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Research Paper

Exploring trends and topics of startup research over 25 years using bibliometric and topic modelling analysis

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Abstract: This study comprehensively examines startup research over the past 25 years. Analyzing a dataset of 1195 papers from the Web of Science, the paper aims to uncover publication trends, top contributing journals, countries, and common research subjects within the startup research field. Topic modeling is used to identify and categorize major research topics within the startup domain. The analysis reveals a significant increase in research interest in startups, especially over the past decade. This surge is linked to the late twentieth-century internet revolution, which catalyzed entrepreneurial activity and caught the attention of researchers, policymakers, and investors. Topic modeling identified ten major themes in startup research: innovation, startup success, startup ecosystem, economic development, markets, gender, leadership & decision-making, venture capital, and social entrepreneurship. The findings have substantial implications for both theory and practice. For researchers, the identified trends and topics can guide future studies and can contribute to a deeper understanding of the startup world. For practitioners and policymakers, insights into the predominant themes and geographic trends can be fed into strategic decisions and policy formulations aimed at enhancing startup ecosystems and supporting entrepreneurial ventures.

Keywords: topic modelling, bibliometric analysis, startups

1. Introduction

It is common knowledge that entrepreneurs play critical roles in growing the economy. The establishing of startups provides many jobs that can reduce unemployment and enhance the prosperity of many families. The function of entrepreneurs in the well-known process of "creative destruction" or innovation was theoretically revealed more than a century ago by Schumpeter (1912).

Even if there is no specific definition for startups, they are deemed usually organizations in their early stage of establishment, and they often have small employee teams and few resources at their disposal. They are unique in that they experience rapid expansion (Graham, 2012). The primary goal of most of those new businesses is to produce and launch a groundbreaking service or product that will shake up the market. Motivated by a desire to make a difference and armed with what they see as a novel strategy or cutting-edge technology, many startup founders set out to change the world (Luger & Koo, 2005). Startups could be inspired to take the plunge by the prospect of monetary gain and the thrill of striking out on their own to create something from scratch. Technology, healthcare, finance, and retail are just a few of the different sectors where we might find startups. Many startups aim to fill a gap in the market by creating something completely new, but others may seek to improve an existing solution or disrupt an existing industry. Obtaining fund, establishing a consumer base, and creating a profitable business model are the main challenges that startups encounter because of their infancy. Many, however, have gone on to become industry leaders, rewarding their founders, investors, and staff handsomely for their initial investments. In addition to fueling innovation and growth across many different industries and giving aspiring business owners a chance to realize their full potential, startups play an essential role in modern business ecosystems (Kane, 2010).

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Using an enormous database of 1195 papers, this study examines the patterns in startup firm research over the last 25 years using bibliometric analysis and topic modeling. It identifies the most influential articles and journals focused on startup research. It also demonstrates how researchers used diverse techniques to gain a thorough understanding of the factors influencing startups and entrepreneurs, as well as their effects on people's lives. The aim of this paper is to answer these questions: How can published research on startups be categorized? What are the top journals and publication countries in the domain of startup research? What are the top ten startup research topics over the past 25 years?

2. Literature review

Typically characterized by innovation and high growth potential startups have become a significant focus of academic research over the past few decades. The dynamism and unpredictability inherent in startups pose unique challenges and opportunities, making this a rich area for scholarly investigation. This literature review aims to synthesize existing research on startups, and explores key themes such as startup ecosystems, funding, innovation, success and failure, and the role of technology.

The concept of startup ecosystems has garnered substantial attention, which point to the interconnected nature of various stakeholders and resources that influence the success of startups. Isenberg (2010) defines a startup ecosystem as a network of interconnected organizations, including universities, investors, accelerators, incubators, and government agencies, which collectively support and sustain startup ventures. Research indicates that a robust ecosystem can significantly enhance the likelihood of startup success by providing access to essential resources and networks (Stam, 2015).

Feld (2012) highlights the importance of a vibrant entrepreneurial culture within ecosystems, arguing that cultural attitudes towards risk, innovation, and entrepreneurship play a crucial role. Moreover, the presence of mentorship and support networks is critical for fostering entrepreneurial skills and resilience among startup founders (Cohen et al., 2019). In recent years, the emergence of specialized ecosystems, such as fintech hubs and health tech clusters, has further underscored the importance of sector-specific support in driving innovation and growth (Brown & Mason, 2017).

Securing adequate funding is one of the most significant challenges faced by startups. Numerous funding sources have been thoroughly researched, including government grants, angel investors, crowdfunding, and venture capital (VC). Gompers and Lerner (2004) provide a comprehensive overview of the venture capital industry, noting that VCs not only provide capital but also bring valuable expertise and networks to startups. The multistage financing model commonly used by VCs helps mitigate risk by providing funding in phases in line with startups' progress and performance (Sahlman, 2022).

Angel investors, typically high-net-worth individuals, are another critical source of early-stage funding. Research by Wiltbank et al. (2009) suggests that angel investors play a pivotal role in bridging the funding gap between initial seed funding and larger VC rounds. Crowdfunding has developed as a relatively new and expanding method of financing, allowing entrepreneurs to obtain small amounts of money from many different individuals via platforms that can be accessed through websites. Studies show that successful crowdfunding campaigns not only provide capital but also serve as a validation of startups' value proposition and market potential (Mollick, 2014).

Government support, in the form of grants, tax incentives, and incubator programs, has also been critical in promoting startup growth. Lerner (2009) discusses the positive impact of government policies aimed at reducing barriers to entry and providing financial support to high-potential startups.

Innovation is at the heart of most startups driving differentiation and competitive advantage. The concept of disruptive innovation, introduced by Christensen (1997), is particularly relevant to startups, which often challenge established industries with novel products or business models. Research indicates that startups are more agile and willing to take risks compared to established firms, which allowing such startups to pursue innovative ideas more aggressively (Ries, 2011).

