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Could the 'Spinner Innovation' and 'Triple Helix' Models Improve System Innovation?

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Abstract: Although several prior studies have outlined and examined models associated with knowledge and innovation in different fields, the literature lacks any solid insights combining the Triple Helix model and the Spinner Innovation model and ascertaining their relevance to innovation. This article correspondingly presents an unprecedented alternative based on two innovation models, analyzing and structuring a process to innovate in different economic sectors. In doing so, this paper seeks to explore how this integration between Spinner Innovation and Triple Helix models could have a significant influence to improve system innovation. We collected data from the Scopus database spanning the period between 2012 and 2021 to study the integration of the models. The analysis identifies how these models differ but are nevertheless of complementary importance for developing regional and national economies through combining the "helices", the "fidgets" and the framework integrating both models and their components to system innovation.

Keywords: business innovation; triple helix model; spinner innovation model; knowledge creation; knowledge transfer; system innovation

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1. Introduction

Recent decades have seen a clear surge in interest in knowledge and innovation, both in research and in practical terms. The role of innovation in driving the knowledge economy has grown within different contexts and domains in many nations all over the world [1]. In this regard, the emergence of the Triple Helix model has played a crucial role in altering the understanding of innovation [1]. In addition, according to [2], the Spinner model provides three major dimensions, incorporating knowledge creation, knowledge transfer and innovation in a dynamic form, while assisting in predicting the propensity of innovation based on knowledge-intensive solutions (KIS), taking into consideration the presence or absence of positive connections between knowledge transfer and knowledge creation.

Although several prior studies have approached, outlined and examined the key issues associated with knowledge and innovation in different fields, how these two models actually assist in creating knowledge solutions for the future of business innovation has rarely been subject to study. To be more specific, it is evident that there is little attention has been given to merging the "Triple Helix" and the "Spinner Innovation" models to explore how this integration could have a significant influence on the innovation system.

As a result, we here pose the following question: "Would the integration of the Triple Helix and Spinning Innovation models contribute more to system innovation than the implementation of these two models separately?" To provide appropriate answers to this question, this current article proposes to identify the extent to which the Triple Helix model and the Spinner model are able to reinforce collaboration for creating knowledge-intensive solutions and innovation capable of generating future businesses.

Jointly considering the aforementioned aspects, the present article provides a series of contributions and implications for interested scholars and/or researchers, scientific research associated institutions and centres as well as professionals and practitioners in this field. Hence, this paper adds to the existing literature on business, the economy, management and innovation by returning solid insights and distinguished overviews of the connections between these two models, namely the Triple Helix and Spinner models and knowledge-intensive solutions and innovation in business. In addition, the study produces an eminently practical framework as well as contributions for entities interest in the role of both these models in co-creating proper knowledge-intensive solutions for future business-related innovations.

The structure of this research paper is as follows. Following this introduction, the Section 2 sets out the theoretical background related to business innovation, the Triple Helix model, the Spinner Innovation model as well as knowledge-related concepts. The Section 3 details the research methods and analysis techniques before the Section 4 outlines and discusses the research findings. Section 5 conveys the conclusion, the limitations and the main directions for future research.

2. Theoretical Background

2.1. Innovation and Knowledge Management

According to [1], innovation is the consequence of industrialization and governments to support the changes to provide a positive impact to business success and improve technology and innovation for the real and virtual organisations. Based on, [2], it's not possible in the virtual context any organization survive without technology and innovation. It's mean that, [3] no technologies, no organisation survives and no innovation, no organisation survives too.

In addition [4], innovation refers to the effective utilization of novel concepts that integrate innovative technologies, design, and optimal methodologies. IT involves transforming novel combinations of materials and components into commercial products. It also involves the implementation of novel procedures, the expansion into uncharted markets, and the adoption of innovative organizational structures. Innovation constitutes a critical factor for the long-term survival of business enterprises. In highly competitive markets, gaining the first-mover advantage is crucial. Hence, being the first to provide a new product or service often means the difference between being profitable and going bankrupt [4]. However, beyond competing to come up with novel and innovative products, businesses must also demonstrate their viability through higher efficiency, lower costs [5] and greater social responsibility [6]. Therefore, business innovation emerges as "a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm" [7] (p. 20).

In order to innovate, and therefore survive, firms usually look towards their suppliers and customers as sources of inspiration and ideas [8]. Some firms go a step further, and even explore opportunities to cooperate with competing firms [9]. Such approaches produce a mutual sharing of resources and risks among all stakeholders when attempting to create, adopt or introduce something new. Fundamentally, this external orientation simply amounts to searching for knowledge. As a key prerequisite for innovation, firms need knowledge about what consumers need (the voice of customers), how to make it (the voice of engineers), and how to deliver it to them (the voice of marketers) [10]. Furthermore, this understands knowledge as susceptible to creation, sharing and facilitating.

