University Spin-Offs: The past, the present, and the future

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Purpose of this paper: This paper examines the past and present of the university spin-off (USO) phenomenon by identifying research findings and synthesizing different spin-off practices from around the globe. The evolution and future of this phenomenon are then discussed, alongside potential new lines of research.

Design/methodology/approach: This study adopts a systematic literature review approach, combined with a Multiple Correspondence Analysis. This approach allows for the creation of a robust and reliable synthesis of the research carried out over the past 35 years (1986-2020), offering a fine-grained depiction of the USOs' underlying relationships through multiple correspondence analysis (MCA).

Findings: This paper contributes to scholarly literature on academic entrepreneurship by providing insights into the analytical trends of the past, current evidence on the configuration of USOs, and discussions of the future of USO research. Several implications for improving performance, productivity, and reinforcing capabilities emerge to assist spin-off CEOs, university managers, and policymakers.

Originality/Contribution: This paper fulfils an identified need by revealing the trajectory of the USO research field. Additionally, it presents an up-to-date reflection of USO antecedents, decisions, and outcomes, outlining an agenda for future research.

Keywords: University Spin-Off, Academic Spin-Off, Research Spin-Off, Literature Review, Multiple Correspondence Analysis.

Article Type: Research paper.

1 INTRODUCTION

In recent decades, university entrepreneurial activities have attracted the attention of academics, practitioners, and policymakers. Given the derived socio-economic impacts of regional development, governments around the world have implemented policy frameworks to stimulate basic components, empowering universities through the efficient allocation of public/private resources, the configuration of the intellectual property protection, and the triple helix collaboration (Guerrero & Urbano, 2021). This intervention has significantly aided the expansion of the academic entrepreneurship phenomenon (Carayannis et al., 1998; Grimaldi et al., 2011; Siegel & Wright, 2015; Aldridge & Audretsch, 2017; Dabić et al., 2016; Dabić et al., 2017; Guerrero & Urbano, 2019b), leading to an exponential increase in university spin-off (USO) research over the last few decades (Miranda et al., 2018). The proliferation of USO publications and the continuous increase in the number of citations signify the consolidation of the USO research line.

Previous literature reviews have contributed to this by shedding light on the field's micro-foundations and taxonomy (Mustar et al., 2006); the university determinants of academic entrepreneurship (Rothaermel et al., 2007; O'Shea et al., 2008; Miller et al., 2018a); the N-helix actors involved in technology transfer (Miller et al., 2018b); other methods of re-thinking USO as an entrepreneurial process that need inputs and generates outputs (Sørheim et al., 2011; Miranda et al., 2018); the university-industry engagement (Skute et al., 2019); and the barriers/drivers of success and performance (Hossinger et al., 2020). Most systematic literature reviews have also highlighted seminal publications (Callan, 2001; De Coster & Butler, 2005; Klofsten et al., 1988; Ndonzuau et al., 2002; Lockett & Wright, 2005; Lockett et al., 2005; Pirnay et al., 2013; Smilor et al., 1990; Wright et al., 2006). Looking to the past helps us to understand previous evolutions and trends, providing insights into contemporary debates that have been ignored by current researchers. This allows us to build a future research agenda to extend USO analysis.

Motivated by these antecedents, this study reviews the last 35 years of published investigations, focusing on the contributions of USO research to the fields of entrepreneurship and innovation studies from 1986 to 2020. In order to accurately portray the dynamic nature of the USO intellectual domain, as well as the scholarly shifts in interest over time, this analysis divides time into two different sub-periods: P1 (1986–2013) and P2 (2014–2020). This division of periods arose due to the exponential increase in the number of articles published after 2013, as recognized by Hossinger et al. (2020). Around 50% of the reviewed manuscripts were published in the P2

timeframe which, in terms of temporality, represents one-fifth of the period covered. The reasoning behind this exponential publication increase could be partially explained by either the *Research Policy* journal special issue on academic entrepreneurship in 2011 ("Special Issue: 30 Years After Bayh-Dole: Reassessing Academic Entrepreneurship"); increased recognition of universities' 3rd mission, especially in Western economies (Miranda et al., 2018); or improved accessibility and transparency in data on USOs. This approach facilitates the depiction of changes in research interests, outlining different spin-off practices from around the globe and giving rise to sub-domain trajectories. Additionally, to provoke discussions on the re-focusing of the phenomenon along new research lines, this review provides contributions to theory testing and development, identifies research gaps, and suggests future research avenues (Snyder, 2019). As such, this paper adds to the body of literature on USOs by delivering insights into analytical trends of the past, providing current empirical evidence on the configuration of USOs, and offering discussions of the future of USO research. Several implications for improving performance, productivity, and reinforcing capabilities also emerge to assist spin-off CEOs, university managers, and policymakers.

The subsequent section outlines previous attempts to synthesize literature around the domain of USOs, which in turn enables ground clearing in an attempt to better understand the phenomenon, before disclosing the methodology and revealing the trajectory of the USO research field.

2 LAYING THE FOUNDATION: PREVIOUS REVIEWS ON USOs

Universities' contributions to society have become contingent upon knowledge transfer and business engagement, causing academic roles to evolve (i.e., teaching and administration) toward technology commercialisation (Miller et al., 2018b). This new role for academics (Etzkowitz, 1983) became a topic of interest for numerous scholars, who acknowledged the increasing value of commercialisation for academic research, as well as the roles it can play in economic development (Clyen & Braet, 2010). However, despite the recognized societal contributions derived from academic research and personnel employed at universities (Miller et al., 2018a), scholars and practitioners agree that the process of value creation and appropriation has always been challenging, slow, and substantially influenced by various factors (Miranda et al., 2018).

