# BIBLIOMETRIC ANALYSIS OF UNIVERSITY-BASED INCUBATION CENTERS IN THE STARTUP ECOSYSTEM

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**Abstract**

Today, with the emergence of digital transformation, the roles of universities have changed. In line with the needs of industrialized society, universities have transformed from research-oriented institutions to institutions that contribute to economic and social development. In the United States, incubators that emerged in the form of "Science Parks" close to universities have evolved continuously and are in direct relationship with startups and universities. The development and success of startups, which have started to play an important role in the economic development of countries, are associated with universities and incubation centers. In the literature, university-based incubators are frequently examined in the context of digital transformation, especially in relation to startups and universities. It was decided to use the Bibliometric Research Method to predict the developments in the literature on the concept of university-based incubators and the topics that may be linked in the future in order to find out how it shows a trend and trend in the literature in all categories. In this context, the concept of "University Based Incubation Center" was searched in the Web of Science (WOS) database between 2000 and 2024, including March 27, 2024. The distribution of publications on the concept of university-based incubation center in WOS between 2000-2024 was determined according to the categories of publications and the distribution of publications on university-based incubation center was determined.

**Keywords:** University based incubators, university, startup.

**Jel Classification:** L26

# STARTUP EKOSİSTEMİNDEKİ ÜNİVERSİTE TEMELLİ KULUÇKA MERKEZLERİNİN BİBLİYOMETRİK ANALİZİ

**Özet**

Günümüzde dijital dönüşümün ortaya çıkmasıyla birlikte üniversitelerin rolleri de değişmiştir. Sanayileşmiş toplumun ihtiyaçları doğrultusunda üniversiteler araştırma odaklı kurumlardan ekonomik ve sosyal kalkınmaya katkı sağlayan kurumlara dönüşmüştür. Amerika Birleşik Devletleri'nde üniversitelere yakın "Bilim Parkları" şeklinde ortaya çıkan kuluçka merkezleri sürekli gelişerek startuplar ve üniversiteler ile doğrudan ilişki içerisine girmiştir. Ülkelerin ekonomik kalkınmasında önemli bir rol oynamaya başlayan startupların gelişimi ve başarısı üniversiteler ve kuluçka merkezleri ile ilişkilendirilmektedir. Literatürde üniversite tabanlı kuluçka merkezleri dijital dönüşüm bağlamında özellikle startuplar ve üniversiteler ile ilişkili olarak sıklıkla incelenmektedir. Üniversite tabanlı kuluçka merkezleri kavramına ilişkin literatürdeki gelişmeleri ve gelecekte ilişkilendirilebilecek konuları tahmin etmek, tüm kategorilerdeki literatürde nasıl bir eğilim ve trend gösterdiğini tespit etmek amacıyla Bibliyometrik Araştırma Yöntemi'nin kullanılmasına karar verilmiştir. Bu kapsamda "Üniversite Tabanlı Kuluçka Merkezi" kavramı Web of Science (WOS) veri tabanında 27 Mart 2024 tarihi de dâhil olmak üzere 2000-2024 yılları arasında taranmıştır. WOS'ta 2000-2024 yılları arasında üniversite tabanlı kuluçka merkezi kavramı üzerine yapılan yayınların kategorilere göre dağılımı belirlenerek üniversite tabanlı kuluçka merkezi üzerine yapılan yayınların dağılımı belirlenmiştir.

**Anahtar Kelimeler:** Üniversite temelli kuluçka merkezi, üniversite, startup.

**Jel Kodları:** L26

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## 1. INTRODUCTION

In parallel with the advancement of technology worldwide, the expectations of individuals have changed, leading to changes in the economic and social structures of countries. The development of countries' economies and social structures is possible through the widespread promotion of entrepreneurial activities. As Romer (1986) and Lucas (1988) have noted, entrepreneurial activity contributes to economic growth as a catalyst for disseminating knowledge, increasing competition, and bringing diversity to the economy.

Entrepreneurship, a concept as ancient as human history itself, has undergone various stages over the millennia in response to the needs and expectations of people from ancient times to the present. In the early 18th century, Richard Cantillon, who first introduced entrepreneurship in economic literature, defined an entrepreneur as someone who buys and sells goods or services for a price, encompassing both the inputs and outputs of production (Tosunoğlu, 2003: 4-5). John Baptiste Say, in classical economics, extensively addressed the concept of entrepreneurship, arguing that economic development is directly proportional to entrepreneurial activity (Peneder, 2009; 80). Austrian economist Joseph Schumpeter, meanwhile, reinterpreted entrepreneurship, laying the groundwork for the idea that remains relevant today (Çetindamar, 2002: 35). In the contemporary context, entrepreneurship is not solely about creating something new, but also about fostering innovation by reshaping existing paradigms or adopting approaches that enable transformation (Fossatti, 2021: 3). In this context, entrepreneurs can consider a broader range of social and environmental values, beyond purely financial goals that dominate linear logic, by taking into account the impacts on nature and other stakeholders (Anand, 2021).

At the beginning of the 21st century, the world entered a period of rapid change, during which all concepts began to be affected and shaped. In this process, entrepreneurship diversified into subcategories, and the desires and expectations of entrepreneurs also evolved. Now, beyond just having an innovative idea, the creative commercialization of that idea and its subsequent sustainable scalability have become increasingly important. Especially in this period, the role of universities has begun to be seen as a significant source of economic growth in the innovative context, providing knowledge (technology). In line with this, universities have adopted the definition of entrepreneurial universities, contributing to economic impacts through the creation, attraction, and retention of talented human capital and entrepreneurs (Bramwell & Wolfe, 2008).

Just as noted by Clearly (2002), universities now play a role that goes beyond the narrow economic and technical approach shaped by intermediary units such as technology transfer and regional development offices, spin-off companies, and science parks. Universities, research institutes, industry, and government increasingly recognize the importance of collaboration in science and technology to

promote sustainable industrial, economic, and social development. Particularly, education and innovation in engineering, science, and technology play a crucial role in bridging the gap between developed and developing countries (Lalkaka, 2005: 2) Universities have increasingly expanded their roles beyond traditional teaching and research, promoting local development through innovative activities that generate economic, social, and cultural value (Thomas et al., 2021).

In line with this, incubation centers, which initially undertook the task of providing entrepreneurs with central infrastructure and office spaces in their early years, have expanded the scope of services they offer to entrepreneurs over the years. Nowadays, incubation centers are seen as a contemporary business model worldwide, facilitating the commercialization of ideas, the growth of ventures, and the development of their respective regions through their evolving financial structures (Lalkaka, 2001: 6). This change is viewed as a leveraged effect in fostering the commercialization of entrepreneurs' ideas, the expansion of ventures, and the development of the region they are located in (Suk & Mooweon, 2006: 30).

