of the Internet and the World Wide Web opened new entrepreneurial opportunities in areas such as e-commerce, social networking, and search engines. Companies like Amazon, Google, and eBay emerged in this period (Sexton & Smilor, 1986).
- 21st century: Scientific and technological entrepreneurship has continued to grow in areas such as artificial intelligence, advanced biotechnology, renewable energy, and electric mobility (Bailetti, 2012). Emerging companies (startups) have transformed various industries through disruptive innovation. Scientific and technological entrepreneurship is global and diverse, with startup ecosystems in

ISSN 0120-1190 – eISSN 2619-3353
DOI: https://doi.org/10.19053/01201190.n36.2024.17414

different parts of the world. Collaboration between academia, industry and investors is crucial to bringing innovative ideas to market.

Scientific and technological entrepreneurship has been an important driver for innovation and economic development around the world (Etzkowitz & Gulbrandsen, 1999). Creative minds, inventors, and entrepreneurs have worked together to bring scientific and technological advances from the laboratory to people's everyday lives. There are several theories and approaches that seek to understand and explain scientific and technological entrepreneurship. These theories offer perspectives on how companies and projects based on science and technology emerge, develop and prosper. Here are some relevant theories:

- Innovative Entrepreneurship Theory: Emphasizes the role of the entrepreneur as an agent of change and innovation in the economy (Giones & Brem, 2017). "Entrepreneurship" as the force behind creative destruction, where new ideas and technologies replace old ones. In the scientific and technological context, this applies to the creation of new companies that introduce disruptive innovations in the market.
- Technology Commercialization Theory: This approach focuses on how technologies developed in research and development environments are transferred and commercialized (Poggesi et al., 2020). It highlights the importance of establishing connections between academic research and industry to bring new technologies to market. It involves the identification of promising technologies, the protection of intellectual property and the collaboration with investors and companies for commercialization.
- Innovation Diffusion Theory: Focuses on how innovations are adopted and disseminated in society (Martin, 1994). It divides adopters into categories based on their willingness to take risks and embrace new technologies. In the context of scientific and technological entrepreneurship, this theory helps to understand how new ideas and technologies gain market acceptance.
- Entrepreneurial Ecosystem Theory: This theory is based on the idea that the success of scientific and technological entrepreneurship depends on a complex ecosystem of actors, such as companies, investors, universities, government

ISSN 0120-1190 – eISSN 2619-3353
DOI: https://doi.org/10.19053/01201190.n36.2024.17414

agencies and more (Wadhwa, Freeman & Rissing, 2008). It focuses on how these actors interact and collaborate to foster innovation and business growth. Tech hubs like Silicon Valley are examples of well-developed business ecosystems.

- Scientific Entrepreneurship Theory: This approach focuses on the unique characteristics of entrepreneurship based on science and technology (Wright et al., 2008). It highlights the importance of intellectual property, technology transfer and collaboration with academia. It acknowledges that science entrepreneurs often face specific challenges related to technological uncertainty and funding.

Each theory offers a valuable perspective for understanding how scientific and technological innovation translates into companies and products that impact the real world (De Jager et al., 2017). Scientific and technological entrepreneurship can be analyzed on different scales, ranging from the individual level to the macroeconomic level. Common scales on which this topic can be addressed are:

- Individual Level: On this scale, entrepreneurship is analyzed from the perspective of individuals who start, and lead companies based on science and technology (Etzkowitz, 2002). Entrepreneurs' skills, experience and motivation are considered, as well as their ability to identify opportunities and take risks. It explores how personal characteristics influence the process of creating and managing technology companies.
- Business Level: At the company level, aspects such as technological innovation, market strategy, resource management and the ability to scale are examined (Shamsuddin, Arome & Aminu, 2018). It considers how science and technology companies develop and market products and services, and how they adapt to changes in the competitive environment.
- Ecosystem Level: This scale focuses on the broader environment in which technology companies operate, including universities, research institutions, accelerators, incubators, investors, and government agencies (Blankesteijn, Bossink & van der Sijde, 2021). It analyzes how the collaboration between these actors influences the growth and success of scientific and technological entrepreneurship.