The role of technology in enabling and accelerating startup innovation cannot be overstated. Digital technologies, in particular, have lowered the barriers to entry for new

ventures by reducing costs and enabling access to global markets. Platform-based business models and leveraging network effects have been a significant area of interest. Parker et al. (2016) explore how platform-based startups, such as Uber and Airbnb, have disrupted traditional industries by creating ecosystems that connect users and providers directly.

The lean startup methodology, popularized by Ries (2011), emphasizes iterative development, validated learning, and customer feedback as essential components of the innovation process. This approach helps startups rapidly test and refine their ideas, reducing the risk of failure and increasing the chances of achieving product-market fit.

Once a startup achieves initial success, scaling becomes the next critical challenge. Research on growth strategies has identified several key factors that influence the ability of startups to scale effectively. Blank (2013) underscores the importance of a scalable business model that can be replicated and expanded without proportional increases in costs. Startups that successfully scale often have a clear understanding of their core value proposition and target market, allowing them to focus resources on high-impact areas.

Internationalization is another common growth strategy with many startups seeking to expand into global markets to achieve scale. Oviatt and McDougall (1995) and Oviatt et al. (1994) introduce the concept of "born global" firms, which are startups that internationalize rapidly from inception. These firms leverage their innovative capabilities and global networks to compete in international markets from an early stage.

Despite the potential for high growth, startups face numerous challenges and a high risk of failure. Research by Aminova and Marchi (2021) indicates that around 90% of startups fail. Common reasons for failure include lack of market demand, insufficient funding, and poor management decisions (Krishna et al., 2016).

Lack of market demand is sometimes stated as the key cause of startup failure. This underscores the importance of thorough market research and validation during the early stages of product development (Eisenmann, 2021). Insufficient funding can also lead to cash flow problems and inability to sustain operations, highlighting the need for effective financial planning and management (Fraser et al., 2015).

Poor management decisions, including issues related to team dynamics and leadership, are another significant factor in startup failures. Franke et al. (2008) emphasize the importance of a strong, cohesive founding team with complementary skills and a shared vision. Effective leadership and decision-making processes are critical for navigating the uncertainties and challenges inherent in startup ventures.

Startups play an important role in supporting economic growth and innovation. They contribute to job creation, technological advancements, and increased competitiveness in various industries. Audretsch (2007) discusses the positive correlation between entrepreneurial activity and economic development, highlighting how startups can stimulate local economies and create spillover effects that benefit broader society.

Moreover, startups often drive technological progress by bringing new products and services to market, which can lead to increased productivity and efficiency across industries. This innovation can also have significant social impacts, addressing pressing issues such as healthcare, education, and sustainability (Autio et al., 2014).

The rise of social entrepreneurship has further expanded the scope of startups' impact, with many new ventures aiming to address social and environmental challenges while achieving financial sustainability. A study by Mair and Martí (2006) explores the dual mission of social enterprises, which combine business acumen with a commitment to social change.

Public policy and regulation strongly influence the startup ecosystem. Governments around the world have established a variety of policies and efforts to encourage entrepreneurship and innovation. Lerner (2009) highlights the importance of creating a favorable regulatory environment that reduces bureaucratic hurdles and provides incentives for startup formation and growth.

Tax incentives, grants, and subsidies are common tools used by governments to support startups. Additionally, policies that promote access to capital, such as facilitating venture capital and angel investment, are crucial for the development of a vibrant startup ecosystem (Gompers & Lerner, 2010).

Intellectual property (IP) protection is another critical aspect, as it ensures that startups can safeguard their innovations and gain competitive advantage. Research by Hsu and Ziedonis (2013) suggests that robust IP protection is associated with increased innovation and higher levels of venture investment.

Gender and diversity have emerged as important topics in startup research. Studies indicate that diverse teams tend to perform better, bringing a variety of perspectives and ideas that can drive innovation (Page, 2007). However, women and minority entrepreneurs often face significant barriers in accessing funding and resources.

Malmström et al. (2017) discuss gender biases that exist in the venture capital industry, where female entrepreneurs are less likely to receive funding compared to their male counterparts. Initiatives aimed at promoting gender diversity, such as women-focused accelerator programs and investment funds, are essential for leveling the playing field and fostering inclusive growth in the startup ecosystem.

3. Methodology

This research relied on publications' abstracts gathered from the Web of Science data base in mid-March 2024. The retrieval yielded 1195 papers after filtering. We searched for the term (startup* OR start-up*) in publications' topics, titles, keywords, or abstracts. The search phrases ensure that the entire term gets searched rather than just one of the two terms, since many researchers use the word "startups" and some use the word "start-up" in the papers. The following terms were considered in the filtering process. Document type: Article, Proceedings paper, Book chapter, Book. Web of science categories: Business or Management. Language: English. Thus, this research focuses on four categories of publications: journal articles (J), conference proceedings (C), books (B), and book chapters (S). Figure 1 illustrates that most abstracts are from peer-reviewed journal papers, followed by conference proceedings:

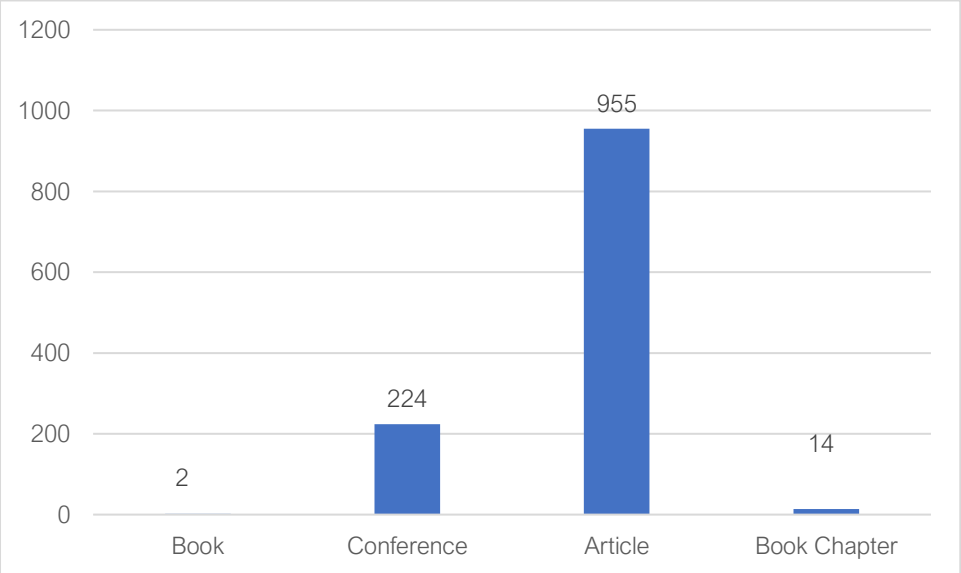

Figure 1. Startups publication types from 2000-2024. *Source: Author's own*

3.1. Method of Analysis

Topic modeling was run using the Machine Learning for Language Toolkit (Mallet) software, while data preparation and bibliometric analytics were done with Microsoft Excel. Mallet is a Java-based program that enables statistical natural language processing, document categorization, clustering, topic modeling, information extraction, and other text-related machine learning applications (Graham et al., 2012). On other hand, a bibliometric study uses quantitative approaches to detect and analyze patterns in previously published literature on a certain topic (Deyanova et al., 2022).

Data preparation involved exporting publication articles to an Excel sheet and organizing them chronologically. Abstracts extracted from the WoS database were saved separately in text format. Each of these files was allocated a unique number ranging from 0 to 1194. This was followed by the first topic modeling experiment on the entire dataset, which

was run on Mallet with the terms and topics limited to ten, with the number of topic words to print 20 and the iterations set to 1000. This was repeated three times until the concepts were clear enough. This highlighted the top ten topics discussed in academia about startup research. Figure 2 illustrates the complete research methodology:

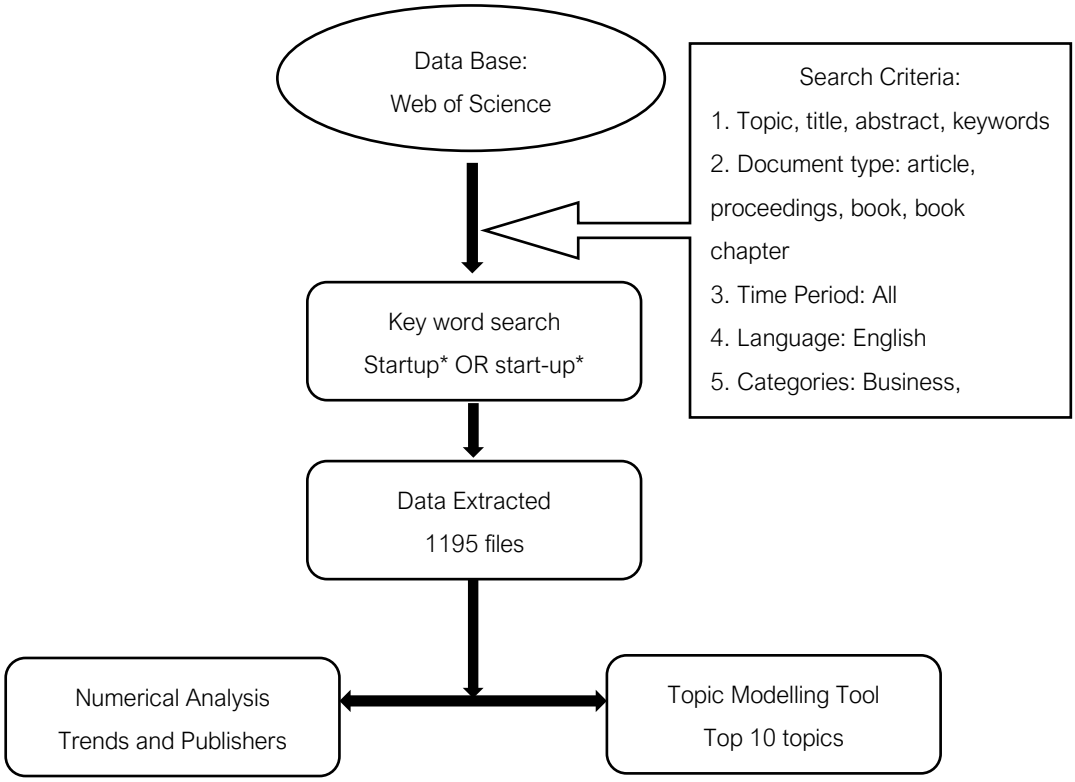

Figure 2. Research methodology. *Source: Author's own*

4. Results and Discussion

The analysis shows interesting results in both bibliometric and topic modeling. Bibliometric results indicate a publication trend over time, top publishing journals and top publishing countries, while the topic modeling explains the top ten topics researched on startups over the past 25 years.

The investigation of studies on startups shows an apparent increase in interest, especially since the year 2000. This trend may be traced back to the rising entrepreneurial activity that followed the internet revolution, notably in the last decade of the 20th century. The introduction of technological advances and extensive internet usage have created a favorable climate for startup entrepreneurs to capitalize on growing opportunities in creative business activities. Figure 3 explains the trend of publications over the past 25 years.

The internet revolution, which gained momentum in the late 1990s, signaled an important shift in corporate behavior. It introduced new levels of connectivity and accessibility, and drastically altered traditional concepts of entrepreneurship. With the expansion of digital technology and the introduction of online platforms, startup owners were provided with new tools and resources to help them develop a competitive environment.