The concept of university-based incubation centers is a multidimensional collaborative effort, thus making it a subject of interdisciplinary studies from various fields. Therefore, there is a need for comprehensive studies that synthesize the findings of previous research. For this reason, bibliometric measurement technique is preferred in this study.

The concept of entrepreneurship has become a determining factor for the socio-economic development of modern societies. Progress is now measured by the prevalence and effectiveness of entrepreneurial activities within a society. As entrepreneurial activities become increasingly critical worldwide, the stages preceding the commercialization of an idea are of vital importance for the long-term success of entrepreneurship. In this context, university-based incubation centers, which focus on developing the entrepreneurship ecosystem, emerge as significant elements that not only contribute to the generation of new knowledge and human capital but also support the entrepreneurial spirit (Özdoğan, 2016).

This study conducts a systematic literature review focusing on university-based incubation centers (UBIs), utilizing bibliometric analysis of 165 studies identified in the Web of Science. The review aims to provide a comprehensive overview of the past, present, and future of UBIs, while also offering a framework that encompasses the theoretical foundations of this field.

The literature predominantly examines UBIs through the lens of their benefits, such as access to university knowledge and resources, entrepreneurship training, and mentorship support (Audretsch, 2014; Çetindamar, 2002). This aligns with theoretical frameworks emphasizing UBIs' role as a "bridge" within the entrepreneurial ecosystem and highlighting their position in the "triple helix" model of

innovation (Etzkowitz & Leydesdorff, 2000).

However, this dominant perspective often overlooks potential drawbacks and criticisms of UBIs. Some research suggests that their focus on commercialization may marginalize alternative models like social entrepreneurship (Nicholls, 2010) or detract from universities' core missions of teaching and research (Pappas, 1997). Additionally, concerns have been raised about UBIs potentially threatening academic freedom and autonomy (Slaughter & Leslie, 1997).

This study aims to provide a broader, more critical perspective by comparing different theoretical perspectives on UBIs (e.g., resource dependence theory, network theory, institutional theory) and the critiques they raise. By highlighting both positive and potentially problematic aspects, this research seeks to shed light on the future development of UBIs.

This study contributes significantly to the understanding of UBIs in the modern world, offering valuable insights into how startups can survive and thrive, and how these centers can actively contribute to their development. The insights gleaned from this study are invaluable not only for scholars seeking to advance academic discourse but also for practitioners in the business world, guiding both academia and industry towards a more informed, efficient, and startup-focused future.

A key finding of this study is the identification of UBIs as a crucial bridge in the context of digital transformation and as a means to better understand the complex landscape of startups. From this perspective, UBIs emerge as significant tools in the development of entrepreneurship, revealing nuanced aspects that may be overlooked in the broader startup ecosystem.

Using bibliometric research methodology, this study analyzes developments in the literature related to UBIs, identifying trends and potential future research topics. This approach allows for a comprehensive and systematic examination of the rapidly evolving field of UBI research, synthesizing existing knowledge, identifying gaps, and suggesting future research directions as the startup ecosystem continues to evolve.

The bibliometric characteristics of articles published on university-based incubation centers in the Web of Science (WoS) database are examined. In this regard, the following research questions are addressed:

**RQ1:** How has the trend of studies and citations on university-based incubation centers evolved over time?
**RQ2:** In which fields are studies on university-based incubation centers conducted?
**RQ3:** Who are the authors with high relationship strength in studies on university-based incubation

centers?

**RQ4:** What are the most researched keywords in studies on university-based incubation centers?

## 2. UNIVERSITY-BASED INCUBATION CENTERS

Global and dynamic competitiveness has emerged as a revival of the higher education system, alongside the superiority of human resources, high standards of quality research, creativity, innovation, and entrepreneurship, coupled with cost and productivity efficiency (Mok, 2005: 540). Building upon this, universities have undergone profound changes to adapt to the new developments worldwide, becoming significant instruments of economic development in the knowledge-based economy (Wissema, 2014: 1). Universities, which were once solely focused on knowledge production (Bruneel et al., 2010: 860), have now shifted their focus to new missions aimed at societal development and economic growth (Schulte, 2004: 187). In this regard, Audretsch (2014), evaluating the shift of universities towards a more facilitating and entrepreneurially encouraging direction, also underscores their significant role as institutions that produce and disseminate knowledge (Kirby, 2005: 561).

Over the past few decades, universities have undergone a transformation in their core activities to structure entrepreneurial ecosystems with the aim of providing multiple employability alternatives such as self-employment, academic entrepreneurship, or entrepreneurially-minded employees (Audretsch, 2014: 315). In this regard, universities have emerged with the entrepreneurial university model as part of the economic and social development process, in addition to their traditional education and research activities (ArroyoVazquez et al., 2010: 65).

In this context, an entrepreneurial university is defined as a university that simultaneously performs three core activities: teaching, research, and entrepreneurship, while also providing an adequate educational environment (Guerrero & Urbano, 2012: 57). Since the recognition of the "Batavia Industrial Center," founded by Joseph Mancuso in Batavia, New York, in 1959, as the world's first business incubator (Albert & Gaynor, 2000: 7), incubators worldwide have become widespread, adopting different names and practices for various purposes (Aernoudt, 2004: 128). Especially since the 1980s, incubators have undergone several stages of evolution, leading to their classification into first-generation incubators, university-based incubation centers second-generation incubators, third-generation incubators, and fourth-generation incubators (Soy, 2015).

Incubators, which emerge as structures aiming to accelerate the development of new entrepreneurs and subsequently enable them to stand on their own feet (Özdoğan, 2016: 116), are generally defined as facilities that provide shared office working spaces to entrepreneurs and offer strategic and value-added monitoring and business consultancy (Hackett & Dilts, 2004: 58). According to Pappas (1997), who

defines incubators as a dynamic process aimed at nurturing and supporting emerging commercial enterprises or individuals, they are structures that help young firms survive and grow during their most vulnerable initial period, when they are most susceptible to failure. These structures nurture young firms to help them weather the challenges of infancy and thrive. With a network comprising individuals and organizations such as university communities and industry connections, which are professional service providers (Hackett & Dilts, 2004: 57), incubators facilitate the development of supportive systems and provide conducive conditions for enterprises to successfully survive (Lumpkin & Ireland, 1988: 60).

Since the 1980s, with the impact of globalization, universities' traditional roles of fulfilling research and education functions have undergone a transformation, evolving into centers for supporting innovation and enhancing economic development through knowledge transfer (Youtie & Shapira, 2008: 1189). Among the various types of support, university-based incubation centers have gained prominence (Grimaldi & Grandi, 2005: 114), assuming a role in supporting the development of research and technology-based firms established within or around university campuses. In this regard, university-based incubation centers established institutions embraced by governments, support and nurture spin-offs and small to medium-sized enterprises during their development and growth stages, contributing to the economy (Studdard, 2006: 77). Many incubators worldwide receive support from universities. Particularly, university-based incubation centers, which have become an increasingly prevalent trend in the development of incubators, offer more extensive support to entrepreneurs compared to other incubator programs (Culkin, 2013: 637). University-based incubation centers, not limited to serving entrepreneurs alone, possess robust infrastructure in terms of human expertise, financial resources, and strategic locations, enhancing innovation and commercialization (Chandra et al., 2012).