ISSN 0120-1190 – eISSN 2619-3353
DOI: https://doi.org/10.19053/01201190.n36.2024.17414

- Regional or Local Level: At the geographical level, we study how business ecosystems in specific regions encourage or hinder the creation and development of technology companies (Wright, Birley & Mosey, 2004). Factors such as talent availability, infrastructure, investment, and government policies are considered.
- National and Global Level: On a broader scale, the role of scientific and technological entrepreneurship in the national economy and its contribution to innovation and economic growth is analyzed (Ergün, 2019). Different countries are compared in terms of their ability to foster innovation and technological entrepreneurship. On this scale, the broader impact of scientific and technological entrepreneurship on society and the economy is assessed. It considers how technological innovations affect the quality of life, job creation, sustainability, and other socioeconomic aspects. It examines how science and technology companies can scale their operations and expand internationally. The challenges and opportunities of entering global markets and adapting to different cultural and regulatory contexts are analyzed.

However, if it is considered that transfer and innovation are the product of entrepreneurial relationships, then it is necessary to establish the predictive sequence that involves the acceptance and adoption of technology as determinants of knowledge translation and new technological proposals.

Therefore, the objective of this work is to establish the relationship between entrepreneurship opportunities based on the acceptance, adoption, and adjustment of technology to innovation projects and communication for its transfer in practitioners and social servants.

Are there significant differences between the relationships of the dimensions of entrepreneurship reported in the literature from 2020 to 2023 with respect to the observations of the present study in a sample of practitioners and social servants in micro-enterprises allied with their public university?

- **Hypothesis 1.** Given that entrepreneurship is reflected in opportunity expectations, it is likely that it is not related to scientific and technological projects, which are distinguished by their programming. In this sense, the

ISSN 0120-1190 – eISSN 2619-3353
DOI: https://doi.org/10.19053/01201190.n36.2024.17414

financial investment supposes opportunities for the development of projects that could be associated with the acceptance and adoption of technology before its programmed utility in a scientific and technological project. If this is the case, then you will see a knowledge management system that is focused on trust between stakeholders rather than its scheduling of functions. In this sense, technological transfer and innovation can be predicted from an entrepreneurial ecosystem focused on trust relationships in technology.

- **Hypothesis 2.** If technological innovation projects require a transfer system centered on trust, then entrepreneurship reflected by accountability opportunities vis-à-vis sustainability may be a predictor of technology acceptance and adoption.
- **Hypothesis 3.** The entrepreneurial ecosystem, as well as the opportunity expectations based on financing, anticipated innovation and technology transfer.

Method

A cross-sectional, correlational, and exploratory study was carried out with a sample of 100 students (M = 24.3 SD = 2.3 age M = 8'897.00 SD = 456.00 monthly income) attached to the strategic alliance system with MSMEs for professional practices and social service.

The Scientific and Technological Entrepreneurship Scale was used, which includes 30 items that measure 10 dimensions related to technological innovation (“The applications allow me to have more market learning”), research and development (“The findings reported in the literature facilitate the design of niche market"), technology transfer ("Conferences allow me to have more information about the local market"), academic and industrial collaboration ("Strategic alliances are beneficial for my training"), intellectual property ("The protection data paves the way for me in the market"), business ecosystem ("The incubation of talents helps me find a job"), socioeconomic impact ("ICTs will impact the quality of life in my town"), scalability and expansion (" Personal growth is a reflection of the growth of my locality"), investment and financing ("State microfinancing will inhibit the desertion of talents"), ethics and sustainability ("My university is socially responsible in the face of the

ISSN 0120-1190 – eISSN 2619-3353
DOI: https://doi.org/10.19053/01201190.n36.2024.17414

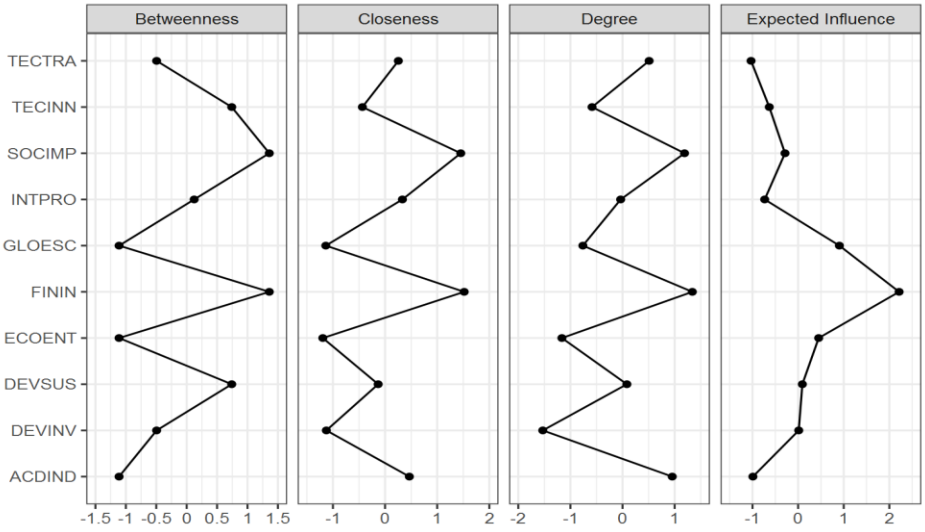
climate crisis"). Each item is answered with one of five options ranging from 0 = “not at all agree” to 5 = “quite agree.” The reliability reported in the literature and established in the present work ranged between 0.760 and 0.773, as well as the validity between 0.356 and 0.678.

