

Role of Technological Innovation and Its Governance in Entrepreneurial Evolution

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ABSTRACT

Studies showcase various aspects of innovation strategies, knowledge sharing, and the role of family firms. Despite this, the authors note the lack of a comprehensive review of technological innovation in entrepreneurship research. This study provides an overview of the relationship between entrepreneurship and technological innovation by conducting a systematic literature review spanning four decades, from 1979 to 2020. It aims to answer three research questions related to the theories and methodologies used, the examined themes, and the implications for researchers while emphasizing the role of electronics governance. Furthermore, the study identifies several key themes in literature, including social capital and entrepreneurship, economic growth and entrepreneurial economy, policy intervention, knowledge economy, and tech venture development. These themes reflect the multifaceted nature of the relationship and offer valuable insights for future research.

KEYWORDS

Entrepreneurship, Literature Review, Social Capital, Technological Innovations

1. INTRODUCTION

Entrepreneurship is identifying opportunities and the marketplace that transfigure enterprises into sustainable profit-making enterprises for economic growth (Cipolla, 1994). Schumpeter (1934) explains entrepreneurship as the ability to commence innovations. It occurs when there is innovation either in improved processes or products. Innovation, particularly technological innovation, like information and communication technologies (ICTs), creates new opportunities, drives competitive advantage, and enhances entrepreneurial culture (Kizgin et al., 2020). In addition, this technological innovation elevates the ability of national industry competition, providing a streamlined governance process. Electronic governance provides an atmosphere conducive to technological breakthroughs by providing digital infrastructure and streamlining administrative operations (Devadoss et al.,

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2003). Entrepreneurs gain from e-governance's information availability and decreased administrative responsibilities, allowing them to focus on creating and bringing new solutions to the market (Calista & Melitski, 2007). Furthermore, e-governance programs that encourage public-private partnerships and market access may enable entrepreneurs to use technology innovation as a driving factor for economic growth and corporate success. In essence, entrepreneurship and technological innovations are the twin engines of economic prosperity (Kropp & Zolin, 2005).

Considering technological innovation in the context of entrepreneurship, researchers investigated specific industries that aided competitive advantage (Song et al., 2010), commercialization of technological innovation (Wong et al., 2005), new density, and the potential of entrepreneurship innovation (Feki & Mnif, 2016). Many researchers even presented reviews on technological innovation. Yang et al. (2012) reviewed technological innovation and related strategies used by Chinese firms; Datta et al. (2015) examined innovation sources, types, and market entry. However, these studies failed to integrate with different technological innovation fields. Moreover, these studies just proposed the selected approaches for future study and did little to incorporate the literature. While these two studies dealt with the status and commercialization of technological innovation, the research of Jones (2017) focused on examining factors impacting the role of knowledge sharing in technological innovation, namely trust, training on technology, and good communication. Although it provided important insight, it restricted its reviews to articles that dealt with knowledge advancement only. Hence, it was not comprehensive in approach (Levy & Ellis, 2006).

In addition, some studies dealt with innovative intermediaries in sustainability transition and technological innovation in family firms (Gliedt et al., 2018), while some focus on the direct effects of family involvement on R&D expenditures, activities, and production outputs (De Massis et al., 2013). Further, it also explored the moderating effects on the relationship existing therein. These articles suffered the anomaly of a limited approach to the existing literature. Beyond this limitation, most past reviews tend to be general (Souitaris, 2003) or specific to a country (e.g., Yang et al., 2012) or domain (e.g., Cappellesso & Thomé, 2019; de Massis et al., 2013). In essence, a study summarizing the state of technological innovation in entrepreneurship research has not been performed yet. Motivated by this objective, the current study offers an overview of technological innovation in entrepreneurship. A literature review on technological innovation and entrepreneurship can inform research trends and advancement in knowledge till now. This study aims to explore the following questions:

- RQ1. What theories and methodologies are used to study research related to technological innovation in entrepreneurship?
- RQ2. What are the themes related to technological innovation and entrepreneurship that have been examined in the literature?
- RQ3. What are the implications for researchers in technological innovation and entrepreneurship?

To analyze the above research questions, we reviewed the last forty-one years of (1979-2020) papers based on content analysis to analyze the research questions. This study uses the TCM (theory, context, and methodology) analysis framework, which emphasizes reviewing theories, methodology, and context under which research was done to provide a broader picture of the research domain. Further, we provide insights in the discussion section and possible future research on technology and entrepreneurship.

The present paper uses a systematic literature review to identify six themes—technological innovation attitude, social capital and social entrepreneurship, economic growth and entrepreneurial economy, policy intervention and entrepreneurship, knowledge economy and entrepreneurial ecosystem, and tech venture development to examine the impact of technological innovation in entrepreneurship. Further, by providing major theories (e.g., achievement theory, psychological field

theory, knowledge spillover theory) and methodologies, this study organizes the knowledge in one place, which can emphasize technological innovation and its governance role in entrepreneurship.

The remaining sections of the paper are organized as follows. Section 2 provides the methodology adopted to analyze the research domain. Section 3 explains the findings of this study, followed by a discussion of future research presented in Section 4. Lastly, we concluded the paper in section 5.

2. RESEARCH METHODOLOGY

2.1 Article Selection

This study aimed to investigate the maturity of the research domain of technological innovation in entrepreneurship research. We adopted the framework adopted by Akter and Wamba (2016). Firstly, the Scopus database is selected for keyword search and related articles due to its extensive coverage of articles and more than 18,000 peer-reviewed journals, conference papers, and book chapters. Secondly, we searched “entrepreneurship” and “innovation” in the title, keyword, and abstract. A total of 405 documents were identified, consisting of articles (60.2%), review papers (4.7%), conference papers (19.3%), book chapters (10.6%), conference reviews (1.5%), books (2.5%), and others (1.2%). Most of the documents were from the business management, engineering, and economics areas. Thirdly, we started filtering documents to prepare a database containing only quality knowledge. So, in this process, conference papers, book chapters, books, and all other documents were excluded except articles and review papers, as these represent the state-of-the-art research output with high impact. In the second level search, we looked for “technological innovation.” We ended up with 242 documents and prepared a database that provided the attributes of these articles, such as article title, journal title, year of publication, abstract, keywords, citations, references, and ISSN number.

2.2 Analysis Method

Based on this paper’s objective, we selected the TCM analysis framework, a valuable tool for the literature review that mainly emphasizes studying the theoretical foundation of the selected domain, mythological rigor including critical evaluation of research methods, data collection techniques and lastly, contextual factors influencing the research findings (Darveau & Cheikh-Ammar, 2021). For theories and methodologies, we visited the selected articles and collected theories and methodologies used to analyze the research questions. For the context, following Tiwary et al. (2021), we have selected content analysis methods from bibliometric analysis. Bibliometric analysis is the statistical analysis of bibliographic data of published journal articles (Shivani et al., 2023; Kumar & Dubey, 2022a; Kumar & Dubey, 2022b). It is used around the globe by academicians, policymakers, and governments. The quantitative analysis evaluates the academic journals and authors by citation method, which is a statistical method. It is essential to define the quality criteria to select a suitable empirical basis for implementation. In addition, visualization and content analysis provide a quantitative, systematic, and objective evaluation of the patterns of themes, words, and concepts in a text (in this case, article abstracts). This literature review approach is more content-oriented and specifies the thematic abstract of approaching critical conclusions in a particular research domain. Therefore, all 242 articles’ abstracts adopted the content analysis method. We performed content analysis using Leximancer software, as suggested by Tiwary et al. (2021).