## 3. METHODOLOGY

The bibliometric analysis method was preferred in this study due to its ability to evaluate the structure and dynamics of the research field at a macro level. Data obtained from bibliometric analysis were subjected to various analysis techniques using the VOSviewer 1.6.16 software.

When selecting the database for the study, criteria such as the number of journals containing articles on university-based incubation centers, ease of access to the database, availability of data download in a file format compatible with bibliometric analysis software packages, and the ability to provide desired filtering to answer research questions were considered. Based on these criteria, the Web of Science (WoS) database was chosen (Gürler, 2022).

Within the scope of bibliometric analysis, citation analysis, co-citation analysis, bibliometric coupling, and co-occurrence analysis were conducted. No filtering was applied between categories to determine

trends and tendencies in the literature on University-Based Incubation Centers in WoS. Taking all categories into account, it was observed that a total of 165 publications were made between 2000 and 2024 as of March 27, 2024.

The evaluation of publications on university-based incubation centers obtained from WoS was conducted using bibliometric analysis methods. Publication information obtained from WoS was analyzed using bibliometric analysis techniques, including citation analysis, co-citation analysis, bibliometric coupling, and co-occurrence analysis.

In order to observe the literature on university-based incubation centers in the study, a search was first conducted based on keywords, subjects, titles, and abstracts. As seen in Figure 2 (a) and (b), it was determined that the concept was studied in 165 publications across different disciplines.

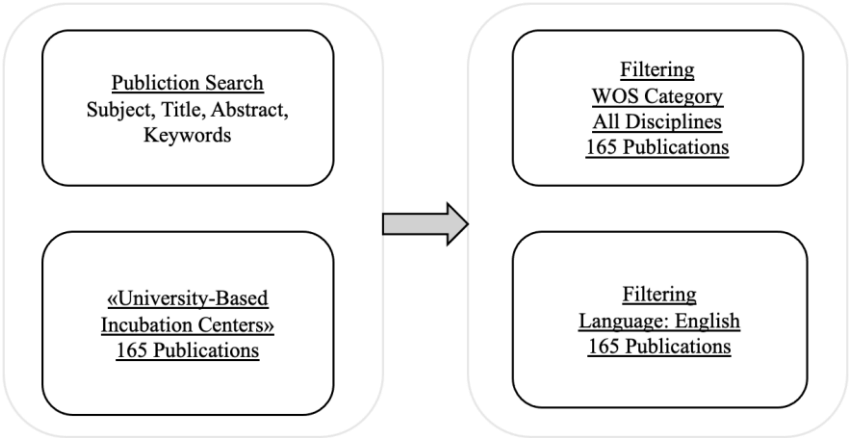


**Figure 1.** Research Flow Diagram

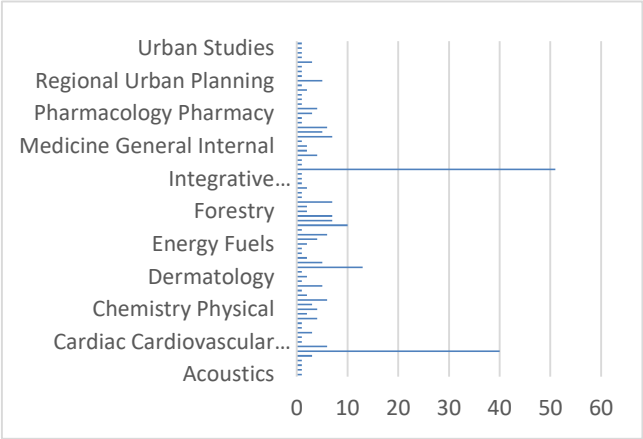


**Figure 2 (a).** Categorical Distribution of Publications in University-Based Incubation Centers Literature

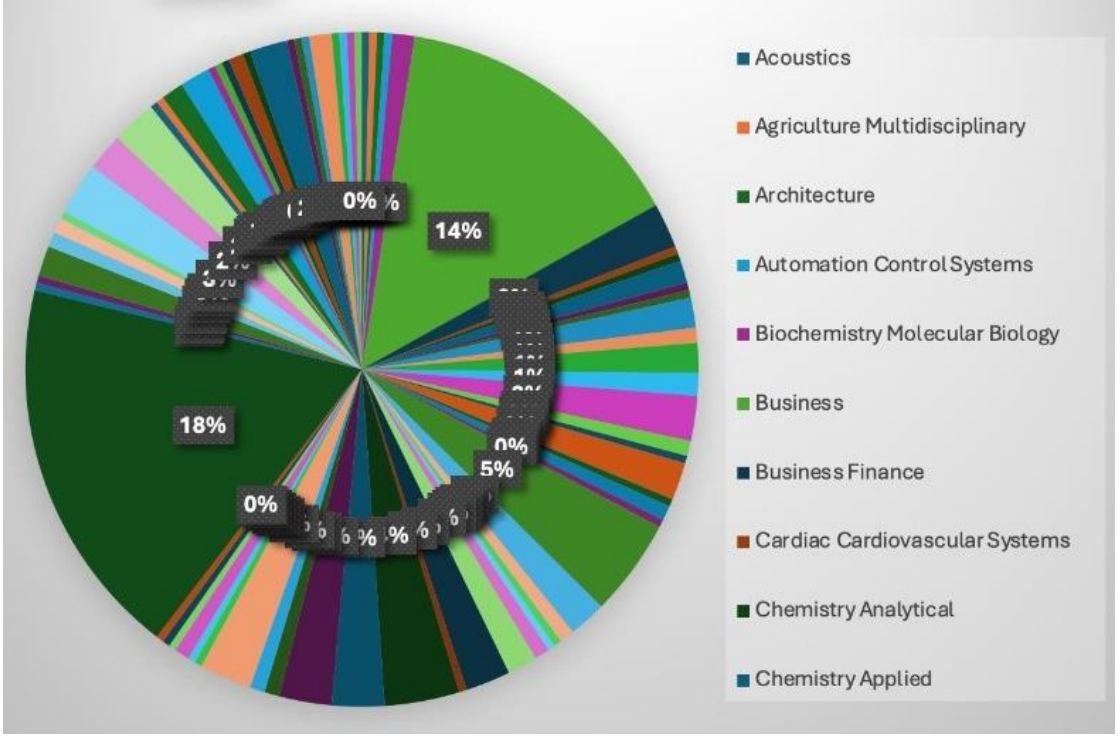


**Figure 2 (b).** Categorical (%) Distribution of Publications in University-Based Incubation Centers Literature

Figure 2 (a) and (b) indicate that university-based incubation center is an evolving concept in various disciplines, including business, business finance, and industrial engineering. However, to understand how the concept has evolved across all disciplines, no narrowing down has been applied to the categories. In this context, to observe the development trend of literature on university-based incubation centers across all disciplines, the study utilizes VOSviewer 1.6.16 software to conduct bibliometric analysis methods such as citation analysis, co-citation analysis, and co-occurrence analysis, and the findings of the research are presented.