Respondents were contacted through their institutional email. Meetings were convened in order to establish the homogenization of concepts through focus groups, the evaluation of the items through the Delphi technique and the piloting of the instrument. In each session, the confidentiality and anonymity of the answers is guaranteed in writing, reiterating the non-remuneration.

The data was captured and processed in JASP v14. The coefficients of centrality, grouping and structuring were estimated to answer the hypotheses and estimate the trajectory model. Values close to unity were assumed as evidence of non-rejection of the hypothesis.

Results and Discussion

Centrality consists of four parameters that indicate the degree of proximity, intermediation, gradation, and influence between a hegemonic node with respect to the other nodes that make up the network. In this sense, the node related to financial investment (FININV) stands out. In other words, the node that regulates scientific and technological entrepreneurship lies in financial investment (Figure 1).



ISSN 0120-1190 – eISSN 2619-3353
DOI: https://doi.org/10.19053/01201190.n36.2024.17414

Fig. 1. Centrality of the scientific and technological entrepreneurship network.

Regarding the grouping which means the establishment of central nodes of entrepreneurship, the coefficients measure the degree of proximity or distance between the main node with respect to the peripheral nodes. In this way, the link between industry and academia stands out as a grouping node. In other words, the scientific and technological entrepreneurship network regroups around strategic alliances between public and private actors (Figure 2).

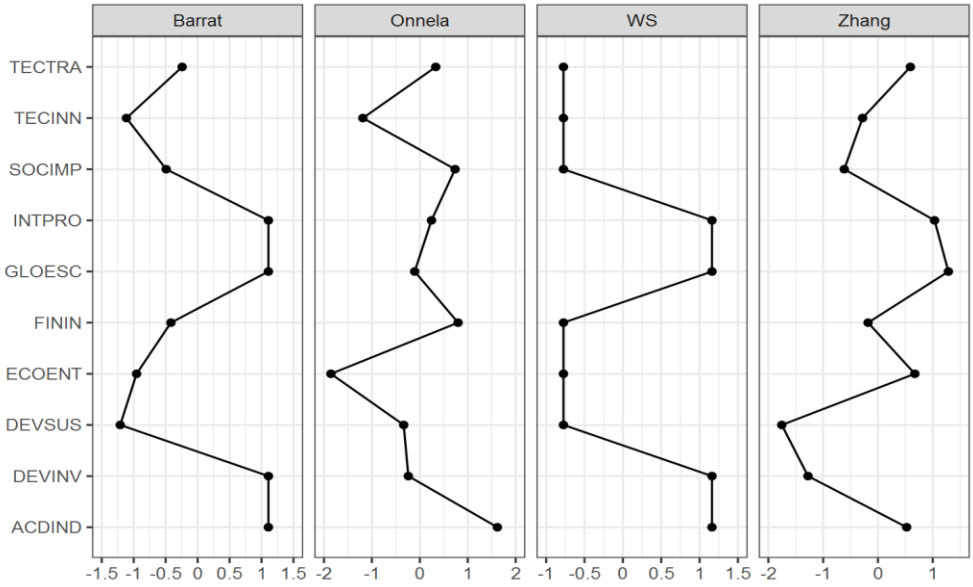


Fig. 2. Grouping of the scientific and technological entrepreneurship network.

Given that both the strategic alliance between universities and companies, as well as financial investment, group and regulate the entrepreneurial network system, the process begins with the business ecosystem and culminates with intellectual property. It means then that scientific and technological development opportunities depend on a sequence of logics that start with sustainability and end with the protection of projects or growth models if they are grouped in strategic alliances and financially regulated (Figure 3).