In this process, we have extracted seven themes: tech innovation attitude, social capital, social entrepreneurship, economic growth and entrepreneurial economy, knowledge economy and entrepreneurial ecosystem, policy entrepreneurship, and tech venture development. The first author coded these themes, followed by other co-authors, and validated the themes with an intercoder reliability of 0.87.

3. FINDINGS

3.1 Theoretical Understanding Emerged From the Literature

We categorize the themes of technology innovation in entrepreneurship research into three main categories based on the theories used:

3.1.1 Theme 1: Theories of Entrepreneurial Behavior and Decision-Making

Researchers used theories from different areas in the literature to investigate the research questions associated with technology innovation in entrepreneurship research. For example, agency theory from the information system area to exhibit the influence of variables on entrepreneurial risk-taking (e.g., founder's tenure) (Zahra, 2005); achievement theory (Myers, 1984) to demonstrate entrepreneurial creativity; and psychological field theory of Kurt Lewin to create an index to evaluate technical innovation talent (Xiao, 2016). In addition, the upper-echelon theory was used to show how firms' top executives' demographic characteristics and personal experiences shape their cognitive perspective and knowledge base, substantially affecting their decision-making and impacting their approach to technological innovation (Wadhwa et al., 2017). Bandera & Thomas (2019) used knowledge spillover theory and the startup survival model to discover that startups that use social capital by collaborating with other agents/stakeholders (universities, industries, and government organizations) significantly outperform.

Furthermore, the knowledge spillover theory was used to identify the knowledge spillovers affecting entrepreneurs in the early stages of startup development (Cuvero et al., 2019). In contrast, Hay (1981) used systems theory and considered entrepreneurs as "systems thinkers" and his venture a "system." The social cognitive theory was used to understand electronic book device adoption behavior (Ratten et al., 2011). Kukk et al. (2016) used the technological innovation system (TIS) theory to show the power of institutional change in innovation systems.

3.1.2 Theme 2: Economic and Growth Theories in Entrepreneurship

The theory of economic growth was used in the literature to connect entrepreneurs and innovation (Jeon et al., 2016), and the theory of the innovation distribution pattern was used for comparing product and process innovation (Xu et al., 1998). Endogenous growth theory was used to show population agglomeration regarding government subsidies and firm innovation (Deng et al., 2020). However, new economic growth and organization theories were used to analyze the relationship between innovation policy and new venture creation in the United States (Woolley & Rottner, 2008). Furthermore, Schumpeter's theory of economic development was used as a premise to show the role of fast-growing firms in economic growth (Wong et al., 2005), while entrepreneurship and innovation theory was used to analyze factors that influence technological innovations development and tech-startup entrepreneurship (Adler et al., 2019; Mujeyi et al., 2015). The theory of spillage, new growth theory, and compensation theory were incorporated to analyze the effect of entrepreneurial technological innovation on economic growth (Feki & Mnif, 2016). The theory of learning (Surie & Torras, 2007) described four stages of economic development (new economy formation, technology recipients, technology adaptors, and global innovators) corresponding to the evolution of entrepreneurship.

3.1.3 Theme 3: Entrepreneurship Theories and Innovation Policy

Moreover, Choi et al. (2020) investigate the role of technology startups on employment and innovative performance by considering the general theory of employment. Liberal feminist (LF) theory was used to investigate the impact of women's leadership on innovation by Small and Medium Enterprises (SMEs) in an emerging economy context (Arun et al., 2020). Used theories such as cluster theory, industrial ecology, the growth pole theory, the resource-based theory, and the developed effect model

show technological entrepreneurship and socio-economic changes in science parks (Xie et al., 2018). The resource-based theory was used to understand startup readiness (Goji et al., 2020) and to explore the nature of the knowledge inputs and the entrepreneurship capacity inputs involved in technological innovation (Hindle & Yencken, 2004).

Moreover, Tebaldi (2001) used Schumpeter's democratic theory to understand the policy needs of entrepreneurs. Training rigor theory was used to show the importance of learning for engineering students to become more intrapreneurial (Menzel et al., 2007). Relational developmental systems theory examines factors related to entrepreneurial intentions among engineering students (Gilmartin et al., 2019). The vocational theory drew on the fit between an engineer's personality traits and occupation (Williamson et al., 2013). Innovation theory and practice were used to show the role of women in technological innovation that is leading to the transition from the industrial to the knowledge society (Ranga & Etzkowitz, 2010). Complexity theory was used to show how university-industry partnerships in developing economies foster the emergence of entrepreneurial capabilities and new ventures (Surie, 2011).

3.2 Methodology Used to Study the Domain of Technological Innovation in Entrepreneurship

Selected literature used diverse approaches for their studies. For example, Merino et al. (2006) characterized the Emerald journals by analyzing thematic profiles, impact publications, and authorship of papers. They examined how the developments have helped it reach such a position. Tang (2006) studied the five navigation technologies to discover why some technological innovations and systems were difficult to adopt by comparing their development's case histories and technological antecedents, applications, and organizations involved. Garriga & Melé (2015) indicated the formation and agenda of theory creation through the technique of "mapping the theory" based on the comparison and study of instrumental theories, political theories, integrative theories, and ethical theories. They suggested developing a new theory to integrate these four dimensions. Moreover, Singhal (2014) focussed on the interest- and motive-based activity of arriving at the achievement of approximate consensus on the term of corporate social responsibility. Bergman et al. (2013) employed content configuration analysis on 70 local and international English-language book chapters, research articles, reports, reviews, and expert commentaries published between 2013 and 2019 to develop a typology of the advantages and disadvantages associated with the Companies Act 2013 with an endeavor to develop a business-society nexus toward sustainability.

Rambe et al. (2017) utilized the critical integrated approach existing at the intersection of the available funding (private and public funding), which mediates the organizational and environmental factors in explaining SME performance. The study deviated from the mainstream studies by placing financing, organizational, and environmental variables as key variables in explaining successful business performance and not just focusing on finances. However, another study emphasized that knowledge dissemination is important for the spread of technological innovation. Entrepreneurship pursued by women may have different drive patterns. This phenomenon was studied by Ogidi (2014), who tested the accountability and credibility of women entrepreneurship by studying their innovativeness and creativity toward applying technological innovations toward poverty reduction among SME sub-sectors in Enugu-North L.G.A.

Sundin (2016) took up the case study using a survey research strategy of 110 small businesses in a South African municipality to find out the prime sources of funding for small businesses and the effect of such funding on technology acquisition, besides studying the complexity of debt financing and the exorbitant interest rates and their impact on venture survival and growth. In their study, AlTabbaa & Ankrah (2016) used narrative analysis to organize, connect, and evaluate the process and results of technological innovations to understand better the underlying mechanism of the type and development path of technological innovation and adaptability.