The internet's ease of access to knowledge and resources helped encourage entrepreneurship. Aspiring entrepreneurs were no longer limited by geographical areas or significant initial commitment. Instead, they could use digital platforms to reach global markets, build strategic alliances, and optimize operations.

The combination of variables fueled an increase in entrepreneurial activity, stimulating broad interest in startups from researchers, policymakers, and investors. The number of research dedicated to understanding the dynamics of startup ecosystems and their impact on economic development has increased substantially during the past few years.

It is worth mentioning that the past decade witnessed a marked increase in research output, which reflects the growing significance of startups in driving innovation and economic growth. However, it is important to acknowledge fluctuations in research output, such as the observed drop in the number of papers in the year 2024. This decline can be attributed to methodological factors, including the inclusion of only two months of publication data, rather than being indicative of a broader trend. The following figure (Figure 3) shows the trend in publications about startups over time:

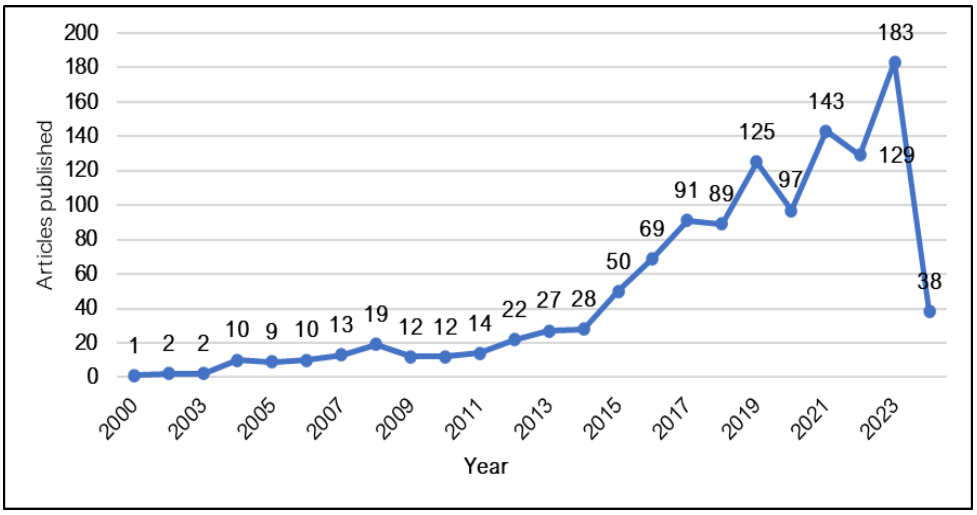

Figure 3. Publications on startups from 2000 to 2023. *Source: Author's own*

The analysis of data retrieved from papers indexed in the Web of Science (WoS) reveals insights into the top journals contributing to research on startups. While several journals have made significant contributions, "Small Business Economics" stands out with the highest number of publications, totaling 54 articles. This prominence is underscored by startups' classification as small or medium-sized businesses during their early stages, aligning closely with the journal's focus on small business economics.

However, other journals also play important roles in advancing knowledge in the domain of startup research. For instance, "Research Policy" and "Technological Forecasting and Social Change" have contributed 30 and 26 publications, respectively, which indicates their importance in exploring the intersection of technology, innovation, and policy within the startup domain. Similarly, the "International Journal of Entrepreneurial Venturing" and "International Journal of Entrepreneurial Behavior & Research" have published 22 and 21 articles, respectively, which demonstrates their commitment to promoting scholarly research on entrepreneurial behavior, ventures, and management practices. Moreover, journals such as the "Journal of Business Research," "Journal of Entrepreneurship in Emerging Economies," and "International Entrepreneurship and Management Journal" have each issued 19 publications, reflecting their dedication to examining diverse aspects of entrepreneurship and its implications for emerging economies. In addition, the "Journal of Small Business and Enterprise Development," "Journal of Technology Transfer," and "Technology Innovation Management Review" have contributed 16 to 17 articles each, which highlights their roles in disseminating research on technology transfer, innovation management, and entrepreneurship. Furthermore, other notable journals have also made significant contributions to the field, with 12 to 14 publications each, as can be seen in Figure 4:

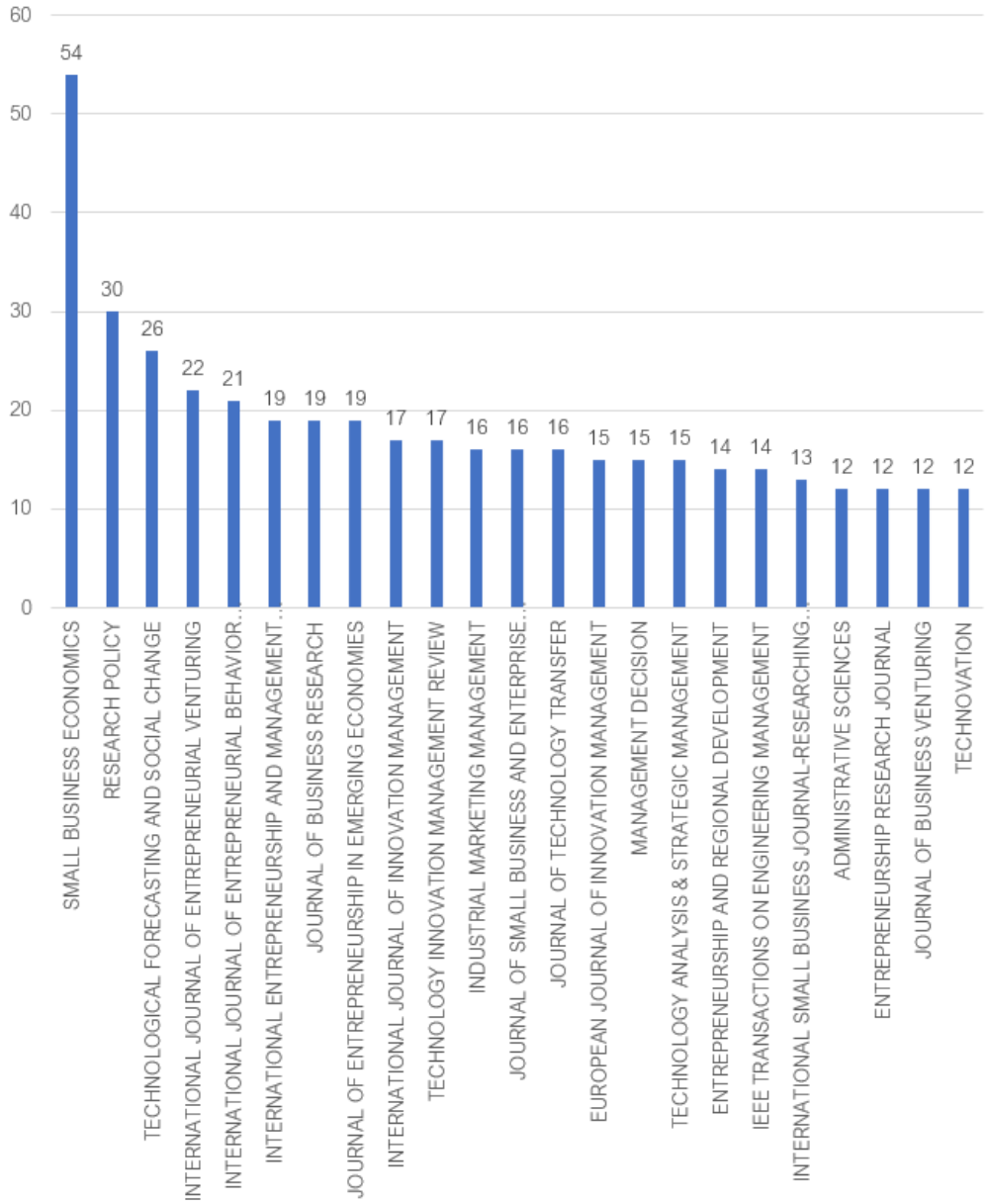

Figure 4. Top publishing journals in the field of startup studies. *Source: Author's own*

As shown in the following figure (Figure 5), the analysis of the countries that have the highest number of publications on startups shows that three countries ranked on the top: these are UK, USA and Netherlands. This may be linked to the fact that these countries are also in top ten for startup performance (startupblink, 2022).

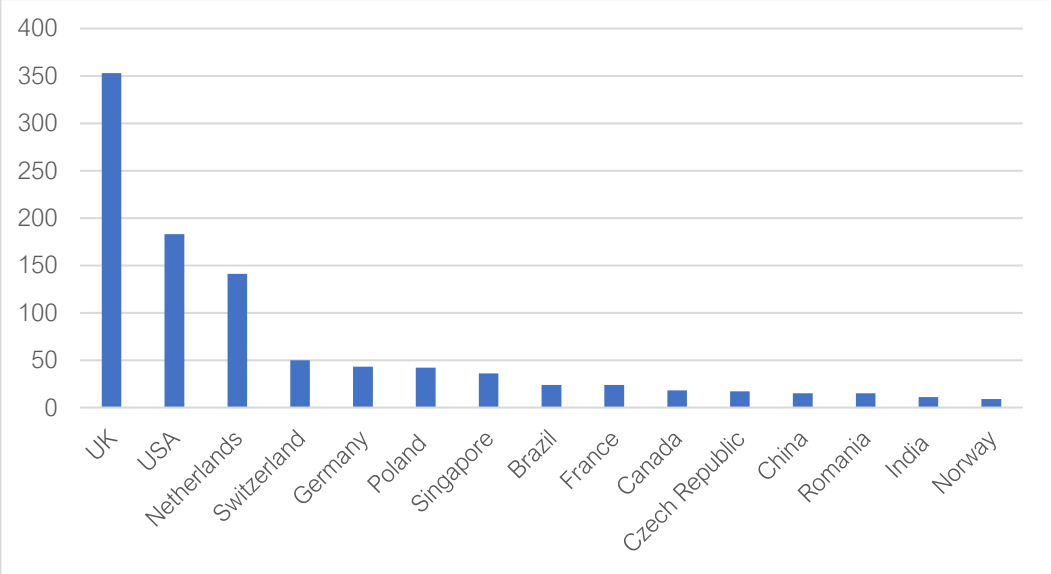

Figure 5. Top publishing countries in the field of startups studies. *Source: Author's own*

The UK ranked first with almost twice as many publications as in USA. This is an unexpected result as USA is the leading country in the domain of startups. Also, we can see that China has a small number of publications in this field: this may be related to the fact that the database included only English-language publications.

4.1. Topic Modeling Analysis

The digitalization of knowledge has necessitated the development of new methods to organize, search, index, and browse large amounts of textual data. The technological sector responded quickly, and yielded machine learning for text mining and word processing. One challenge is determining the concepts discussed in a document, which human readers struggle with. Topic modeling was introduced to make this possible for computers.

Topic modeling is a text mining method that uses algorithms to analyze documents by generating a list of recurrent topics. It does not require prior remarks or tags, and it does not require prior annotations. The Latent Dirichlet Allocation (LDA) approach is used to detect main topics in large text files from online sources. LDA is popular due to its simplicity and ability to handle lexical ambiguity, allowing for topical clusters to be formed from different contextual meanings (Barde & Bainwad, 2017).