Entrepreneurship is critical for the development of any country. It injects much needed innovation into society and the economy, enhancing problem solving capabilities and making long-term improvements to quality of life [11]. Accordingly, policy makers have tended to dedicate considerable attention and resources towards fostering innovation [12]. In this regard, governments have often turned towards academia to drive their innovation and entrepreneurship aspirations. Academic environments, such as universities and laboratories, have proven very influential in promoting entrepreneurship [13].

As the testing grounds for new ideas, innumerable commercial ventures can trace their origins back to universities and colleges and commonly referred to as academic spin-offs [14]. A wide range of studies has hitherto investigated the role of academic environments in producing these spin-offs (e.g., [15–17]). However, significant gaps in the literature remain as regards various aspects of academic spin-offs. In particular, to the best knowledge of the researchers, there is a concerning lack of research focusing on the combined role of government, industry and academia in producing successful spin-offs.

The ability to create knowledge has long been regarded as a core requirement for the sustainability of firms [18]. While there is no universal definition of 'knowledge', the term is understandable as the sum of what we know [19]. Accordingly, knowledge creation emerges as a transcending process and we must thus reach beyond the boundaries of that already known to imbibe new learnings. In [20], Nonaka and Toyama offer insights into the means of activating this process. They explain that all knowledge starts out with some kind of contradiction or conflict existing between two or more ideas.

This sparks a discourse among the individuals, groups or organizations involved. Eventually, through argumentation, justification, and the synthesis of reasoning [21], the involved parties arrive closer to the truth. Each party then absorbs this truth into their body of knowledge. Furthermore, it is important to acknowledge that, fundamentally, a contradiction represents a disagreement about how we interact whether with our environment or with each other. Therefore, we should appreciate that all knowledge is contextual and inseparable from the social, cultural, historical or geographic realities of the arguing parties.

In turn, one definition of knowledge transfers identifies them as "the process by which knowledge concerning the making or doing of useful things contained within one organized setting is brought into use within another organizational context" [22] (p. 44). Hence, the link between academia and industry has been correspondingly highly conspicuous. Firms are keen to commercialize new scientific knowledge [23] and academic researchers are simultaneously enthusiastic about exploring new research directions and receiving funding [24]. Similarly, it has now become commonplace for academic and commercial organizations to forge partnerships, collaborative research projects, and even research-based consultancies [25]. The evidence suggests the outputs of such academic-industry endeavors are particularly productive and valuable [8]. Despite these partnerships having begun to interest scholars in recent years, there continues to be a considerable dearth of relevant literature.

For both firms and academic institutions, identifying and establishing relationships with appropriate partners often poses challenges. As regards the desired innovation, there needs to be mutual appreciation of the objectives each party holds, and the resources and expertise they each need to bring into the partnership [25]. Moreover, both parties require mutual access and, therefore, should be within reasonable geographic distance of one another [26].

These challenges have given rise to a new type of business service known as Knowledge Intensive Business Services (KIBS). In essence, KIBS stands out as the middlemen in knowledge transfers between academia and industry. They act as the focal point for scientific discoveries by forging strong ties with various academic institutions. In turn, they disseminate appropriate knowledge, innovation, and technology to their industrial clients [27].

In this way, they facilitate the transfers of knowledge from academia to industry [28]. Along similar lines, researchers have already commented on the especially high pace of

knowledge transfers achieved by KIBS. The validity of these comments, and the importance of their economic role, reflects in the increasing proliferation of KIBS in areas of intensive manufacturing [29].

2.2. Triple Helix and Spinner Models

2.2.1. Triple Helix Model

A useful framework for assessing the interactions ongoing among these three players stems from the triple helix model of innovation. Researchers have previously deployed this model to understand how innovation processes lead to entrepreneurial outcomes [30–32]. The model is based on three spheres, respectively representing government, industry and academia. The government sphere emphasizes the supportive role played by policy makers in promoting and facilitating innovation and entrepreneurship [30]. For example, they set the rules and regulations that may or may not encourage the launch and expansion of new enterprises as well as the development or adoption of new innovations.

Furthermore, policy makers can influence both the development and dissemination of innovation by providing financial incentives [33]. The industry sphere reflets how firms and corporations act as catalysts and drivers in activating and mobilizing innovation [31]. In brief, commercial organizations come up with the capital required and the corporate endorsement that supports and justifies the launching of new research projects [34]. Moreover, business firms nurture the launching of start-ups through any combination of financial, professional or commercial support. The academia sphere depicts the developmental role that academic institutions undertake in cultivating innovation [35].