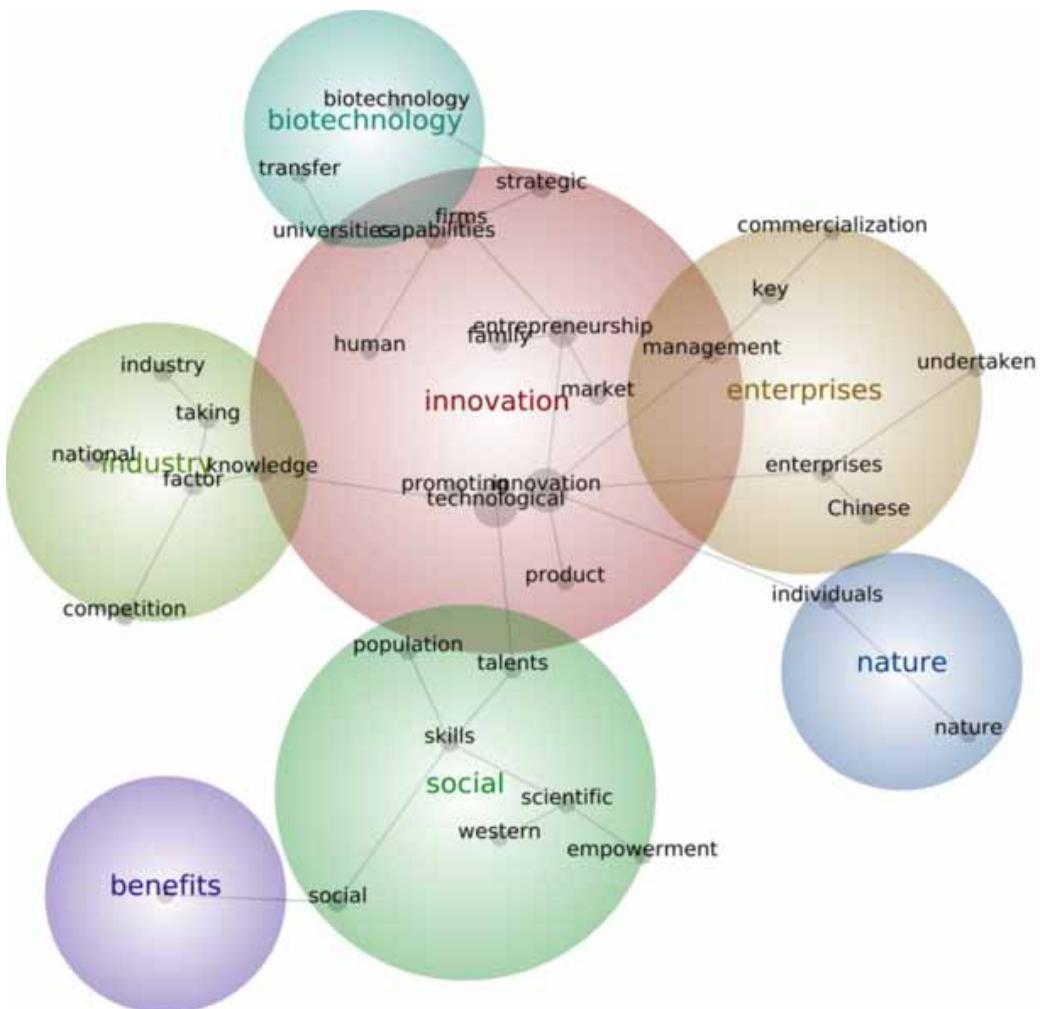
3.3 Content Analysis and Visualization

3.3.1 Technological Innovation Attitude

The discussion within this theme primarily centered around the following cluster names (see Figure 1): “innovation,” “enterprises,” “nature,” “social,” “benefits,” “industry,” and “biotechnology.” These themes were rooted in crucial concepts, such as innovative entrepreneurs, skills development, the commercialization of technological innovation, university capabilities, Chinese enterprises, knowledge factors, biotechnology firms, and innovation strategy. However, the most dominant theme that emerged was “innovation,” closely linked with the concepts of “market” and “product.” The authors extensively stressed the importance of innovation in achieving economic development.

For instance, Xie and Ran (2016) discovered that the capability to transform technological innovation into knowledge is a critical factor in enhancing a nation’s industry competitiveness. Subramonian and Rasiah (2016) underscored the significance of technological innovations and innovation systems in fostering growth and development. Furthermore, Choo (2007) and Datta et al. (2015) emphasized the necessity of commercializing technological innovation to achieve entrepreneurial success.

Figure 1. Network of key words extracted from the selected category under the theme “Technological Innovation Attitude”



Moreover, technological innovation plays a fundamental role in economic and industrial transformation, reshaping the structure and operation of industries. For instance, biopharmaceutical companies have leveraged technological innovation to gain insights and improve technology, ultimately bringing new drugs to market (Jeon et al., 2016). From a business perspective, technological innovation is a critical outcome of innovation systems (Subramonian & Rasiah, 2016) and is the primary driving force behind the innovation process (Petti & Zhang, 2011). Furthermore, innovation systems, markets, and players are interdependent in business, working harmoniously to drive economic growth and enhance firm competitiveness. When combined in various configurations, including technical, sectoral, regional, and national systems, innovation systems give rise to hybrid innovation systems, as exemplified by the governance model in Iran's petrochemical technology and other sectors, which delivers combined benefits.

Recognizing the significance of technological innovations, researchers have proposed mechanisms such as integrating and self-designing imported technology (Xu et al., 1998) and creating specialized mechanisms at the national and strategic levels (Sikka, 1999). However, embracing innovation also entails risks, introducing uncertainties into the operational framework and work environment, necessitating that employees adapt to unpredictable situations (Myers, 1984). Effective leadership (Nam & Tatum, 1997) and internal entrepreneurship (Burgelman, 1985; Quinn, 1979; Wani et al., 2003) are essential to navigate these uncertainties. Additionally, the key to entrepreneurial success lies in the commercialization of technological innovation (Choo, 2007; Datta et al., 2015), which requires various internal changes and external networking. Companies can collaborate with R&D firms operating in the markets or strengthen their R&D efforts to achieve this goal. Based on the discussion, we provide the following propositions:

Proposition 1: The central theme of innovation, closely associated with the concepts of market and product, is the driving force behind economic development, and it plays a pivotal role in enhancing the competitiveness of industries and nations.

Proposition 2: Achieving entrepreneurial success relies heavily on effectively commercializing technological innovations. This proposition is substantiated by the repeated emphasis on the need to commercialize technological innovations to attain entrepreneurial success.

3.2.2 Social Capital and Social Entrepreneurship

In this section, a series of sub-themes emerged (see Figure 2), all linked to "social," "capital," "agencies," "Nollywood," "problems," "feedback," and "SMEs." These sub-themes were intertwined with broader concepts, including social entrepreneurship, innovation ecosystems, technical knowledge, venture funding, economic development, social capital diffusion, positive impact, international markets, and technology-based industries. However, the predominant theme that consistently surfaced was "social," often paired with terms like "capital," "networks," "innovation," and "entrepreneurship" in the articles.

For instance, in their study, Ghazinoory et al. (2020) concluded that social capital and social entrepreneurship play pivotal roles within problem-oriented innovation systems, shedding light on the crucial link between social entrepreneurship and technological innovation. Chaves et al. (2013) emphasized the problem-solving prowess of social entrepreneurship. Additionally, Mulloth et al. (2016) highlighted the role of social entrepreneurship in creating value for social causes and local communities, exemplified by Prezi, a Budapest-based technology company.

Drawing from Thompson & Doherty's (2006) definition, social enterprises are defined as "organizations seeking business solutions to social problems" (p. 362) These entities employ financially sustainable business models to benefit stakeholders and society. Social entrepreneurship is gaining traction as a catalyst for growth and development, particularly when intertwined with technological innovation. For example, the Irula tribe in southeast India utilized an innovative rat trap developed by

Moreover, human capital (CEOs) and social capital (embeddedness in international markets) play vital roles in technological innovation by enabling access to foreign customer knowledge and international markets (Mulloth et al., 2016). Additionally, individual personality traits impact innovative social skills (Wood, 2012; Wadhwa et al., 2017), helping entrepreneurs seize opportunities through social networks. Startups that leverage both social and human capital in collaboration with universities, industries, and government agencies outperform those that do not (Bandera & Thomas, 2019), with the potential for further acceleration through small business funding and research-business partnerships to drive technological innovation (Shic et al., 2015). When initially introduced on a small scale within existing institutions, social entrepreneurship has the potential to scale up and challenge established norms, as demonstrated by projects like Prezi's, which is challenging the current political institutions in Hungary. Additionally, it is a critical innovation source for technology-based industries (Mulloth et al., 2016).