### 3.1. Findings Related to the Research (RQ1, RQ2)

In the Web of Science (WOS) database, publications related to "University-Based Incubation Centers" are observed. Filtering was not applied to see how the concept of university-based incubation center is trending in the literature across all categories in WOS. As a result, 134 articles, 24 proceeding papers, 8 reviews, and 4 early access studies on University-Based Incubation Center were identified, totaling 170 studies. The distribution of these studies in WOS is shown in Figure 3.


**Figure 3.** Distribution of Publications Related to University-Based Incubation Centers

During the querying stage of the University-Based Incubation Centers studies in WOS, it is observed that there are 170 publications related to the field of university-based incubation centers across all categories. Since all categories were considered in the study, disciplines ranging from water resources to ecology and multidisciplinary science were included. It is noted that 51 studies focusing on university-based incubation center in the fields of management, leadership, strategic management, human resources management, operations management, marketing management, financial management, information technology management, and entrepreneurship were published in the "Management" journal. Additionally, 6 studies focusing on university-based incubation centers in the field of computer science and information systems were published in the "Computer Science Information System" journal.

The "Computer Science Information System" journal primarily focuses on technology-oriented topics such as Data Mining, Data Analytics, Artificial Intelligence, and Machine Learning. However, in recent years, the contributions of universities to entrepreneurship and technology have also become notable. The increasing importance of university-based incubation centers has led to diversification in research in this field. Nowadays, it has become inevitable for universities to focus on commercializing technology-based ideas through collaboration with the business world. Therefore, leveraging the experiences and knowledge accumulated by universities in this area is crucial.

As shown in Figure 3, it is evident that publications in the management and business fields largely dominate the relevant literature. To observe the trend of publications over the years, Table 1 presents the data obtained from WoS. Compared to journals covering other topics, the publication rate of the "Computer Science Information System" journal in this field is relatively low, yet promising.

To understand the trend of studies related to University-Based Incubation Centers, the distribution of citation numbers over the years is depicted in Figure 4.

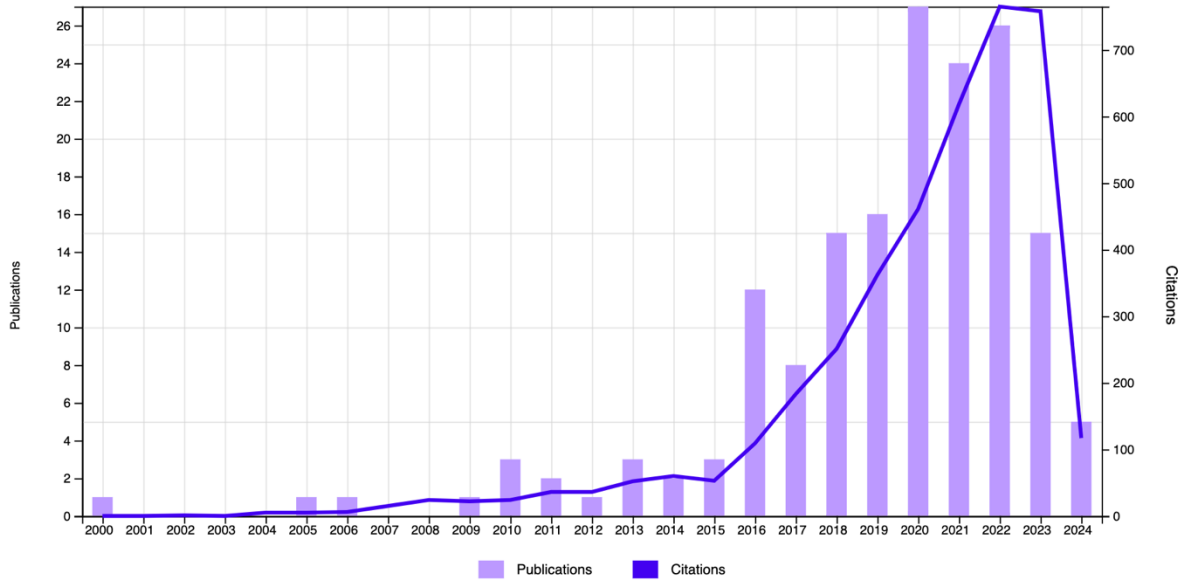


**Figure 4.** Citation Distribution for Studies on University-Based Incubation Centers

**Reference:** (Web of Science (WOS), March 29, 2024).

https://a8f59890210bb2a36cc265c34c80a801c14e01d5.vetisonline.com/wos/woscc/citation-report/fa2722c3-07ec-4a89-8540-d58053236013-da692e42?page=1&sort=sort-group-background-citingcount

Figure 4 provides the citation distribution of publications related to university-based incubation centers in WOS over the years across all disciplines. When examining the citation and publication distribution between 2000 and 2024, it is observed that there was a noticeable increase in both publications and citations, particularly starting from 2009. However, while there is an increase in citations between 2016, 2020, 2021, and 2022, it is noteworthy that there is not a significant increase in the number of publications during the same period. Especially, the dramatic increase in citations in 2022 and the reasons behind the increase in citations between 2020 and 2022, which follow a similar growth rate in publications, need to be further investigated through co-citation analyses to understand the reasons behind these trends.

### 3.1.1. Findings on citation analysis and co-citation networks (RQ3)

Breaks in publication and citation increases between 2019 and 2022 regarding university-based incubation centers are highlighted in Figure 2. In order to identify publications that could cause these breaks, Table 1 provides information on authors, publications, and citations.