They act as a platform for the discussion and promotion of the objectives and needs of government and industry [22]. This allows for interested actors and stakeholders to discuss and debate potential solutions to socioeconomic problems in an environment with ready access to comprehensive knowledge [36]. Therefore, by highlighting the problems, communicating the available support, and providing the tools necessary to identify the solutions, academia acts as a launch pad for innovation and entrepreneurship [37]. In turn, the researchers of [38] distinguish three types of Triple Helix Model, specifically, the "Statist Model", the "Laissez-faire Model" and the "Balanced Model" In the "Statist Model", the government constitutes the controlling agent, leading and dominating relationships with academia and industry in the development of projects, applying resources and advancing with initiatives. In the "Laissez-faire Model", the agents, industry, academia and government demonstrate management autonomy and act broadly independently of each other, thus only interacting across institutional boundaries. In the "Balanced Model", the approach encapsulates flexibility in which each agent assumes the role of the other, configuring a relationship between institutional spheres and separate organizations within an overlapping system.

According to [39], the Triple Helix framework incorporates multiple social science theories, including Simmel's triad, Schumpeter's organizational entrepreneur, social networks and institutional logics, in order to increase its explanatory powers.

In addition, according to the literature, there is now a clear justification for recourse to the Triple Helix Model to describe the relationships between academia, industry, and government. Within this vein, regional development theories maintain that stronger connections between universities, business and local government (state or municipal), as well as particular local activities (such as local technology transfers, the growth of human capital, and networking), together lead to better overall outcomes [40]. In the context of knowledge-based societies, Triple Helix related theories return some evidence that universities may play a more significant role in innovation (e.g., [40,41]).

Furthermore, the applications of the triple helix model span different contexts and sectors, including the development of fields of innovation [42], the revitalisation of cities in Brazil [43], as well as the travel and tourism sector (e.g., [44]). The literature has noted its potential relevance for the development of the tourism sector [45].

2.2.2. Spinner Innovation Model

The Spinner Innovation Model (Figure 1) set out a current and dynamic model for analyzing the propensity for innovation in SMEs. This model has already undergone application in different scientific fields, including management, information system and economics, and has both bolstered the understanding of and contributed to the European Commission in terms of regional development, performance and economic growth [46].