However, on the contrary, venture capitalists' social ties and entrepreneurs' social connections can sometimes hinder rather than facilitate technological innovation (Ma et al., 2018). Funding remains critical in commercializing new technology (Terjesen, 2007), and innovative funding strategies must be explored and implemented. Lastly, in this theme, we provide the following propositions:

Proposition 3: Social entrepreneurship, intertwined with concepts such as social capital, networks, innovation, and entrepreneurship, emerges as a dominant and vital theme within problem-oriented innovation systems.

Proposition 4: Integrating social entrepreneurship with technological innovation offers a potent pathway to achieving economic development. This proposition is grounded in the idea that social entrepreneurship employs entrepreneurial principles, processes, and operations to drive innovation.

3.2.3 Economic Growth and Entrepreneurial Economy

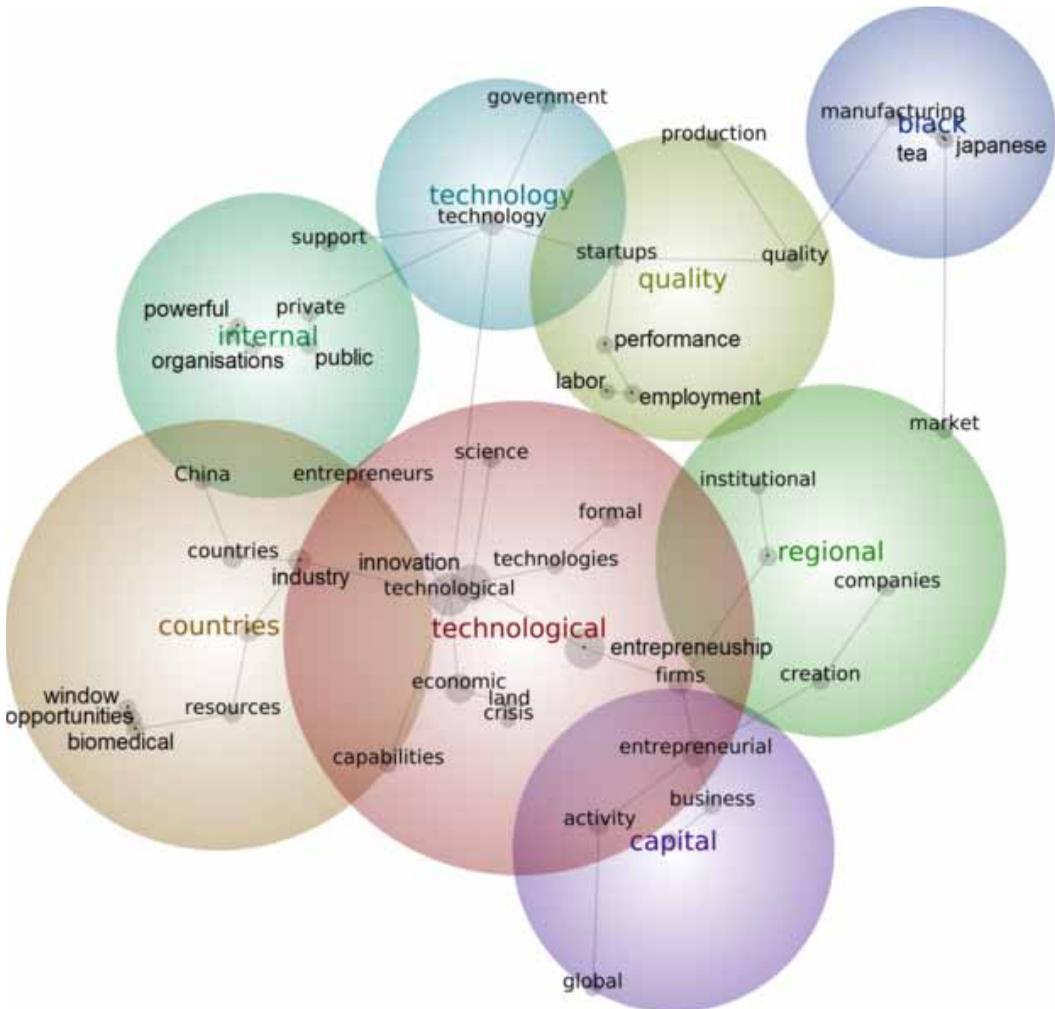
The discussion in this section primarily focused on themes that fell under the cluster names (see Figure 3): "technological," "countries," "capital," "regional," "quality," "black," "technology," and "internal." These clusters were formulated because the topics of interest were fragmented across windows of opportunities, human capabilities, employment creation, science parks, tech-startup entrepreneurship, global entrepreneurship monitor, and the Japanese market gave rise to the sub-themes. The most dominant theme of all was "entrepreneurship," which was paired extensively with the terms "tech-startup," "global," and "internal" in the articles.

For example, Faria (2015), Chadha, and Dutta (2020) explored the importance of an entrepreneurial economy. Haour (2005) discussed the important role of venture capital and entrepreneurial economy in the development of Israel. Furthermore, Rico and Cabrer-Borrás (2019) concluded that new business and regional entrepreneurship are crucial for economic development. The entrepreneurial cooperation between public and private technology helps develop a strong foundation for economic growth (Geisler & Turchetti, 2015; Regan, 2017).

If employment and growth need to be attained, entrepreneurial activity needs to be scaled up. In this context, Faria (2015) mentioned the HOPF bifurcation theorem, which indicates the entrepreneurial economy's utility, accumulating more capital than the Ramsey model. For example, total entrepreneurial activity (TEA) in GEM countries has positively impacted economic growth through technological innovation, entrepreneurial finance, and physical infrastructure in 2016 (Chadha & Dutta, 2020). Similarly, Israel commands the world's highest level of venture capital and invests twice the figure done by the US (Haour, 2005). Spain also shares this experience wherein new business and regional entrepreneurship positively impact economic growth (Rico & Cabrer-Borrás, 2019).

Entrepreneurship and technological innovation have high growth potential and result in economic growth (Wong et al., 2005) and industrial growth (Nakamura & Managi, 2020). Entrepreneurial

Figure 3. Network of key words extracted from the selected category under “Economic Growth and Entepenuerial Economy”



cooperation between public and private technology enterprises is increasingly recognized as a solid economic and technological foundation for growth and prosperity (Geisler & Turchetti, 2015; Regan, 2017). Moreover, innovation leads to the revival and helps grapple with technological innovation, regulatory changes, cyclical industry downturns, and ownership restructurings to survive. Regan (2017) explored how the innovative approach adopted by Shannon Airport, a public-sector organization located on the periphery of Ireland and Europe, led to its revival and growth. Furthermore, Evans (1995) discussed the incessant novelty and innovation in the unique ecosystem of Silicon Valley, which has spawned the fastest-growing firms. They highlighted that the high-technology firms in Silicon Valley succeed in a highly combative arena and maintain a maverick, entrepreneurial spirit and make Silicon Valley unique in the scale and success of creating a high-technology cluster in an environment that, only three decades ago, was resplendent with orchards.