**Table 1.** Distribution of Publications and Citations on University-Based Incubation Centers

Between 2020-2024 Years

| Authors | Publication | Citations | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | 2020 | 2021 | 2022 | 2023 | 2024 | |
| Markman, GD; Phan, PH; (…); Gianiodis, PT (2005) | Entrepreneurship and university-based technology transfer | 26 | 24 | 13 | 22 | 77 | 347 |
| Kohler,T (2016) | Corporate accelerators: Building bridges between corporations and startups | 28 | 29 | 28 | 28 | 5 | 165 |
| Spender, JC; Corvello, V; (…); Rippa, P (2017) | Startups and open innovation: a review of the literature | 28 | 24 | 27 | 41 | 6 | 161 |
| Phan, PH and Siegel, DS (2006) | The Effectiveness of University Technology Transfer | 18 | 18 | 4 | 5 | 3 | 148 |
| Cohen, S; Fehder, DC; (…); Murray, F (2019) | The design of startup accelerators | 11 | 32 | 50 | 36 | 11 | 141 |
| van Weele, M; van Rijnsoever, FJ and Nauta, F (2017) | You can't always get what you want: How entrepreneur's perceived resource needs affect the incubator's assertiveness | 15 | 11 | 22 | 9 | 1 | 78 |
| van Rijnsoever, FJ (2020) | Meeting, mating, and intermediating: How incubators can overcome weak network problems in entrepreneurial ecosystems | 12 | 17 | 22 | 20 | 2 | 73 |
| Di Pietro, F; Prencipe, A and Majchrzak, A (2018) | Crowd Equity Investors: AN UNDERUTILIZED ASSET FOR OPEN INNOVATION IN STARTUPS | 12 | 16 | 14 | 11 | 3 | 65 |
| Stayton, J and Mangematin, V (2019) | Seed accelerators and the speed of new venture creation | 10 | 9 | 18 | 12 | 1 | 51 |
| Sansone, G; Andreotti, P; (…); Landoni, P (2020) | Are social incubators different from other incubators? Evidence from Italy | 5 | 13 | 14 | 18 | 0 | 50 |
| Surana, K; Singh, A and Sagar, AD (2020) | Strengthening science, technology, and innovation-based incubators to help achieve Sustainable Development Goals: Lessons from India | 2 | 7 | 16 | 21 | 3 | 49 |
| Yin, BQ and Luo, JX (2018) | How Do Accelerators Select Startups? Shifting Decision Criteria Across Stages | 4 | 7 | 20 | 6 | 3 | 40 |

As seen in Table 1, the studies with the highest citations in the relevant field are respectively Markman (2005), Kohler (2016), and Spender (2017). This observation is further supported by Figure 5, which presents the publications citing university-based incubation centers between 2018 and 2024.

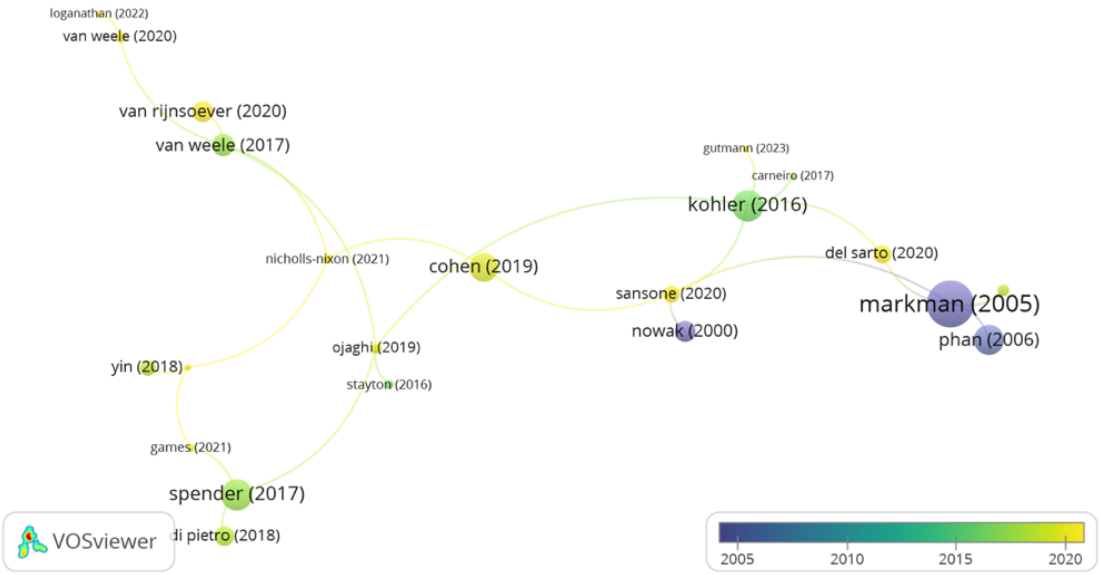

**Figure 5.** Bibliometric Matching of Studies on University-Based Incubation Centers in the Entrepreneurship Ecosystem

In Figure 5, references to other studies related to Markman (2005), Kohler (2016), and Spender (2017) are provided. The main reason for universities to act as an economic driving force in the development of startups and the commercialization of ideas is highlighted. Clark (2001) defines universities as institutions with unique genetic characteristics and developmental trajectories predicted by their general tendencies and social commitments. Rosan (2006) expresses universities as indispensable elements in increasing knowledge levels within society and raising living standards by stimulating increased production of goods and services as a result of economic development. Consequently, with the transformation and change experienced across all sectors of society starting from the Industrial Revolution, the role of universities has expanded. It directly influences the success of startups when universities, acknowledged as technology providers (Guerrero and Urbano, 2012), effectively transfer technology to entrepreneurs. In this context, it can be considered that Markman (2005) extensively addresses the reasons underlying the success of university-based incubation centers and technology parks, while Kohler (2016) discusses corporate innovation to reshape the business models of startups, focusing on internal innovation to enable companies to capture agility by shedding inertia over time. Additionally, Spender (2017) is presumed to examine the role of startups in open innovation processes and conduct a literature review in this area.

### 3.1.2. Findings regarding co-occurrence analysis and co-occurrence networks (RQ4)

Detection of focal points in studies related to university-based incubation centers can be observed through citation and publication analyses. Figure 6 displays the clusters of studies obtained from the co-occurrence analysis of all 165 studies on university-based incubation centers in various categories in WOS.