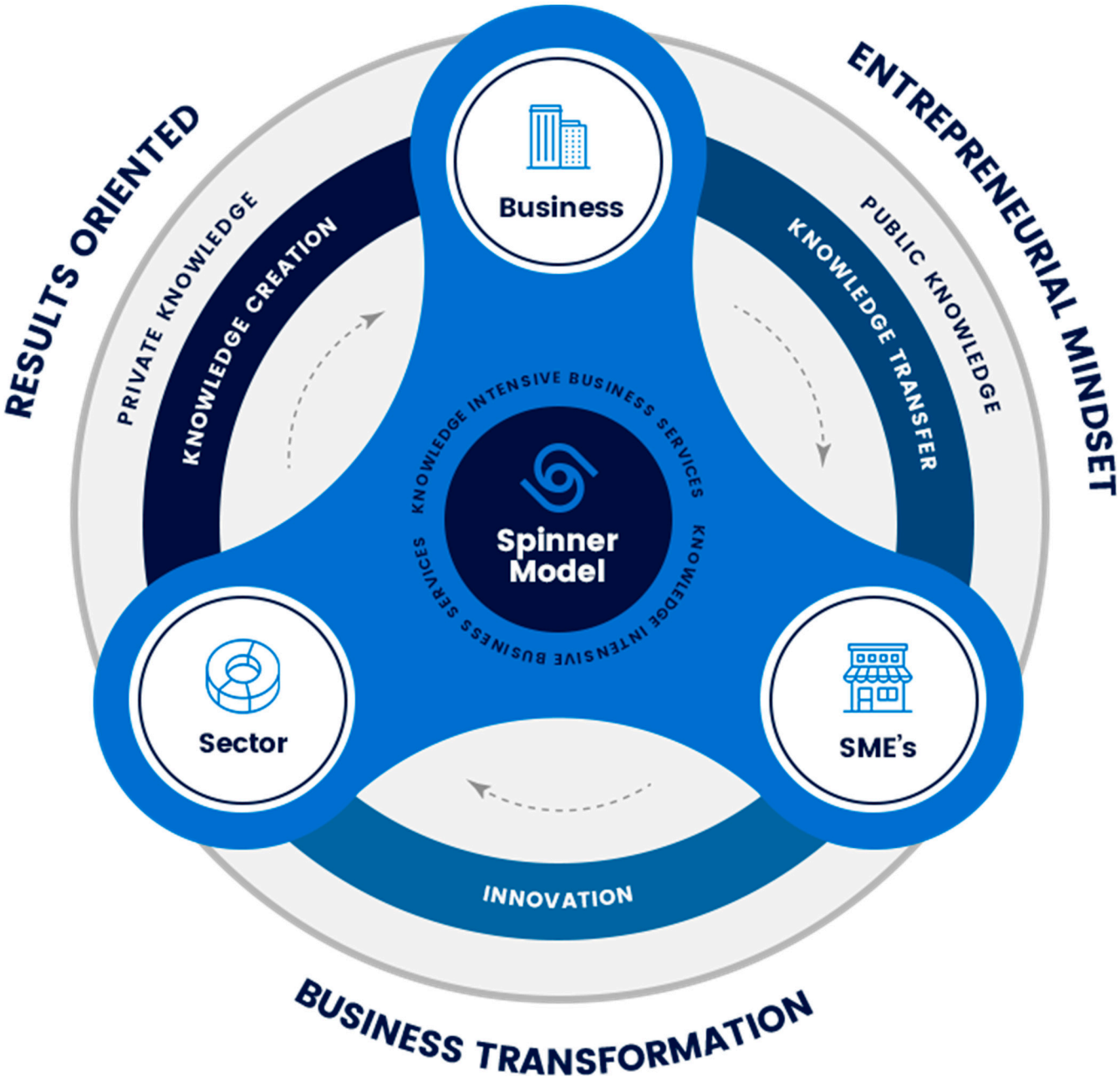

Figure 1. Spinner Innovation Model.

The model's main contribution stems from analyzing and understanding the propensity to innovate in SMEs based on three variables, knowledge creation, knowledge transfer and knowledge intensive-solutions [47]. The model incorporates the dimensions of sector, SME and business to support the analytical approach. Firstly, the model identifies the sector, including the first, second and third economic sectors. Subsequently, the model analyses the variables in order to grasp the propensity to innovate, including private and public

knowledge. The knowledge intensive solutions provided may derive from professional, technological or cultural knowledge and the typologies of innovation span the product, its marketing, the business model and processes [2].

In terms of an example, the technology service sector strives to improve innovation as a driver of the strategy to obtain greater competitiveness. However, this clearly requires understanding the propensity to innovate and identifying any shortcomings in the variables supporting future business innovation processes. Furthermore, the model returns different results as per the individual variables and/or all the variables integrated into the model. In addition, this contributes further value in terms of the knowledge needed for firms integrating into partnerships involving private and public knowledge [48]. The Spinner Model was supported by the Spinner Flow concept that deploys several technological tools for structuring innovation processes [46].

3. Method

In keeping with this theoretical background, the scope of this review seeks to describe the contributions made by the Triple Helix and Spinner Innovation models to co-creation processes ongoing in system innovation. This orientation guided the literature search and analysis carried out in Elsevier's Scopus online database [49] (http://www.scopus.com (accessed on 1 January 2023)), incorporating all documents published through to 2021.

Applying the Boolean operators [50], the search terms featured the keywords: "innovation"; "triple helix model" and "spinner model", (TITLE (innovation) AND TITLE-ABS-KEY (triple AND helix) OR TITLE-ABS-KEY (spinner AND innovation AND model)) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SUBJAREA, "BUSI")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2014) OR LIMIT-TO (PUBYEAR, 2013) OR LIMIT-TO (PUBYEAR, 2012)).

We applied additional limitations and checkpoints taking into consideration only peer-reviewed journals, articles in English, and the Business, Management and Accounting subject fields. We thus collected a total of 128 publications, which we then exported in the BibTex format [51]. The process and criteria deployed to understand and select the papers in terms of analysis adopted the five criteria proposed by [52].

The articles published (1) span the 2012–2021 period; (2) are in English to facilitate comparisons; (3) are theoretical and/or empirical academic papers; (4) closely relate to the topics under analysis, the Triple Helix Model, the Spinner Model and innovation, and, finally, (5) are significant works systematically cited as key references in other selected studies with quite similar focuses.

We applied the "summative approach" to identify the codes (key-words) before and during data content analysis [53]. This process assisted with single words in the innovation context as well as understanding the meaning of specific terms related with the Spinner and Triple Helix models and innovation. Content analysis served to clarify some of the similarities and distinctions between innovation under the Spinner and the Triple Helix models: (a) applications of these models have focused on the innovation context; (b) their main targets are similar and particularly industry and SMEs, government, academia and research centres, (c) society and regional development; (d) environmental impacts and sustainability.