Internal entrepreneurship of the scientific and technical workforce in both organizations (public laboratories and private industry) is the most potent predictor of commercialization and technology transfer in public-private cooperation. In this regard, Geisler and Turchetti (2015) argue that senior management support and organizational culture are two factors that influence the success of the

commercialization effort (Geisler & Turchetti, 2015). Moreover, the convergence of various theories (such as the catch-up effect and windows of opportunity) confirms that countries that focus their economies on knowledge, research, development, and commercialization of technology and innovation have a better and more stable growth rate in the medium and long run (Bas & Orlu, 2018).

Entrepreneurship aligned with technological innovation impacts technology startups' employment quality and innovative performance (Choi et al., 2020) and leads to national and regional development. However, the short-term impact of technological innovation on growth is negative but catapults growth in the long run, as suggested by the spillage theory (Feki & Mnif, 2016). For instance, the production and manufacturing innovations were the primary reasons for the revival and spread of Japanese black tea, which further led to entrepreneurial farmers establishing fermentation manufacturing technology; this got transferred to other Japanese black tea farmers and resulted in the rapid creation of the Japanese black tea market (Takano & Kanama, 2019).

Family businesses are widely regarded as a significant source of entrepreneurial and technological innovation (Zahra, 2005). In addition, it gets promoted through technology parks, incubators (Torres et al., 2016), and science parks (Lindelöf & Löfsten, 2006; Xie et al., 2018) as done in Sweden, wherein science parks, new technology-based firms, stand out as a particular group of small firms in performance (growth: sales and employment). Technological innovation, risk, and proactiveness were the most important latent constructions for science park firms and entrepreneurship. In addition, there is a need for a better understanding of the NTBF's development process (and other processes: innovation processes, diffusion processes) before approaching whether the incubation function can be made more effective (Lindelöf & Löfsten, 2006).

3.2.4 Policy Intervention and Entrepreneurship

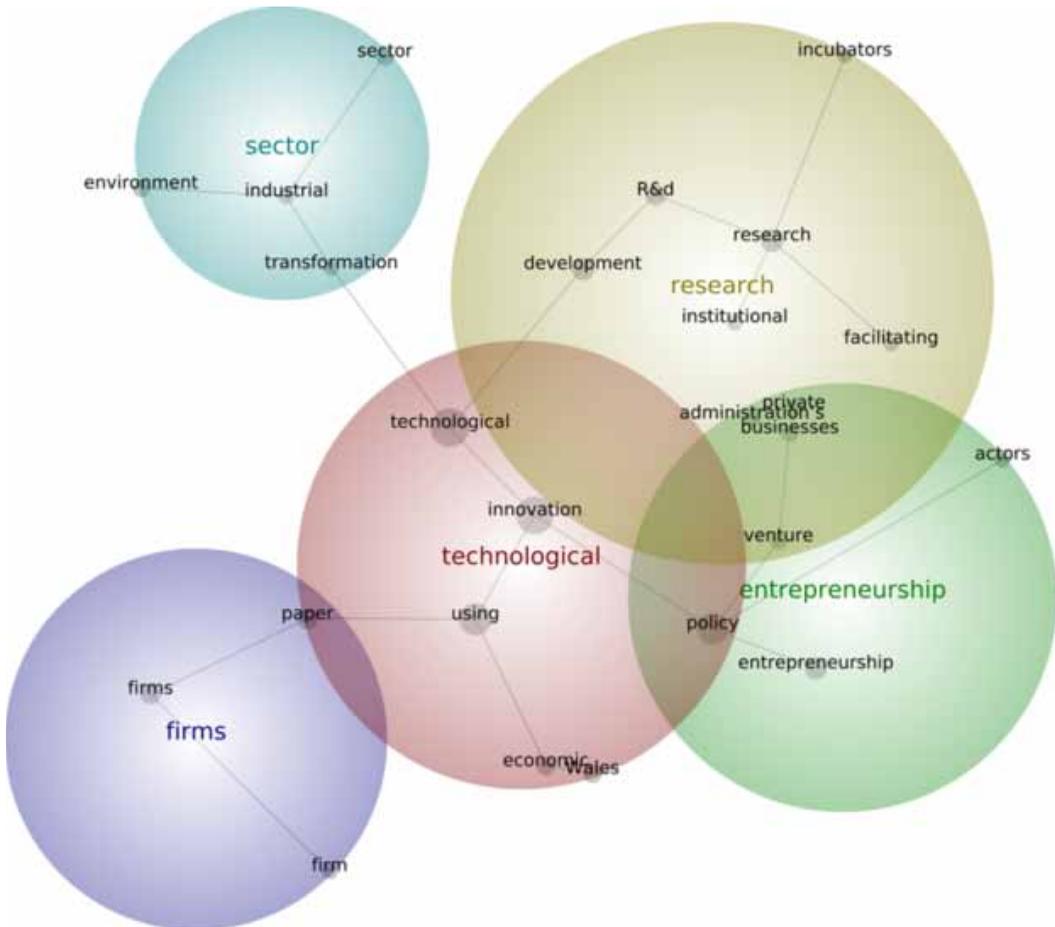
The discussion under this theme revolved around five sub-themes (see Figure 4) falling under cluster names "technological," "entrepreneurship," "research," "sectors," and "firms," which were based on the concepts of venture businesses, incubators, development policy, R&D intensity, innovation and entrepreneurship in Wales, private innovation actors, business environment, and institutional entrepreneurship, that are used extensively in research articles. These concepts were frequently addressed in different articles.

For example, Tiffin et al. (1987) and Woolley and Rottner (2008) emphasized the utility of policy intervention on legitimacy and venture formation. Deng et al. (2020) discussed the case of China for the efforts undertaken by its government toward mass entrepreneurship. Furthermore, de Oliveira and Biondi (2013) put forward the case of Brazil and the programs "Bahia Innovation" and "Empreende Bahia" adopted by it for stimulating entrepreneurship and technological innovation.

Through direct support or improving entrepreneurial ecosystems, policy intervention helps develop new technologies and lead to innovative practices that are a vital link between different technological cultures (Tebaldi, 2001). When adopted rightfully, it encourages entrepreneurship, innovation, and other technologies. For example, the policy adoption led to the development of mechanical technologies for agriculture in Nigeria, which has increased a surprising amount of activity. Moreover, deliberate efforts toward developing technical entrepreneurship and innovation practices through policy interventions help increase resource legitimacy and venture formation (Tiffin et al., 1987; Woolley & Rottner, 2008). As in China's case, the government's mass entrepreneurship schemes and innovation policy resulted in rapid government subsidies for small-cap enterprises (Deng et al., 2020). It has also been witnessed that indigenous support, in the form of awareness training to SMEs for technology transfer services available to them, stimulates entrepreneurship and technological innovation, as happened in the case of the "Bahia Innovation" and "Empreende Bahia" programs adopted in Brazil (de Oliveira & Biondi, 2013).

Public policy changes must encourage entrepreneurship and innovation to yield industrial development at little cost (Tiffin et al., 1987). Moreover, they should reduce barriers for technical entrepreneurs to invest, set up profit-oriented firms, and commercialize them.