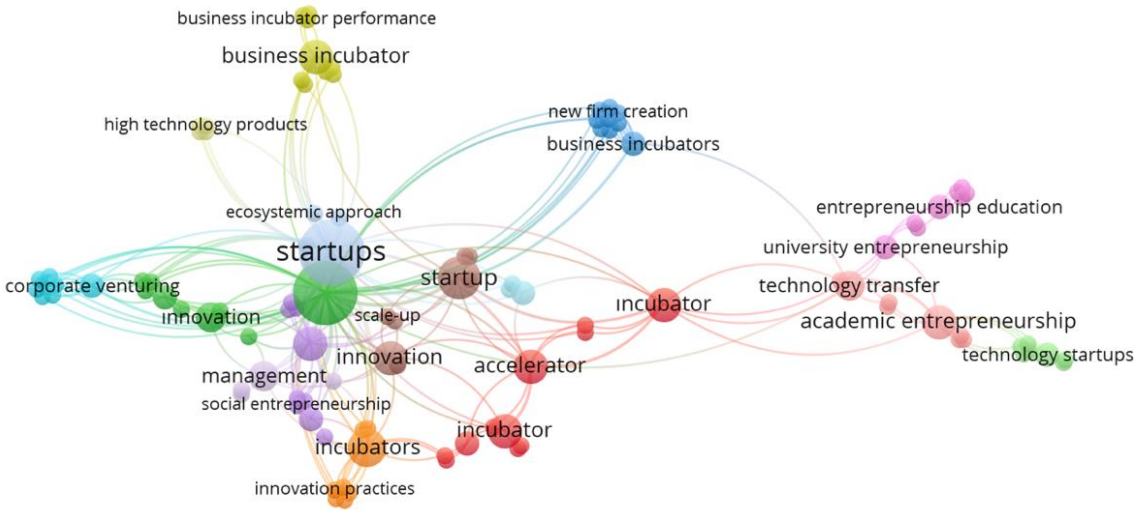


**Figure 6.** Co-occurrence Analysis of University-Based Incubation Centers

As indicated in Figure 6, the focal points of the studies related to university-based incubation centers include entrepreneurship, startups, business incubator, and new firm creation concepts. According to the co-occurrence analysis of publications in WOS, although an attempt was made to create a study cluster related to the concept, the concepts within each color scale have not been clustered due to their interaction with the concepts in the other color scales and their interchangeable nature, but evaluated based on colors. In this context, 5 color scales stand out in Figure 6.

As depicted in Figure 6, the red color scale, focusing on accelerating the commercialization and scaling of an idea; the blue cluster scale, focusing on the interaction of corporate entrepreneurship with internal company performance; the purple cluster scale, similar to the purple cluster, focusing on incubation centers, incubation center management, and incubation center strategy, preparing the ground for the development and growth of ventures; the yellow cluster scale, focusing on the impact and performance of the incubation center, and successfully commercializing the processes of an idea; the green cluster scale, focusing on innovations and the role of accelerators in ventures, by centralizing ventures that have reached a certain stage, stands out.

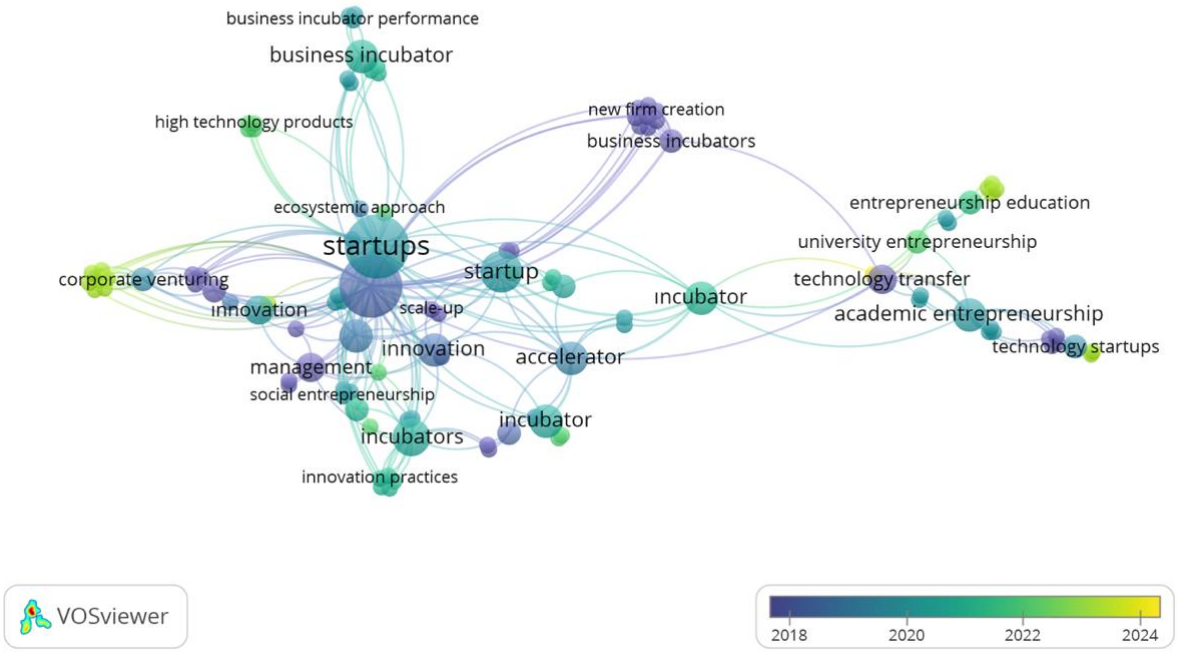


**Figure 7.** Co-Occurrence Analysis of University-Based Incubation Centers

As shown in Figure 7, a visual representation of co-occurrence analysis of publications related to university-based incubation centers in the Web of Science (WOS) is presented. This analysis is based on the high-scoring studies in terms of citation, interconnectedness, and bibliographic similarity. The evaluation encompasses the concepts found in WOS publications between 2018 and 2024. In 2018, publications associated with entrepreneurship, firm growth, management, technology transfer, scale-up, and business incubators are prevalent. Towards the end of 2018 and the beginning of 2020, there is a focus on startups, incubators, business incubator, and business incubator performance. In 2022, the interaction between startup, incubator, accelerator, and academic entrepreneurship is emphasized. From late 2022 to the present, the literature predominantly explores the relationship between entrepreneurship and startups, with a focus on university-based incubation centers, entrepreneurship education, and ventures. To better understand the distinct patterns in these developments, a point-by-point evaluation based on years regarding university-based incubation centers could be beneficial. In other words, analyzing the networks individually through co-occurrence analyses, as depicted in Figure 8 (a), (b), and (c), would be necessary.

As emphasized in Figure 7 and Figure 8, the literature intersecting startups, incubators, and accelerators in 2020 indicates a structuring focus. Particularly within the entrepreneurship ecosystem, there is a noticeable academic interest in entities such as incubators, accelerators, and venture capital that play

significant roles in the realization of ideas. These concepts are regarded as facilitating entrepreneurship processes and contributing to the successful survival of ventures.