In terms of limitations of this method, the applied inductive logic may not be tested in the future by third parties and we do not know whether the proposed integration of the Spinner and Triple Helix models will return positive results.

4. The Triple Helix Model and Spinner Models of Innovation: Why Are They So Important to System Innovation?

The initial purpose of the Triple Helix model [38] was to understand regional economic growth and promote entrepreneurship through dynamic interactions ongoing among the three spheres of university, industry and government. On the other hand, the origins of the Spinner Innovation model were to contribute to the European Commission in terms of economic growth, regional development and performance by engaging with three dimensions: (KIBS), (FIRM) and the (Service Sector).

The Triple Helix model has experience the evolution of its helices, both supporting and expanding the model by taking into consideration the new features emerging in contemporary societies and their citizens. In turn, the Spinner model has been working on the challenges of supporting SMEs through establishing regional ecosystems and adding more variables to the new "fidget", intellectual property (IP) for example.

Finally, the number of helices has undergone a sharp increase in the Triple Helix model, firstly considering academia, universities and higher education systems, secondly, industry, firms and economic systems, thirdly, states, governments and political system, fourthly, media-based and cultural-based publics and fifthly, the natural environment and social environmental contexts. According to [54], more knowledge-based economies may be stimulated through the creation of public demand for technical advances and innovations, thus demonstrating the significance of the public's role in the sense of society. While not opposed to adding additional propellers to the Triple Helix model, these authors maintain that doing so makes measuring the relationships still more complex. On the other hand, in [55] the researchers report that Quadruple and Quintuple Helix models interlink with production mode 3, which is 'a multi-lateral, multi-nodal, multi-modal, and multi-level systems approach to the conceptualisation, design, and management of real and virtual, 'knowledge-stock' and 'knowledge-flow', modalities that catalyze, accelerate, and support the creation, diffusion, sharing, absorption, and use of co-specialized knowledge assets'. (p. 205), while the Triple Helix still remains in production mode 2.

At the same time, the Spinner Innovation model has experienced a rise in the number of new "fidgets" in accordance with its application to different economic sectors: the primary (raw materials and primary sector jobs), the secondary (manufacturing and industry), the tertiary (service industries), the quaternary (intellectual outputs), and the quinary (hospitals, governments and non-profit agencies) sectors.

Furthermore, the Triple Helix model particularly serves as a framework for analyzing national innovation policies and hence generating policy recommendations. In contrast, applications of the Spinner model focus on analyzing the propensity of SMEs to innovate and provides advice and recommendations for structuring innovation processes.

Based on the Triple Helix model [38], Henry Etzkowitz sets out the model in his book "Triple Helix: University-Industry-Government Innovation in Action", now in its second edition. On the other hand, the creator of the Spinner Innovation model, Ronnie Figueiredo discusses and presents the model in the book "Spinner Model: Innovation in the Service Sector".

As regards the Triple Helix model, other scholars have since contributed to developing its theoretical foundations, returning insights through drawing on social network and game theories. In the Spinner Innovation model, several researchers have deployed different techniques to analyze the propensity for innovation, such as machine learning, econometric and structural equation modelling.

Furthermore, we should recall that the proposal behind the Triple Helix model sought to label certain new developments in innovation based on advances in science and technology. In turn, the design of the Spinner Innovation model seeks to ascertain the real propensity of the business to innovate before embarking on structured innovation processes.

The Triple Helix model captures the "Innovation in Innovation" interacting among the three spheres of university, industry, and government, especially at the regional and local levels. In addition, the institutional reconfiguration for supporting start-ups and

technology transfers, as well as inventing new mechanisms, represent key facets of this concept.

In turn, the Spinner Innovation model understands innovation as a lengthy process, daily "Testing and Testing" and integrating private knowledge into public knowledge in a co-creation process to develop knowledge-intensive solutions capable of meeting customer needs while developing regional economies.

The Triple Helix model differs in its incorporation of three types of models: the "statist", "laissez-faire", and "balanced" models while the Spinner Innovation model adopts a totally different approach through its three variables of "knowledge creation", "knowledge transfer" and "knowledge-intensive solutions" and resembling a fidget spinner.

4.1. The Spinner and Triple Helix Frameworks

The objective of the proposed framework (Figure 2) involves creating more value for businesses by integrating these two models of innovation: Spinner and Triple Helix. Both conceptions require integration by specific businesses to support their system innovation. Furthermore, this also acknowledges the importance of analyzing whether the innovation is necessary coupled with the propensity for innovation in accordance with the respective actors in the system innovation. before actually embarking on any innovation process.