Figure 4. Network of key words extracted from the selected category under the theme “Policy Intervention and Enterprenuership”

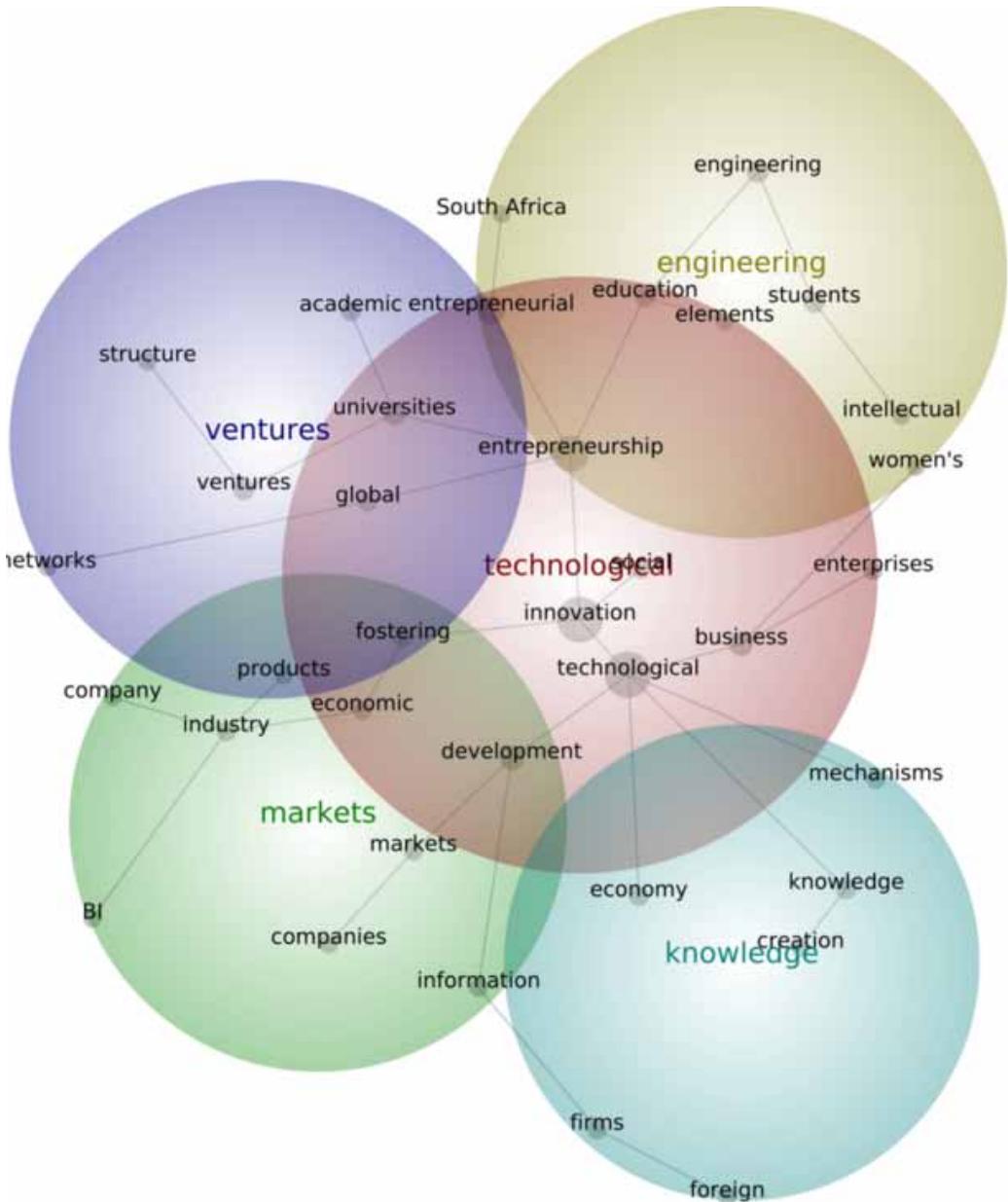


3.2.5 Knowledge Economy and Entrepreneurial Ecosystem

Under this section, the authors extensively discussed concepts related to the sub-themes (see Figure 5) “engineering,” “ventures,” “markets,” “knowledge,” and “technological” that were based on the concepts of economic development, knowledge creation, entrepreneur, incubator networks, engineering programs, and entrepreneurial intent. However, “technological” emerged as a major sub-theme that the articles extensively referred to in technological-related content. For example, Carayannis et al. (2006) emphasized the utility of information and communication technology in fostering entrepreneurial development. Lee and Kyeun Kwun (2003) cited Korea’s case, which is developing a knowledge-based economy and planning for long-term national innovation. Furthermore, Musteen and Datta (2011) examined the case of the Czech Republic to establish the relationship between a firm’s technological innovation and its international performance.

Economies are aspiring to convert their economies to knowledge-based economies (KBE), which requires building a knowledge-based entrepreneur ecosystem (KBEE) (Al-Mubarak et al., 2015; Basole et al., 2019) to attain economic development. For example, Iran, which lags behind developed countries, identifies the elements of KBEE and their linkage and interactions to encourage innovation and entrepreneurship to absorb, create, apply, and exploit knowledge and information. This supports the maxim that knowledge economies thrive on technological learning, information,

Figure 5. Network of keywords extracted from the selected category under “Knowledge Economy and Entrepreneurial Ecosystem”



and communication technologies (ICT) that foster entrepreneurial development (Carayannis et al., 2006). As in Korea, public innovation policies pave the way for a knowledge-based economy to plan for long-term national innovation (Lee & Kyeun Kwun, 2003). In addition, it has decided to compensate for the weakness of small and medium-sized businesses by increasing the number of new high-tech startups by providing finance, skill development facilities, and technology and marketing support (Kim et al., 2005).

Knowledge economy fosters communication technology and entrepreneurial development and leads to economic development (Lee & Kyeun Kwun, 2003; Carayannis et al., 2006; Musteen & Datta,

2011) by building KBEE (Al-Mubarak et al., 2015; Basole et al., 2019). It also delineates innovation education (Hindle & Yencken, 2004), a phenomenon that is gaining traction in academia and practice for benefitting from innovation spaces (Gilmartin et al., 2019; Kruger & Steyn, 2020) by capitalizing on entrepreneurial opportunities (Musteen & Datta, 2011) and disseminating entrepreneurial skills (Surie, 2011).

The knowledge base is created by university-industry collaborations that promote socio-economic development by incubating innovations and disseminating entrepreneurial skills (Surie, 2011). Studies about Greek and South African institutes have manifested that a knowledge base leads to a positive attitude and enthusiasm for entrepreneurship in the technological industry (Metallidou et al., 2020), and lack of it leads to low entrepreneurial tendencies as in South Africa (SA), which had the lowest youth entrepreneurial tendency of just 23.3 percent (GEM, 2016). Most prominent is the case of Chinese development, whose economic growth and social advancement are inextricably linked to scientific and technological innovation and necessitate the development of innovative talents in colleges and universities (De Jager et al., 2017; Jiang & Hou, 2019) and the development of knowledge base (Menzel et al., 2007; Holly, 2010; Williamson et al., 2013). It also advises moving toward Romer's economy, emphasizing the importance of knowledge in boosting the current economy (Scuotto et al., 2020).