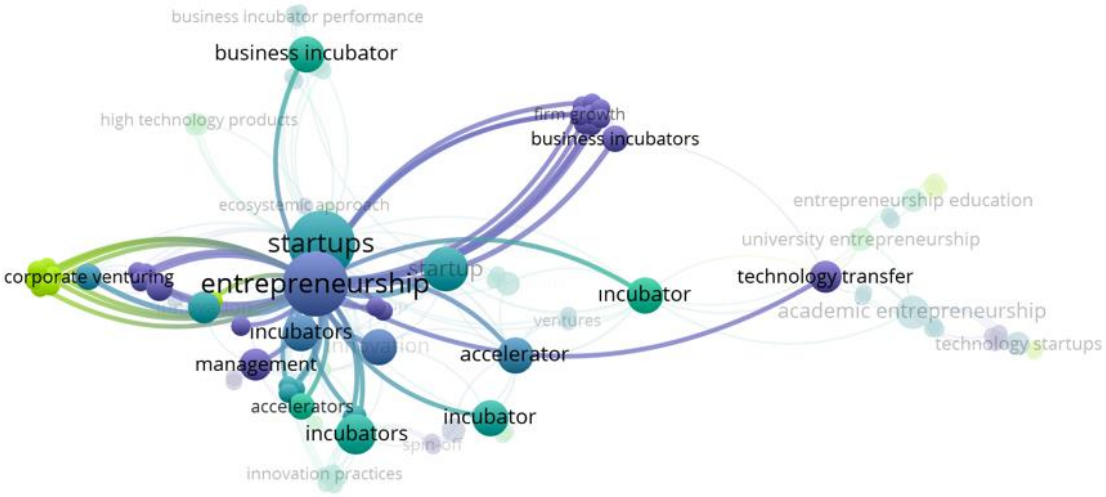


**Figure 8 (a).** Co-Occurrence Analysis of Entrepreneurship-Oriented Studies

In Figure 8a, it can be observed that the concepts of business incubator, incubators, and technology transfer intersect within the entrepreneurship domain. Additionally, concepts such as firm growth and management, which are associated with entrepreneurship, are also within the entrepreneurship cluster but appear to be at a greater distance.

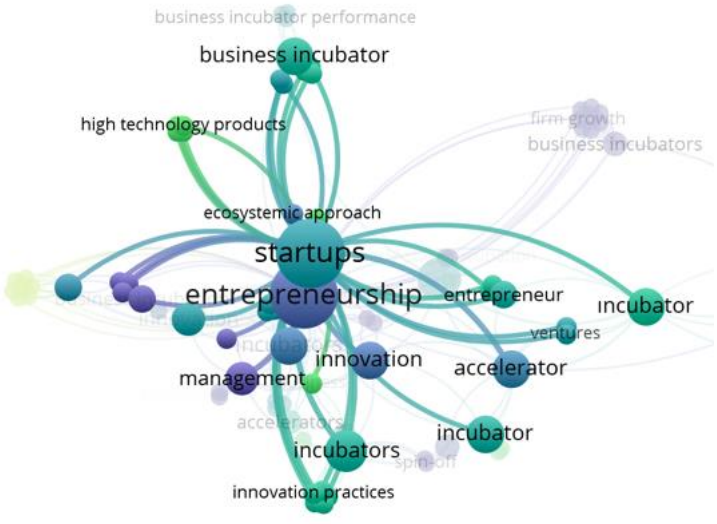


**Figure 8 (b).** Co-Occurrence Analysis of Startups and Business Incubator Oriented Studies

In Figure 8b, startups are positioned at the center of the cluster, with the intersecting concepts of incubators and business incubator, which play a crucial role in the development of startups. It can be observed that the concepts presented here are interrelated with each other.

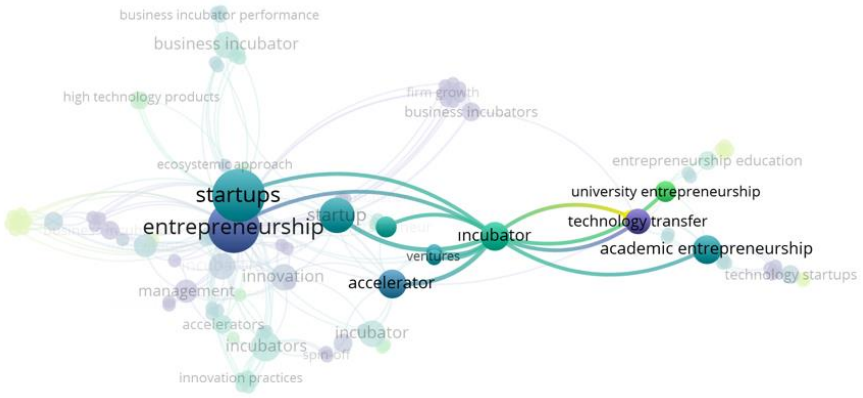


**Figure 8 (c).** Co-Occurrence Analysis of Incubator-Oriented Studies

In Figure 8c, it is observed that at the intersection of the entrepreneurship and startup clusters, the center is occupied by the concept of incubator, and the incubator concept is equally related to both startups and entrepreneurship, as well as university-based incubation centers and technology transfer, indicating mutual reinforcement among these concepts.

To observe the distribution of publications contributing to conceptual linkages in the literature of university-based incubation centers at the country level, Figure 9 presents a co-occurrence analysis of countries related to university-based incubation centers.

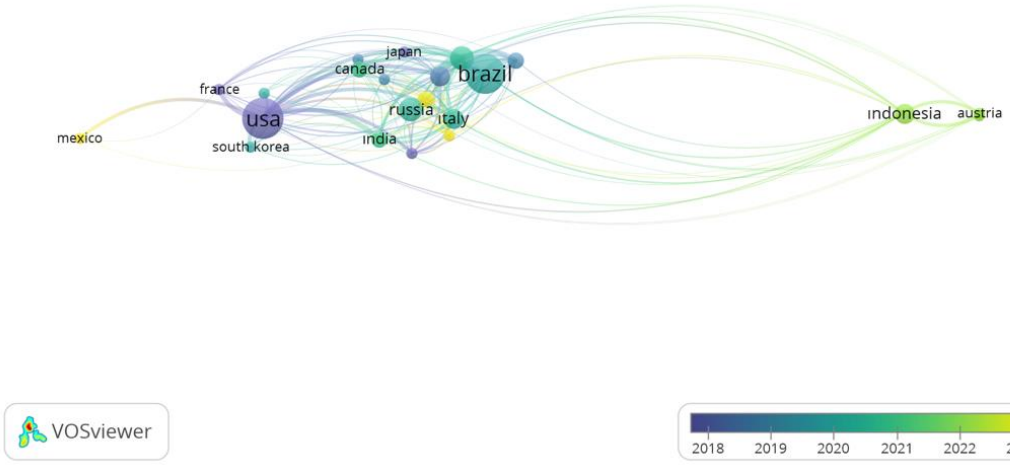


**Figure 9.** Co-occurrence Analysis of Countries Related to University-Based Incubation Centers

In recent years, there has been a notable increase in academic interest in university-based incubation centers. Particularly in 2020, 2021, and 2022, this increase has become more pronounced compared to previous years, as visually confirmed through various figures and tables. For instance, while publications in 2018 primarily originated from countries with advanced capital markets such as the United States, Japan, France, and Singapore, from 2020 onwards, these publications shifted towards emerging economies like Brazil, Italy, Spain, and Russia. Contributions from countries such as Austria, Indonesia, and Saudi Arabia were observed between 2022 and 2024, indicating a dynamic shift influenced by dynamic business environments and opportunities presented by developing economies.