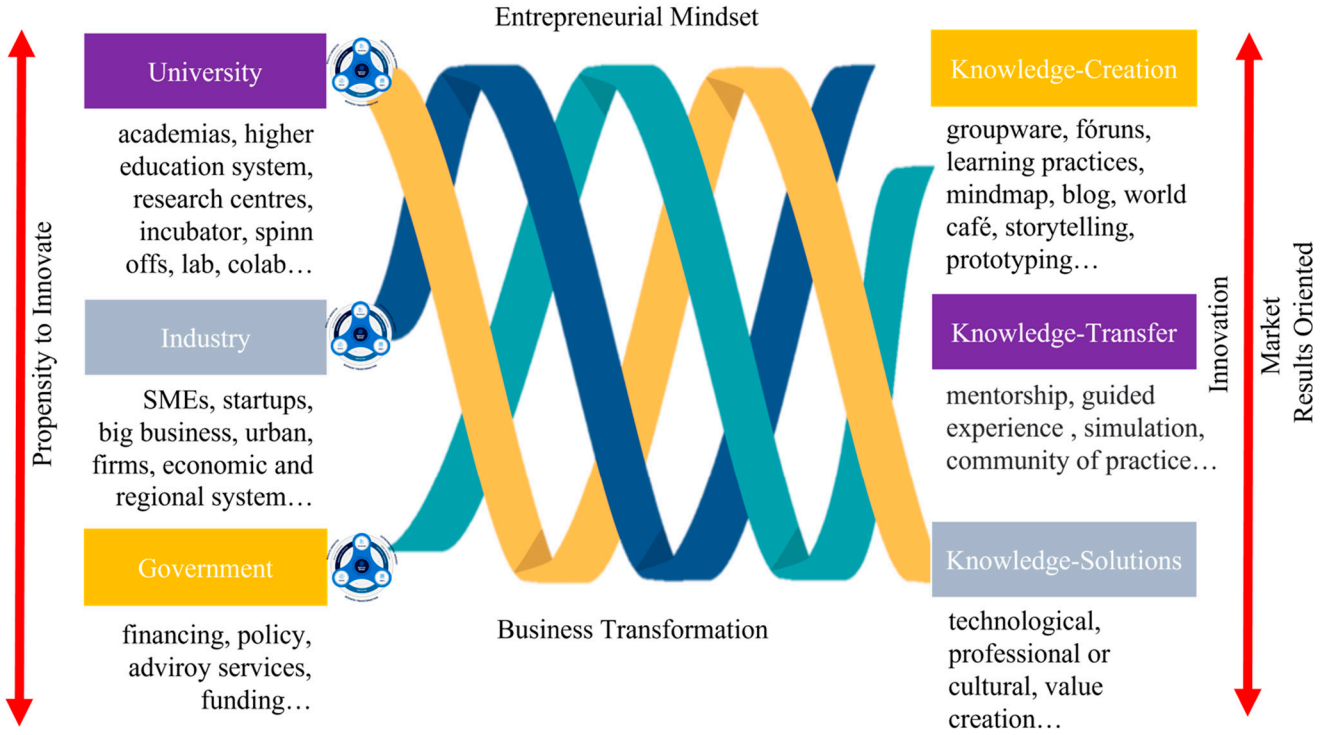

Figure 2. Framework to Integrate the Spinner Innovation and Triple Helix Models.

According to the framework, a number of actors, whether one, two or three (Triple Helix), may or may not display the propensity to contribute to the respective innovation. The framework provides this option by applying the (Spinner) and analyzing the three fidgets, knowledge creation, knowledge transfer and knowledge solution. In terms of an example, imagine a university lab or research center opting to support industry (an SME) in the agriculture sector. It's important to analyse the propensity to innovation in order to understand the university's potential for collaborating with the SME through an system innovation. Subsequently, the result of the fidgets portrays the propensity to innovate of the university entity under analysis. The same terms of analysis may then extend to the SME before comparison of the outcomes underpin the strategic decisions that drive innovation processes.

4.2. Spinner Flow and Triple Helix Interactions

To support all the actors in terms of their propensity to innovate, the Spinner works with the flow, a structured process for orienting innovation processes and measuring progress based on nine steps (Figure 3). The "Flow" includes several technological tools to help leaderships in terms of their innovation related decisions.