ISSN 0120-1190 – eISSN 2619-3353
DOI: https://doi.org/10.19053/01201190.n36.2024.17414

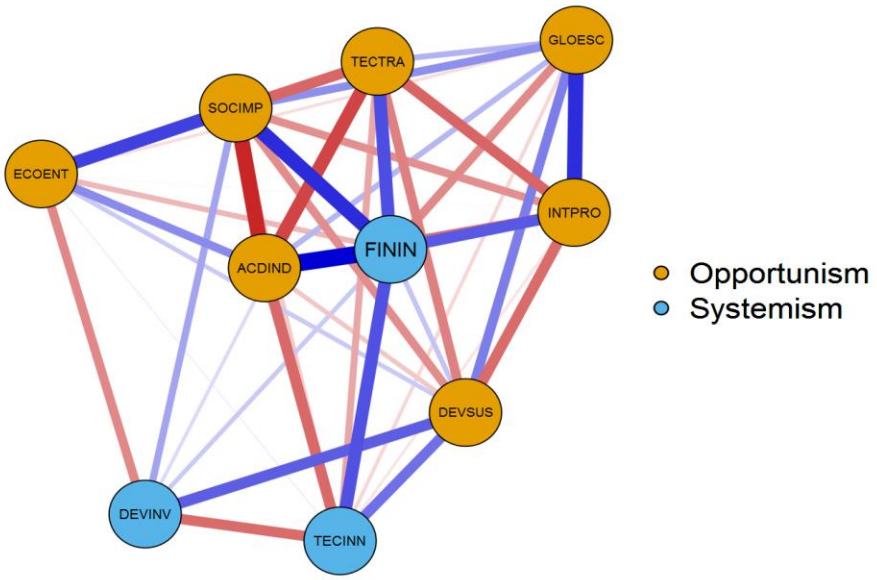


Fig. 3. Scientific and technological entrepreneurship network.

Given that the nodes related to the business ecosystem, industry and academia alliance, financial investment and intellectual protection are axes of the entrepreneurship system, we proceeded to estimate their dependency relationships as determinants of technology transfer and technological innovation. In this sense, financial investment (FIN) anticipated technological innovation (TECI), but sustainable development (DEVS) affected technology transfer (TECT). Therefore, scientific, and technological entrepreneurship, reflected in technology transfer and technological innovation are predicted by sustainable development and financial investment (see Figure 4).

ISSN 0120-1190 – eISSN 2619-3353
DOI: https://doi.org/10.19053/01201190.n36.2024.17414

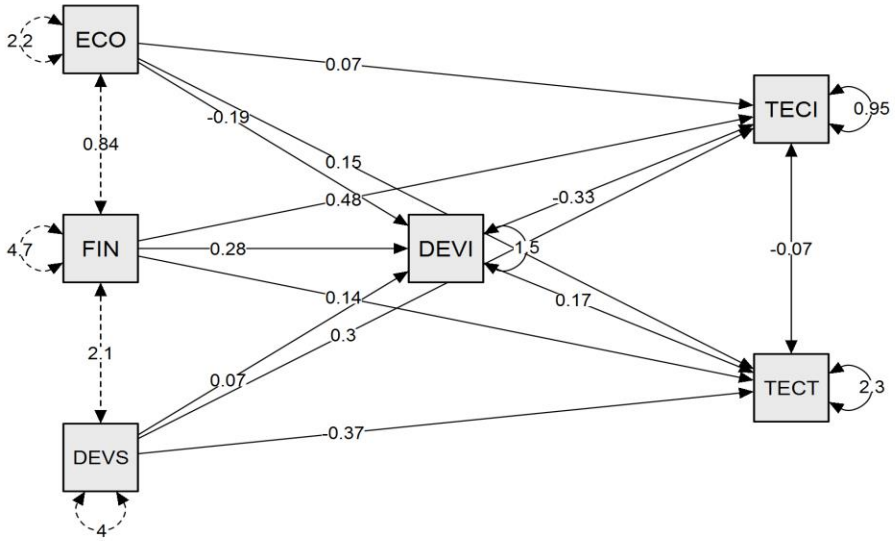


Fig. 4. Determinants of technology transfer and technological innovation.

The adjustment and residual values suggest the non-rejection of the hypothesis regarding the significant differences between the theoretical model with respect to the observations made in the present work. In this sense, scientific and technological entrepreneurship is reflected in the dimensions reported in the literature and evaluated in this paper. In addition, the relationships between these dimensions indicate that technology transfer is achieved from sustainability and technological innovation is anticipated from the amount of financial investment.

Conclusion and Recommendations

The contribution of the present work to the state of the question lies in the establishment of a network of dimensions reported in the literature and observed as reflective and determinants of the transfer and technological innovation in the present study. The scope of the work can be seen in the dimensions that affect technological transfer and innovation, namely: responsibility for sustainability and financial investment. It is true that as a management system, entrepreneurship begins with a business ecosystem, but it is financial investment that regulates entrepreneurial proposals. From this finding, technological innovation will be possible to observe as an objective of scientific and technological entrepreneurship.