The literature on university-based incubation centers is extensively documented in major databases such as Web of Science (WOS), focusing on publications in management and business disciplines. Bibliometric studies have deeply analyzed the publication history and academic impact of these centers, presenting collaboration networks and citation data. The results of these studies emphasize the scientific significance and impact of university-based incubation centers. For example, pioneering work by Markman (2005) extensively describes the success factors of these centers and the new opportunities they offer for entrepreneurs.

Developing economies offer increased opportunities for new ventures and innovation, attracting entrepreneurs and investors alike. University-based incubation centers have become a crucial part of this ecosystem by providing entrepreneurs access to necessary resources and support.

Dynamic and evolving business environments tend to be more receptive to innovation and new ideas, thereby increasing interest in the programs and services offered by university-based incubation centers. Advanced capital markets facilitate easier access to finance for ventures, contributing to the development of entrepreneurship. University-based incubation centers can facilitate this process by connecting entrepreneurs with investors.

Publications on university-based incubation centers encompass a wide range of disciplines in management journals. This interdisciplinary approach helps us understand their operations and evaluate their socio-economic impacts. Literature covers various disciplines such as management, leadership, strategic management, human resources management, operations management, marketing management, financial management, information technology management, and entrepreneurship, addressing contributions of these centers.

However, there are significant gaps in research on university-based incubation centers that need attention. Particularly, there is a need for comparative analyses of these centers across different countries and investigations into their long-term impacts. Additionally, more qualitative research is needed on the

internal operations of university-based incubation centers and their effects on entrepreneurs. Research on the long-term effects and sustainability of university-based incubation centers is also necessary. Furthermore, the potential disadvantages and limitations of these centers should be critically examined.

In conclusion, university-based incubation centers emerge as significant tools for promoting entrepreneurship and fostering innovation. The increasing interest in these centers in recent years underscores the need for further development in research and practices in this field.

Future research can offer new perspectives by conducting more in-depth studies on how these centers operate in different geographical contexts, their impact on developing economies, and their long-term sustainability. Additionally, critical examination of the potential disadvantages and limitations of these centers is essential.
Moreover, to observe developments in the university-based incubation center literature, a bibliometric study was conducted using publications in the fields of management and business available in WOS, focusing on collaboration networks and citation analyses. Evaluations of research findings will be discussed in detail in the conclusion section.

## 4. CONCLUSION

University-based incubation centers present an important conceptual framework at the intersection of entrepreneurship, accelerators, and incubators. In our study, a bibliometric analysis was conducted based on 165 publications across all disciplines in the Web of Science database. The limitation of this study lies in its reliance on publications up to March 2024, with limited data available for 2024. The analysis of relevant studies reveals an increasing interest in the concept of university-based incubation centers between 2020 and 2022. These centers play a critical role in the development of the entrepreneurial ecosystem.

The level of economic development of a country is directly proportional to the level of development of its entrepreneurial ecosystem. Particularly, the transition of the United States from an industrial society to an information society, and the rapid spread of this transformation to European countries, has made support structures such as incubation centers necessary for the survival of enterprises, which form the backbone of developed economies. The increasing demand in entrepreneurship and innovation fields has heightened interest in incubation centers that act as bridges from the idea stage to the commercialization stage.

In the late 2010s, rapid technological advancement significantly contributed to the transformation of universities into entrepreneurial universities and underscored the role of university-based incubation

centers. An analysis of publications and citations related to university-based incubation centers across countries shows that in 2018, publications were particularly concentrated in the United States, which aligns with state policies and incentives aimed at developing the entrepreneurial ecosystem. However, between 2020 and 2021, there was a shift towards developing economies where entrepreneurship began to emerge more prominently. Regarding digital entrepreneurship, the distribution of publications and citations across countries indicates a concentration in Germany in 2019, driven by state policies and incentives leading the way in digitalization and technological advancements. However, from 2020 to 2021, there was a transition towards countries that adapted to technological advancements later but encouraged the establishment of entrepreneurship centers and were open to technological investments. A rapidly evolving literature, especially with significant progress in the ecosystem approach from 2018, has been observed. The increasing interest in accelerator-incubator interactions, startup-incubator relationships, and university-based incubation centers between 2018 and 2020 indicates a rapid development of the concept.

In this context, university-based incubation centers in different countries can be examined. For example, in the United States, the Stanford Incubation Center, MIT Entrepreneurship Lab, and Berkeley Entrepreneurship Center stand out. Projects such as Google, which started at Stanford, showcase the impact of these centers. The MIT Entrepreneurship Lab has produced many successful ventures that have secured significant positions in the tech world. The Berkeley Entrepreneurship Center offers extensive support to students and researchers, facilitating the commercialization of innovative ideas.

In Europe, the European Entrepreneurship Center (Brussels), the Cambridge Incubation Center (United Kingdom), and the Munich Entrepreneurship Center (Germany) are prominent. The Brussels center provides robust support to entrepreneurs across the continent. The Cambridge Incubation Center has fostered strong ventures, particularly in biotechnology and information technology. The Munich Entrepreneurship Center enhances Germany's leadership in digitalization and technological advancements. Significant examples are also found in developing economies. The INSEAD Entrepreneurship Center in Singapore serves as a key entrepreneurial hub in Asia, producing globally successful ventures. The Kadir Has University Incubation Center in Turkey supports local and regional entrepreneurs. The Ashoka Incubation Center in India promotes social entrepreneurship, offering innovative solutions to social problems. Successful entrepreneurial stories highlight the tangible contributions of university-based incubation centers. For instance, Google, which began at Stanford University, has grown into one of the largest technology companies globally. Dropbox, emerging from the MIT Entrepreneurship Lab, provides a widely used file storage service worldwide. DeepMind, founded at Cambridge University, achieved significant success after being acquired by Google.

Policy recommendations to enhance the effectiveness of university-based incubation centers are crucial.

Increasing government financial support, strengthening physical and digital infrastructure, and developing mentorship and training programs provided by experienced entrepreneurs and business leaders are key areas for improvement. These recommendations can help incubation centers reach more entrepreneurs and enhance their knowledge and skills. Conducting a comparative analysis of university-based incubation centers across different countries or types can provide valuable insights into their effectiveness. For example, examining the differences and similarities between incubation centers in the United States and Europe can be illuminating. Analyzing the distinctions between incubation centers in developed and developing economies, in terms of government support, infrastructure, and entrepreneurial culture, can help identify effective models and approaches.

Finally, collecting primary data through surveys or interviews with entrepreneurs and managers who use university-based incubation centers can offer valuable insights into their perceptions and effectiveness. Surveys and interviews can enhance the robustness and reliability of your study. These practical examples and recommendations will increase the practical contribution of your study and improve its chances of being published in a peer-reviewed journal.

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