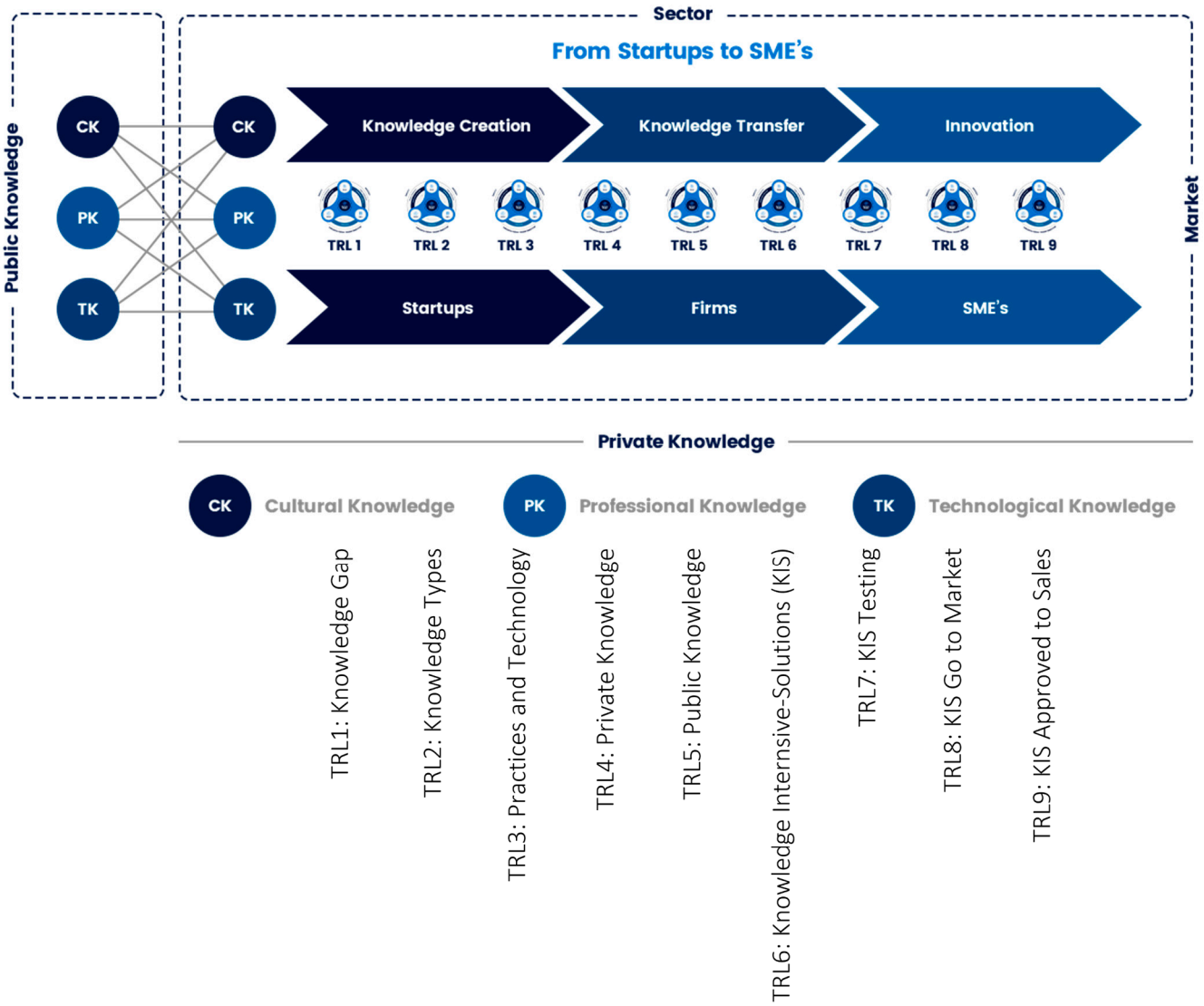

Figure 3. The Spinner Knowledge Flow in Support of Triple Helix Model Interactions.

Starting the flow requires identifying the main actors before integrating practices and technologies capable of structuring the innovation process and measuring the evolution of the knowledge intensive solutions provided. The TRL (Technology Readiness Level) scale, designed by NASA (National Aeronautics and Space Administration) serves to measure the progress in technological innovation, beginning at level 1, TRL1 and concluding in terms of complexity at level 9, TRL9, in the Spinner Innovation model.

According to these steps, the practices and technologies work in conjunction during the development of knowledge intensive solutions. This situation results from integrating the actors and the fidgets. TRL 1 reflects "The Knowledge GAP", the knowledge needed when starting out structuring innovation processes.

Next, the process needs to incorporate whatever the type of knowledge identified as a need, e.g., whether cultural, professional and/or technological. Then, TRL 3 incorporates

certain technologies e.g., machine learning and with particular practices, such as mentoring in order to collaborate with TRL2 and TRL1. In addition, the knowledge identifiers in TRLs 1 and 2 require support from sources of private and/or public knowledge, TRLs 4 and 5.