ISSN 0120-1190 – eISSN 2619-3353
DOI: https://doi.org/10.19053/01201190.n36.2024.17414

However, the limits of the study lie in the size of the sample that cannot be generalized to the population of the public university. In addition, scientific and technological entrepreneurship can be at the incubation level and not professional. Or the influence of financial investment and responsibility with sustainability are corporate traits that predict entrepreneurship of this type and not scientific and technological. Therefore, it is advisable to compare two models, one corporate university and the other scientific and technological to observe the differences between students and scientists or technology.

References

Bailetti, T. (2012). Technology entrepreneurship: overview, definition, and distinctive aspects. *Technology innovation management review*, *2* (2).

Blankesteijn, M., Bossink, B., van der Sijde, P. (2021). Science-based entrepreneurship education as a means for university-industry technology transfer. *International Entrepreneurship and Management Journal*, *17* (2), 779-808.

De Jager, H. J., Mthembu, T. Z., Ngowi, A. B., Chipunza, C. (2017). Towards an innovation and entrepreneurship ecosystem: A case study of the central university of technology, free state. *Science, Technology and Society*, *22* (2), 310-331.

Ergün, S. S. (2019). Examining the STEM Awareness and Entrepreneurship Levels of Pre-Service Science Teachers. *Journal of Education and Training Studies*, *7* (3), 142-149.

Etzkowitz, H. (2002). *MIT and the Rise of Entrepreneurial Science*. Routledge.

Etzkowitz, H. (2011). The triple helix: science, technology and the entrepreneurial spirit. *Journal of knowledge-based innovation in China*, *3* (2), 76-90.

Etzkowitz, H., Gulbrandsen, M. (1999). Public entrepreneur: the trajectory of United States science, technology and industrial policy. *Science and Public Policy*, *26* (1), 53-62.

Ezeudu, F. O., Ofoegbu, T. O., Anyaegbunnam, N. J. (2013). Restructuring STM (science, technology, and mathematics) education for entrepreneurship. *Online Submission*, *3* (1), 27-32.

Fayolle, A., Lamine, W., Mian, S., Phan, P. (2021). Effective models of science, technology and engineering entrepreneurship education: current and future research. *The Journal of Technology Transfer*, *46*, 277-287.

Giones, F., Brem, A. (2017). Digital technology entrepreneurship: A definition and research agenda. *Technology innovation management review*, *7* (5), e2984542.

Hameed, I., Khan, M. B., Shahab, A., Hameed, I., Qadeer, F. (2016). Science, technology and innovation through entrepreneurship education in the United Arab Emirates (UAE). *Sustainability*, *8* (12), e1280.

Kuschel, K., Ettl, K., Diaz-Garcia, C., Alsos, GA (2020). Stemming the gender gap in STEM entrepreneurship–insights into women's entrepreneurship in science, technology, engineering and mathematics. *International Entrepreneurship and Management Journal*, *16* (1), 1-15.

Martin, M. J. (1994). *Managing innovation and entrepreneurship in technology-based firms* (Vol. 20). John Wiley & Sons.

ISSN 0120-1190 – eISSN 2619-3353
DOI: https://doi.org/10.19053/01201190.n36.2024.17414

Poggesi, S., Mari, M., De Vita, L., Foss, L. (2020). Women entrepreneurship in STEM fields: literature review and future research avenues. *International Entrepreneurship and Management Journal*, *16* , 17-41.

Shamsuddin, I. M., Arome, A. T., Aminu, I. (2018). Entrepreneurship, science and technology education for self-reliance and economic diversification. *International Journal of Engineering Management*, *2* (1), 1-7.

Sexton, D. L., Smilor, R. W. (1986). The art and science of entrepreneurship. *University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship*.

Wadhwa, V., Freeman, R. B., Rissing, B. A. (2008). Education and tech entrepreneurship. *Available at SSRN 1127248*.

Wright, M., Birley, S., Mosey, S. (2004). Entrepreneurship and university technology transfer. *The Journal of Technology Transfer*, *29* (3-4), 235-246.

Wright, M., Liu, X., Buck, T., Filatotchev, I. (2008). Returnee entrepreneurs, science park location choice and performance: An analysis of high–technology SMEs in China. *Entrepreneurship theory and practice*, *32* (1), 131-155.

ISSN 0120-1190 – eISSN 2619-3353
DOI: https://doi.org/10.19053/01201190.n36.2024.17414