Topic modeling has been utilized in a variety of business disciplines, including management, organizational research, human resource management, and marketing. This study stands out for its unique approach. To answer the primary research objectives in this work concerning the startups, the author employed Mallet, and ran topic modeling on all 1195 abstracts obtained from the WoS database. Table 1 shows the list of keywords and their relevant subjects, outlining the top ten topics researched in startups over the past 25 years. These topics were summarized based on the key words of the 20 topic words in each of the 10 topics modelling output. Each topic offers valuable insights into various aspects of startups.

Table 1. Top ten topics in startup research. *Source: Author's own*

Topic No.	Descriptions	Keywords
1	Innovation and Economic Development	startups innovative research paper development business tech high knowledge results support based analysis level economic growth creation related policy.
2	Startup Processes and Success Factors	business model startup entrepreneurial process entrepreneurs startups success lean study learning framework software development research venture based ventures stage failure
3	Startup Ecosystems and Economic Support	startups startup ecosystem entrepreneurship development entrepreneurial digital economic ecosystems accelerators research support programs accelerator growth innovation creation role innovative policy
4	Innovation Networks and Corporate Dynamics	innovation knowledge firms startups resources performance network study open capabilities corporate research literature role relationships dynamic large networks technology established
5	Project Management and Decision Making	process management method project-based risk companies startup decision product criteria model projects making evaluation system analysis methods systems selection.
6	Business Models and Market Dynamics	business companies technology company digital market marketing model global case service industry economy models innovation small customer study based emerging
7	Entrepreneurship Education and Gender	business entrepreneurs university women entrepreneurship gender start students female incubation family entrepreneurial education academic universities experience activities data employees individuals
8	Venture Capital and Financial Performance	capital firms venture firm performance study financing growth financial results effect funding startup survival market data investors effects sample high
9	Social Entrepreneurship and Leadership	social study entrepreneurial performance leadership relationship entrepreneurs positive startup results effect influence impact factors online research based communication team findings
10	Research Methodology and Study Design	study research purpose approach design findings methodology factors implications originality data literature paper analysis practical authors interviews aims context identify

We attempted to show the research trend over a 25-year period using data from topic modeling analysis which included the top hundred ranked publications for each distinct topic. The results, as shown in Table 2, provide significant findings:

Table 2. Evolution of startups topics 2000-2024. *Source: Author's own*

Topic	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1				x					x	x	x	x			x	x	x	x	x	x	x	x	x	x	x
2					x	x	x	x	x	x			x	x		x	x	x	x	x	x	x	x	x	x
3													x	x		x	x	x	x	x	x	x	x	x	x
4									x		x			x	x	x	x	x	x	x	x	x	x	x	x
5			x		x		x		x			x	x	x	x	x	x	x	x	x	x	x	x	x	x
6					x	x	x	x	x				x		x	x	x	x	x	x	x	x	x	x	x
7							x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
8			x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
9							x	x	x			x		x	x	x	x	x	x	x	x	x	x	x	x
10									x	x			x			x	x	x	x	x	x	x	x	x	x

Table 2 shows that throughout the last decade all analyzed issues within the startup area have been subject to scholarly investigation, which indicates widespread interest among academics. However, the first years of research focused on two disciplines: project management and decision making, as well as venture capital, which received scholarly attention in 2002. These aspects are critical for the growth and viability of startups since good management and financial resources are much needed for startups.

Furthermore, a new topic emerged in 2003: this focused on innovation and economic development, emphasized the critical role of startups in supporting economic advancement and created employment opportunities, particularly among young people. In addition, the rise of research articles related to startup ecosystems only received interest in 2012, which represented the development of the frameworks conducive to startup activity, thus indicating a thriving ecosystem with identifiable stakeholders. In the following sections, we will go briefly into each of these ten topics studied in the domain of startups using the citations of top ranked articles.

Regarding the first topic of Innovation and Economic Development, startups play an important role in the development and spread of innovative inventions throughout industries, particularly in high-tech sectors. These firms investigate and develop in new technological fields, which causes the sector to renew and grow dynamically. Spin-offs and spin-out firms from academia and the industry are effective means of transferring technology since they are frequently bought by larger corporations. Innovation is associated with the establishment of new businesses, the discovery of new market niches, the acquisition of potential clients, and the removal of entry obstacles (Van Nuffel et al., 2009). Entrepreneurship has become a significant focus for policymakers as it contributes to a country's innovation and economic growth. Policymakers have implemented various financial, economic, and legal interventions to encourage domestic entrepreneurs to create new technology-based firms and to attract innovative firms from other countries to strengthen the existing high-tech sectors (Cannone & Ughetto, 2015).

Turning to the second topic of Startup Processes and Success Factors, the fact that three out of four startups fail emphasizes the importance of surviving and the risks associated with being new. Startups may have an advantage in product creation and innovation due to the lack of established processes and business models. Failure is an essential component of entrepreneurship and can manifest in a variety of ways, including a terrible loss or a learning experience. Entrepreneurs who have made many attempts at venture formation, product-related challenges, industry legitimacy, and resources such as human, technological, and financial resources are the four key causes of failure. The notion of virtual embeddedness, which builds interorganizational connections through electronic technology, is thought to reduce new venture liabilities and improve new venture survival rates. This concept is not on the list of key causes of failure in relation to Silicon Valley-based startups (Mäkäräinen-Suni, 2017).

Furthermore, the business side of startups can influence revenue growth and success. Most startups fail to measure and track key indicators for their business at appropriate times. Metrics are critical for entrepreneurs to design, create, and sustain strong products that deliver consistent outcomes. They can be used as a verification tool to indicate a positive step or a turning point. Analyzing historical data can help set goals and find crucial KPIs. Even if there is no universally accepted set of metrics for startups, a systematic approach can make the process of business formation more structured, process-oriented, and efficient (Shanbhag & Pardede, 2019).