To continue with the flow, in TRL6, the system innovation actors provide knowledge-intensive solutions (KIS) for discussion and improvements. Testing these "KIS" takes place in TRL 7 for a specific period of time. Following the approval of these solutions, the next step involves "Go to Market" with TRL8 testing them with initial adopters. To finalize the innovation process, TRL9 collects feedbacks from the market and launches official sales. Whenever so necessary, the flow may repeat any TRL or do so at the end to establish different loops of learning.

In addition, there might also be testing of another scale by the Spinner Innovation and/or Triple Helix models. For example, the TRL scale was developed with 7 levels in 1974 before expansion to 9 levels in the 1990s [56]. However, there is also the Innovation Readiness Level (IRL) scale studied by [57], which incorporates six "Cs" into the lifecycle of innovation processes: concept, component, completion, chasm, competition and changeover. Furthermore, in [58] the author proposed integrating the Technology Readiness Level and Innovation Readiness Level into a specific framework. This considers all the TRLs between IRL1 and IRL3 (TRL1–TRL9) with the subsequent three phases, from IRL4 to IRL6, designed to maintain the evolution of innovation. When considering the Spinner Innovation framework and considering the additional IRLs, we might feasibly integrate IRL4, IRL5 and IRL6 after TRL9 to support the sustainability of future innovation. In the near future, other models and frameworks, for example Open Innovation, Stage-Gate and Design Thinking might also be susceptible for integration to support innovation development alongside the IRL and/or TRL scales.

5. Conclusions

Discussions of innovation have spanned different scientific fields with different approaches and contributions, whether to the performance of SMEs, economic growth and/or regional development. Some models emerged years ago and have their own traditions while others are more recent. However, integrating these models may return deeper understandings of the respective different needs encountered by SMEs worldwide. Furthermore, the literature frequently defines innovation as a structured process involving several steps or stages perceived differently by SMEs.

The importance of the existing differences explains the proposition of the two innovation models and aligning the stages and steps to foster opportunities to make several types of innovation happen, including process, marketing, services, product, model, organizational . . . As the authors have presented and proposed in this article, the two models, Triple Helix and Spinner could support a structural process between the helix and the fidget that respectively underpins these models. Therefore, the question, "why are they so important to system innovation? seems well justified.

The results of this paper demonstrate a new approach through presenting a conceptualization of innovation processes integrating two famous models, Triple Helix and Spinner. This approaches innovation processes through the interactions of different actors, whether by the Triple Helix or the different fidgets of the Spinner Innovation Model.

From the perspective of the authors, the integration of both models supports the relationships between universities, government, SMEs and other actors engaged in structural system innovation. Furthermore, the authors are in no way proposing that innovation simply happens after applying these integrated models because innovation processes require testing every single day until producing results. Innovation arises from the ongoing interactions between actors, captured by the fidgets, as they strive to build up the right combination of resources and inherently posing challenges to businesses.

The conceptual framework proposed respects the differences in the models and how they bring value to business by integrating exactly those differences. Universities, government, industry . . . and knowledge-creation, knowledge transfer and knowledge-intensive

solution . . . , configure a new way to interconnect with the needs of society and create new ways of working in systems for innovation through engaging in innovative activities. Therefore, the framework proposed in this paper correspondingly needs further refining and developing for application to different approaches, sectors, businesses and actors around the world.

As any study, there are some limitations that require outlining for future research. The first limitation of this paper derives from the capacity to test the framework in different economic sectors and provide the results to validate the proposed framework. Therefore, we would recommend future research examines applications of the current study framework to different contexts. Another limitation interrelates to the collection and analysis of the retrieved data from only a single database, namely Scopus. Incorporating another database, such as Web of Science, as an inclusive dataset [59], might complement this study and indicate appropriate directions for future research through gathering and analyzing additional scientific productions/publications to generate clear insights into both models and their associated outcomes in relation to knowledge and innovation within different contexts and domains. This could also help in obtaining relevant papers published in reputed and high rank journals. Such databases contain high-quality journals, and publications of different scientific domains and fields (e.g., Business and Management, Social Sciences, Engineering, Education, etc.). Indeed, this could help in developing synergies on the current research subject [60]. In addition, future research could employ advanced bibliometric techniques such as concept maps and bibliographic coupling/analysis or content analysis of the publications retrieved from such datasets to provide in-depth understanding concerning the research themes [61–63]. Moreover, this paper depended on English language articles published in peer-reviewed journals within the subject field of 'Business, Management and Accounting'. Hence, future research might search for articles within other subject fields. Additionally, this might collect and analyse other scientific outputs on these research subjects (e.g., book chapters, proceedings, and conferences, etc.) to provide a broader overview of the significance of these two models for knowledge and innovation [64–66].

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