3.2.6 Tech Venture Development

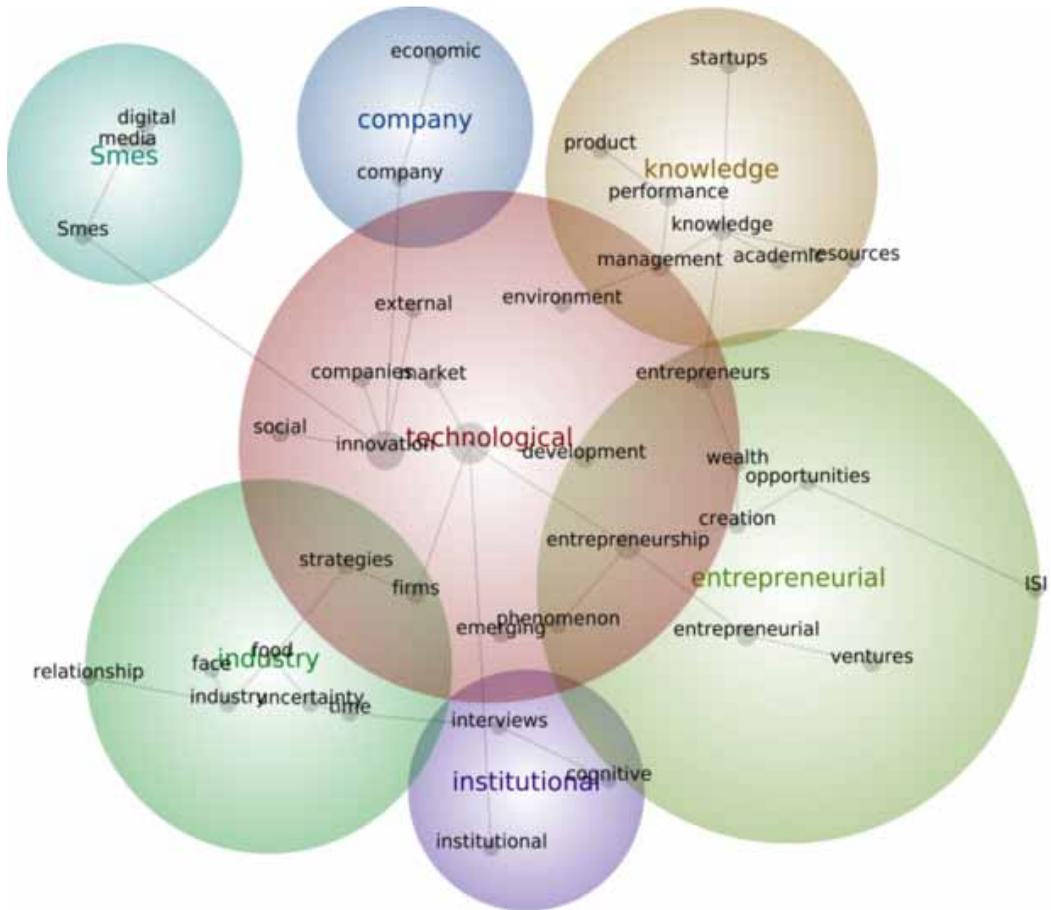
The sub-themes under this section focused on “company,” “technological,” “entrepreneurial,” “knowledge,” “institution,” “industry,” and “SMEs.” The concepts that led to the emergence of these themes are digital media, external sources, industry-university research coordination, knowledge management, entrepreneurial ventures, and product and process innovation, which were discussed in different articles. For example, Eckhardt and Shane (2011) discussed the utility of tech venture development in an entrepreneurial opportunity. Cunnington (1989) cited the case of Australia to manifest the importance of tech venture development in its entrepreneurial culture. Furthermore, Cuvero et al. (2019) discussed the knowledge spillover theory of entrepreneurship (KSTE) to examine the impact of new knowledge and proximity on exploiting entrepreneurial opportunities and establishing startups.

Companies' current backbone is technological innovation. Exploiting and testing new knowledge improves one's chances of success in today's volatile economy (Del Giudice et al., 2019). It is an important determinant of entrepreneurial opportunity (Eckhardt & Shane, 2011). Moreover, technological entrepreneurship transforms potentially viable technical opportunities into profitable businesses (Petti & Zhang, 2014). However, knowledge and physical capital are crucial in technology entrepreneurship (Hong et al., 2017) and in translating ideas into businesses. For example, Australia has a proud record of its inventions. However, it lacks the entrepreneurial culture necessary to translate vision into innovation (Cunnington, 1989), leading to manifold development.

As stated by the knowledge spillover theory of entrepreneurship (KSTE), which examines the impact of new knowledge and proximity on the exploitation of entrepreneurial opportunities and the subsequent establishment of startups (Cuvero et al., 2019), entrepreneurial venture success depends on how accurately they perceive the community's needs and the resources (innovations) available to meet them (Hay, 1981). Therefore, new ventures should gain the required technical skills and resources early in product development to ensure consistent product differentiation and seek marketing skills and resources later (Song et al., 2010). For example, in Brazil, innovation, entrepreneurship, and technological development are significant and balanced through social effort; governments, universities, and companies have made various attempts to promote innovation, and the number of incubators and technology parks has increased significantly (Yamamoto & Dos Reis Coutinho, 2019).

Partnerships between companies, universities, and incubators for technological innovation management processes are vital (Shah & Pahnke, 2014), and it is critical to developing a strategy for developing technological entrepreneurship in businesses that use the technical and intellectual capacity of organizations (Badzińska, 2016). Although the background of entrepreneurs and the internal

Figure 6. Network of key words extracted from the selected category under the theme “Tech Venture Development



environment are similar in developed and developing countries, the external environment distinguishes the two. While a developing country like India is less likely to rely on outside assistance, a developed country like Japan has to (BalaSubrahmanya, 2009). It finally leads to tech venture development for grabbing entrepreneurial opportunities (Cunnington, 1989; Eckhardt & Shane, 2011) for establishing startups (Cuvero et al., 2019), developing profitable businesses (Petti & Zhang, 2014), technology entrepreneurship (Hong et al., 2017) and translating vision into innovation (Cunnington, 1989). This can be done through incubators and technology parks (BalaSubrahmanya, 2009; Shah & Pahnke, 2014; Yamamoto & Dos Reis Coutinho, 2019) and using the intellectual capacity of organizations (Badzińska, 2016) and use of digital media (Yin & Luo, 2018), which helps in reducing costs (Subrahmanya & Kumar, 2011; Camilleri, 2019) and overcoming resource constraints and risks.

4. DISCUSSION AND IMPLICATIONS

We started investigating the influence of technological innovation to find the progress in technological innovation and entrepreneurship. Our first objective was to collect the theories associated with the selected research. In the above section, we have discussed the theoretical framework used to examine previous research. We found that technological innovation determines the extent of industrial transformation by incorporating new insights and improved technology (Jeon et al., 2016). It leads to

critical outcomes (Subramonian & Rasiah, 2016), further driving innovation (Petti & Zhang, 2011). Our study reveals that undertaking commercialization and external networking (Choo, 2007; Datta et al., 2015) can generate leadership (Nam & Tatum, 1997) and internal entrepreneurship (Burgelman, 1985; Quinn, 1979; Wani et al., 2003).

The study further suggests that the development of technological innovation attitude is based on social capital and social entrepreneurship (Thompson & Doherty, 2006), which are indispensable parts of problem-oriented innovation systems (Ghazinoory et al., 2020). Moreover, this alliance can lead to a financially sustainable business model to benefit society and the stakeholders. As elucidated by Wood (2012) and Wadhwa et al. (2017), we show that social networking assists in getting a better acquaintance of foreign customer base and international markets (Wood, 2012; Wadhwa et al., 2017) and helps seize entrepreneurial opportunities, which strongly catalyzes the development of startups (Bandera & Thomas, 2019).