The third topic is Startup Ecosystems and Economic Support. Entrepreneurial ecosystems are critical for reducing a country's economic disparities. The entrepreneurial ecosystem comprises six domains: policy, finance, culture, support, human capital, and markets. Policy refers to the role of government, finance refers to the availability of money to fund startups, culture represents group characteristics, supports include public and private institutions that provide stimulus, markets refer to the available audience ready to purchase products and services, and human capital refers to available human resources and their academic and professional backgrounds (Torres Jr et al., 2023).

Additionally, entrepreneurship is deeply embedded in the industrial structure of the area where it develops and emerges in a variety of forms, responding to the context's strengths and opportunities discovered via the entrepreneurial activity effect. However, gaps persist, such as measuring entrepreneurship as the simple formation of a new firm, underestimating the mechanisms driving diverse typologies, and focusing too heavily on the impact of complexity on entrepreneurship (Mazzoni & Innocenti, 2023).

With the theme of Innovation Networks and Corporate Dynamics (Topic 4), startups frequently collaborate with large firms to gain resources, but success requires capturing and maintaining their attention. Corporate managers compete for attention, as do divisional managers in business units. These managers have varied goals, therefore their attention to startup actions varies. Startups must acknowledge this diversity and manage the attention-attraction process through partner-centric actions. Large organizations should be aware of and attentive to the obstacles that these managers may present to good collaboration outcomes (Prashantham & Madhok, 2023).

Project Management and Decision Making (Topic 5) highlights how startups differ from microenterprises because of their specific qualities. Startups, according to the Federal Association of German Startups, are enterprises that are less than ten years old, highly inventive, and focused on growth. They desire to increase staff and turnover rates significantly. Startups accelerate technical advancement and have a favorable impact on the national economy by generating disruptive ideas. However, their creative business approach or product exposes them to significant dangers. While success can result in large expansion, innovation does not always necessitate the use of modern technologies. Implementing a quality management system can improve innovative capability, but individual decisions must consider potential benefits and drawbacks (Klute-Wenig & Refflinghaus, 2020).

With regard to topic 6, Business Models and Market Dynamics, dynamic capability theory suggests that startups can adapt to changes in the business environment by creating, extending, and manipulating their resources. Entrepreneurs' commitment is crucial for their survival, and relational capabilities like personal networks are essential. Startups, which are often small and fail at a higher rate than established companies, aim to contribute to survival, fill managerial gaps, support technological development, and sometimes support scientific research.

However, startups face unique challenges due to rapid growth, agility, and constant transformation. To survive, they need dynamic capabilities to adapt to market uncertainty and respond to changing environments. Collective knowledge of adaptation and innovation are crucial. Startups' performance depends on reconfiguration and the exploitation of existing resources, which allows them to exploit new opportunities and manage both tangible and intangible resources for business growth (Pigola et al., 2022).

Our seventh topic was found to be Entrepreneurship Education and Gender. Female entrepreneurship is on the rise in many nations, yet women entrepreneurs remain underrepresented when compared to male entrepreneurs. Factors contributing to this gap include difficulty receiving institutional assistance, fear of failure, holding themselves to a higher standard of competence, and societal beliefs and gender biases. Women also believe they have a lower level of self-efficacy in carrying out entrepreneurial duties, which leads to a

decreased interest in startup activities. Long-term solutions to gender disparities in entrepreneurship can start with the educational system (Johansen, 2013).

To attain long-term competitive advantage and growth, startups must invest in human capital (HC), social capital (SC), research capital (RC), and innovation capital (IC). HC is critical for operational flexibility, which results in successful innovation initiatives and the creation of new goods and technology. These critical areas relate to topic 8: Venture Capital and Financial Performance

Social capital consists of networks with consumers, partners, and suppliers that enable companies to acquire access to resources required for survival, growth, and long-term competitive advantage. RC and IC are critical for R&D and innovation since they promote growth and are difficult to replicate by competitors. To acquire these resources, startup firms require adequate financial resources throughout their life cycle. However, financial constraints frequently hinder businesses from gaining these resources. In order to overcome these limits, startups seek outside funding, which can be difficult due to the risks and uncertainties associated with unproven technologies, undeveloped markets, and intangible assets. This prompts companies to contact external finance sources that invest in high-risk, high-growth entrepreneurial projects: these include business angels, venture capitalists, banks, and private equity firms. Each startup's distinct character and financial requirements differ, which results in variable preferences and access to external sources. Overall, these resources are critical to a technological startup's success and expansion (Singh & Mungila Hillemane, 2021).

In a similar vein, Social Entrepreneurship and Leadership (Topic 9) also play a crucial role. Leadership communication is crucial for internal communication and has a significant impact on employee attitudes and behavior. Recently, there has been a greater emphasis on CEOs using social media to engage stakeholders and achieve corporate outcomes. Social presence theory sheds light on how the public perceives CEOs by emphasizing the communicator's psychological sense of belonging among other social actors in a mediated situation. More CEOs are strategically projecting and expanding their social media presence, thus presenting themselves as honest, pleasant, and genuine in order to foster connection and interaction with the general public.

In addition, executive leaders are responsible for shaping an organization's direction and tone, developing strategy, coordinating business activities, and maintaining alignment. Effective CEO communication is critical for achieving excellent organizational outcomes. As stakeholders increasingly evaluate an organization's presence on social media, it has become a cost-effective way to promote brand and revenue. CEO blogs and online communication may personalize large organizations, enhance consumer interaction, and humanize CEOs as chief engagement officers. It is worth mentioning that CEO communication tactics and objectives differ depending on organizational aspects such as size. Startups, which are typically small to medium-sized innovative businesses, have to create imaginative and cost-effective strategies to engage stakeholders. Startups frequently use relationship-building techniques such as professional networking, speaking, and community events to increase awareness, knowledge, and business outcomes (Yue et al., 2019).

With regard to our tenth and final topic, Research Methodology and Study Design, the triple-A philosophy, which stands for agility, adaptability and alignment, is critical for startups to thrive in a fast-changing world. The integration of the A's (triple-A) has been connected to firm performance, with research focused on the triple-A supply chain. This enables startups to respond to short-term changes, adjust to long-term market trends, and match goals with consumer wants.

Startups' agility, defined as their capacity to adjust rapidly and effectively to environmental and market changes, improves operational and interpersonal performance as well as financial efficiency. Adaptability refers to a company's ability to adapt its resources in response to long-term changes, which highlights various sorts of transitions and responses. Rapid product innovation is an important method for increasing adaptability, which can enhance productivity and support long-term company sustainability. Alignment refers to a startup's capacity to spread risks, profits, and costs fairly among all participants, with the goal of increasing customer value through value co-creation. However, the use of the Total Interpretive Structural Modeling (TISM) technique, which helps to discover and investigate enablers of agility, adaptability, and alignment in startups, has contributed to finding that key importance should be given to management involvement, conflict management, collaboration and information integration (Sreenivasan & Suresh, 2023).

5. Conclusion

This present study uses two unique methodologies, quantitative analysis and topic modeling, to provide vital insights into startup research. The evaluation of the most influential publications, countries and journals enables new and established researchers in the subject to quickly locate the most relevant sources of information. The dataset was taken from the Web of Science, and yielded 1195 papers after filtering. This is a quite high number of research projects for any such study. The period under examination spans 25 years, from 2000 to 2024. The trend of publishing demonstrates how the academic research community's interest in this topic has grown dramatically over time, particularly in the last ten years, fueled largely by the late 20th century internet revolution. The introduction of digital technologies and online platforms promoted entrepreneurship, which allowed ambitious persons to explore the competitive field more easily.

Using the topic modeling technique the study focuses on the top 10 topics explored by scholars in startup research across a 25-year-long period, which is valuable for policymakers, researchers, and entrepreneurs. The findings reveal that management and decision-making, as well as venture capital and economic development evolved as research areas during the early years of startup study. On the other hand, startup ecosystem studies first appeared in 2012, rather late after startup activities became mature. Every topic has been explored in this study from the past ten years, which indicates that startup studies continue to be of interest to many parties. Each of the ten topics resulted from topic modelling provides useful insights into different elements of startups, and points towards their role as catalysts for innovation, economic growth, and social change. This finding is significant because it identifies gaps in startup research that may be relevant for future studies.

Despite extensive research on startups, significant gaps present opportunities for future studies. Most studies focus on high-tech sectors, leaving non-tech industries underexplored, along with the long-term sustainability of innovation in startups, particularly in developing countries. Universal frameworks for startup KPIs and systematic approaches to learning from failures are lacking. Research on startup ecosystems emphasizes well-established hubs, overlooking emerging regions and diverse typologies. Collaboration challenges with large firms and the evolution of dynamic capabilities across startup life cycles remain underexplored. Gender disparities in entrepreneurship lack intersectional analysis, and the effectiveness of educational interventions have been found in this study to also be a potentially fruitful research direction. Alternative financing mechanisms and the influence of venture capital on strategic decisions are insufficiently researched. Leadership strategies for balancing communication with operational demands and the application of frameworks like agility, adaptability, and alignment across industries require deeper examination. Moreover, the global diversity of startup contexts and their environmental and social sustainability are often neglected. Addressing these gaps with interdisciplinary and regionally diverse approaches would enrich the theoretical and practical understanding of startups, and further enhance of this field of study.

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Appendices

Appendix 1: Questionnaire

Below are the questions from the conducted questionnaire in the research field in Google Forms:

1. What is your age group? (18-20/ 21-24/ 25-29/ 30 or above).
2. What is your current level of education? (Undergraduate student/ Graduate student Master's or Ph.D./ Completed undergraduate degree but not currently enrolled).
3. Have you ever invested in cryptocurrencies? (Yes/ No).
4. If yes, what are the primary motivational/psychological factors for investing in cryptocurrencies? (Potential for high returns/ Interest in technology and blockchain/ Recommendation from friends or family/ FOMO/ Diversification of investment portfolio/ Other).
5. What are your primary concerns or reservations, if any, about investing in cryptocurrencies? (Lack of regulation and legal uncertainties/ Volatility and price fluctuations/ Security risks (e.g., hacking, theft)/ Complexity and technical barriers/ Reputation and credibility of cryptocurrencies).
6. How would you rate your level of risk perception when investing in cryptocurrencies? (Very Low, Low, Moderate, High, Very High).
7. How would you rate your knowledge and understanding of cryptocurrencies and blockchain technology? (Very Low, Low, Moderate, High, Very High).
8. What sources do you primarily rely on for information and research about cryptocurrencies? (News websites and blogs/ Social media platforms and applications (e.g., Twitter, Reddit, Revolut)/ Cryptocurrency exchanges/ Online forums and communities/ Academic research articles/ other).
9. How often do you monitor the performance of your cryptocurrency investments? (Multiple times a day/ Once a day/ Few times a week/ Once a week/ Less than once a week).
10. Have you ever experienced significant gains or losses from your cryptocurrency investments? (Yes, significant gains/ Yes, significant losses/ No, neither significant gains nor losses).
11. How do you react to sudden price fluctuations or volatility in the cryptocurrency markets? (Buy more cryptocurrencies/ Hold onto existing investments/ Sell some or all of my investments/ Wait and observe before making any decision/ Other).
12. Based on your overall previous experience in crypto markets. How confident are you to make successful investment decisions in cryptocurrencies? (Not confident at all/ Not very confident/ Neutral/ Confident/ Very confident).