Further, we contribute to the innovation literature where the study has tended to put greater emphasis on academic help from education and research centers and their partnership (Shic et al., 2015; De Jager et al., 2017; Jiang & Hou, 2019) in the creation of a knowledge based economy (Hindle & Yencken, 2004; Menzel et al., 2007; Holly, 2010; Williamson et al., 2013) by the creation of innovation spaces. We show that these enablers, such as innovativeness and novelty of approach in unison with policy intervention by the government, can attain a greater degree of growth and development (Wong et al., 2005; Geisler & Turchetti, 2015; Bas & Oliu, 2018) in the short and long run especially for regional businesses (Faria, 2015; Chadha & Dutta, 2020; Rico & Cabrer-Borrás, 2019).

4.1 Implications

4.1.1 *Insight on Research in the Area of Technological Innovation and Entrepreneurship*

Our SLR has highlighted that the debate on technological innovation in entrepreneurship is emerging, covering more than four decades, from 1979 to 2021. Quinn published their first paper in 1979. After that, every year two or three papers were published. It was only after 2009 that the number of scholarly articles start increasing, demonstrating an emerging interest in this domain. In 2020, 50 articles were published. Regarding authors' specialization, the scholar's community work in this field is not restricted to particular domains such as business management and social sciences. However, the topic has attracted attention from several other disciplines, such as computer science, engineering, decision science, and economics. Similarly, keywords analysis showed that besides the two main topics (technological innovation and entrepreneurship), authors have shown differentiated interests in topics such as technology management, knowledge management, big data, and entrepreneurship education. All these show multi-dimensional phenomena and suggest new avenues for future research toward cross-disciplinary and integrated frameworks.

4.1.2 *Insight From Themes Extracted From Technological Innovation and Entrepreneurship Literature*

The analysis of the thematic clusters in the field of technological innovation in entrepreneurship was explored by using a text-mining procedure on articles' abstracts within six themes: 1) tech innovation aptitude; 2) social capital and social entrepreneurship; 3) economic growth and entrepreneurial economy; 4) policy intervention and entrepreneurship; 5) knowledge economy and entrepreneurial ecosystem; and 6) tech venture development. The bibliometric and content analysis allowed us to design the papers by characterizing them into different themes depending on their specializations and limitations.

Although the two areas of technological innovation and entrepreneurship have received significant attention in business management and entrepreneurship communities separately, their intersection discloses several deepening areas. Indeed, some conclusions can be drawn from SLR analysis: social capital and networking aid entrepreneurs to be technologically innovative by collaborating with

universities, industries, and government agencies (Wadhwa et al., 2017; Bandera & Thomas, 2019). Similarly, science and technological parks in developed and developing countries are gaining popularity by providing opportunities for entrepreneurs to be innovative (Lindelöf & Löfsten, 2006; Torres et al., 2016; Xie et al., 2018). However, with the growing concern about the impact of innovation on societies, we found that most studies necessitated the creation of economic and socially viable technologies. Further, we found that researchers have extensively used a few theories (such as Schumpeter's theory of economic development, knowledge spillover theory, resource-based theory, and social cognitive theory) for different research problems in technological innovation and entrepreneurship research.

4.1.3 Implications of Technological Innovations and Entrepreneurship for Governments and Policy

The finding from this study suggests several implications for government, as government leads in fostering technological innovation and entrepreneurial growth; their policies should foster social entrepreneurship, knowledge-based economies, cooperation, and essential support. Firstly, the government needs to encourage social entrepreneurship by addressing the societal issues where traditional market strategies do not apply. Secondly, policies need to be developed to promote technological innovation through collaboration between universities and industries to develop more sustained products. So, the government should support KBEE and emphasize entrepreneurial education and innovation spaces. They should recognize the importance of incubators and technology parks and reduce barriers for technical entrepreneurs to invest in commercialized innovations.

Further, to build the policies, the government should first identify the priority areas where continuous technological innovation is required, and based on that information, foster the innovation ecosystems. Also, the role of technological innovation and its governance in entrepreneurial evolution helps governments make policies like supporting R&D, promoting technology transfers, and commercialization to help entrepreneurs drive technological breakthroughs. Government can use this information for policies that incentivize and support R&D initiatives (e.g., tax incentives, grants) or policies that ease the process of transferring technology. Governments must create flexible regulatory frameworks that accommodate and regulate emerging technology without impeding creativity. In essence, the role of technological innovation and its governance offers policymakers knowledge and instruments for developing policies that encourage circumstances favorable to entrepreneurship. Governments may build policies that allow technology dissemination and respond to the changing environment of technological entrepreneurship by understanding the shifting patterns of innovation.

4.2 Future Research Agenda for Researchers in Technological Innovation and Entrepreneurship

In this literature review article, we have identified some good themes through bibliometric and content analysis. We have also highlighted a few research questions that need to be addressed in the future regarding technological innovation in entrepreneurship (see Table 1). These questions were selected based on the areas under-researched or still unexplored and to derive roots for the future agenda of researchers, practitioners, and policymakers.

5. CONCLUSION

This review aimed to identify gaps in academic research and recommend how to conduct viable research on implementing technological innovation in entrepreneurship settings. The research domain in implementing technological innovation in entrepreneurship has recently gained popularity. A country's growth depends on certain factors, one of which is innovation. Technological innovation helps a country to be more competent. Businesses are the major innovation drivers, transforming the market's structure and functioning. Strong leadership from the entrepreneur is essential for firms to be viable in the age of technology. Similarly, science and technological parks in developed

Table 1. Suggested future research questions

| Theme | Research Questions | References |
|--|--|--|
| Impact of innovation on firm's survival | How are various forms of innovation among startups linked with their survival? What features of a new venture's technology/R&D strategy would allow it to use shared innovation resources in the ecosystem without increasing its reliance on the ecosystem? How do the features of the innovation platform affect a new venture's capacity to cooperate and compete with other ecosystem members simultaneously? | Hyytinen et al. (2015) Nambisan & Baron (2013) |
| Innovation in social enterprises | What type of innovation is most likely to succeed in social enterprises? | Del Giudice et al. (2019) |
| Effect of forms of entrepreneurship on firm's efficiency | Which type of entrepreneurship is the most economical, least expensive, and innovative? What industry-specific characteristics indicate that one style of entrepreneurship does better in that sector than another? | Burger-Helmchen (2008) |
| Factors influencing entrepreneurial intentions | How many different combinations of self-efficacy and locus of control affect entrepreneurial intentions? What is the impact of family social norms, which appear to influence individuals' desire to pursue entrepreneurial careers? What are the self-regulatory skills of entrepreneurs that help develop dynamic capabilities in their new ventures? What societal factors and compromised ethics in a community transform aspiring entrepreneurs into reprobates? | Miller (2015); Nambisan & Baron (2013); Zellweger et al. (2011) |
| A financial element of entrepreneurship | How do entrepreneurs use the resources they obtain with fintech for organizational success? How do entrepreneurs who access new alternative forms of finance manage relationships with different lenders and investors? | Bruton et al. (2015) |
| Geographical impact on innovation and entrepreneurship | How do different geographical sizes (cities, suburbs, and rural areas) affect innovation and entrepreneurship? | Adler et al. (2019) |
| Role of KIS in entrepreneurs' decision | What factors influence entrepreneurs' decision to use public or private (knowledge-intensive services) KIS? Do all possible KIS combinations have the same synergistic effects? | Soriano & Huarng (2013) |

and developing countries are gaining popularity by providing opportunities for entrepreneurs to be innovative. However, with the growing concern about the impact of innovation on societies, we found that most studies necessitated creating economic and socially viable technologies. The future study should work on the meta-analytic (Jadil et al., 2022; Tamilmani et al., 2019) and empirical research (Pillai et al., 2022) along the lines of the role of technological innovation and how it may influence entrepreneurship initiatives by governments at various levels.

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