The progress of USOs, and their recognition as an international phenomenon with multiple recognized challenges, has provoked debates with regards to the definition of USOs. This can be observed through various attempts at conceptualization. Firstly, Mustar et al. (2006; p.289),

building upon Smilor's (1990) definition, conceptualized USOs as "…the creation of ventures based on the formal and informal transfer of technology or knowledge generated by public research organisations". De Cleyn and Braet (2010; p.54-55) then highlighted the shortcomings of conceptualizations by Carayannis et al. (1998), Smilor et al. (1990), and Steffensen et al. (1999), proposing that USOs represent a spin-off originating from an academic parent organization. This organization must be "(1) a new legal entity (company) (2) founded by one or more individuals seconded or transferred (sometimes part-time) from a parent company (3) to exploit some kind of knowledge (4) gained in the parent company and transferred to the new company". Likewise, Miranda et al. (2018; p.1008) posited that USO is "…when the company was established within a higher education institution, putting into practice the knowledge generated in these centres through the R&D activity of academics". More recently, Hossinger et al. (2020; p.98) defined USO as "…a new company that is established by the exploitation of a core technology or technology-based idea generated within a university, where the founding member(s) may or may not be affiliated to the academic institution".

The observed distinction in conceptualization, alongside the changing roles of academics, inspired scholars to synthesize the intellectual domain and consider re-focusing the phenomenon along new lines. This can be seen in the shift away from the traditionally non-commercial academic environment, motivated Mustar et al. (2006), in which USO literature was reviewed in order to develop a taxonomy based on the relevance of institutional links, business models, and resource allocation, identifying common themes regarding spin-off creation and development. Next, Rothaermel et al. (2007), adopted a broader approach, analysing 173 articles on university entrepreneurship published between 1981 and 2005. The researchers recognized that, in order to foster entrepreneurial activities among academic members, there was a need to support the university-industry link at regional/policy, institutional, and individual levels. Moreover, Miller et al. (2018b) highlighted the relevance of USOs to the overall entrepreneurial system and the importance of new knowledge sources originating from academic institutions, while also pointing out the somewhat overlooked position of the individual academic. Miller et al. (2018) distinguished between two changing roles of academics: (i) entrepreneurial academics ("seeking opportunities to support research by less formal modes of engagement") and (ii) academic entrepreneurs ("use formal modes to commercialize and capitalize on specific market opportunities") (ibid; p.15). Accordingly, Hossinger et al. (2020) reviewed 193 articles published between 2000 and 2019,

indicating that individual factors possess more explanatory power in defining what should be considered academic entrepreneurial behaviour. Though the USOs creation and development are in addition to the micro-level, they are also strongly dependent on meso and macro-level factors (e.g., relationships with parent organisations and regional contexts). Hossinger et al. (2020) revealed numerous micro-meso-macro drivers, barriers, and factors that can affect USOs' creation and development. In sum, while the USO domain is rapidly expanding, previous reviews have followed either an objective bibliometric approach (Skute et al., 2019) or a subjectively biased expert view (Miranda et al., 2018). This review adopts a computer-aided content analysis approach, which provides a balanced degree of the author's subjectivity with objective analysis (Furrer et al., 2020). It also uses a larger sample of reviewed literature.

3 METHODOLOGY

3.1. Integrative literature review

Building upon Callahan's notion of the integrative literature review, which is considered "a piece of research that focuses on a specific topic and uses a replicable methodology in order to reveal the intellectual structure of the research" (2010, p.301) and Shafique's view that the intellectual structure is "a set of salient attributes of the knowledge base that can provide an organized and holistic understanding of the chosen scientific domain" (2013, p.63); we carried out the following steps: i) we conducted a content analysis of the literature indexed in Web of Science[1] and Scopus[2] databases, then using QDA Miner v.5 and Wordstat v.8 software; ii) we performed a multiple correspondence analysis (Hoffman and De Leeuw, 1992; Greenacre & Blasius, 2006); and iii) we developed a customized framework, mapping the genealogy of USO studies. Our work acknowledges previous reviews on the topic (Rothaermel et al., 2007; Miranda et al., 2018; Skute et al., 2019; Hossinger et al., 2020) and explores the trajectory of the USO research field by synthesizing the antecedents (Thomas et al., 2020), decisions, and outcomes of different schools of thought, assessing their role in USO outcomes and proposing a future research agenda.

For data collection, in order to address the trajectory of the USO field, we began by searching for articles that contained keywords such as "university spin?off*" or "research spin?off*" or "academic spin?off*" or "university spin off*" or "research spin off*" or "academic spin off*" in

[1] For further details, please review http://mjl.clarivate.com/publist ssci.pdf
[2] For further details, please review https://www.scopus.com/sources.uri

their Title, Abstract, or Author Keywords. Secondly, to ensure the validity of the review, we limited our analysis to academic journals with a peer-review process that were written in English (Podsakoff et al., 2005). We excluded conference proceedings, book chapters, editorial notes, and reviews. Thirdly, to map the trajectory of the field, we did not impose any time-constraints. This allowed us to better understand the nature of the progression of the USO research field. The search criteria at the date of extraction (27th May 2020) resulted in 488 articles. Following Graneheim and Lundman's (2004) recommendations, the selected manuscripts were reviewed by an international team consisting of four members. The final list includes articles published in highly ranked business management journals from 1986 to 2020. This topic was mainly disseminated by the three leading journals in innovation, entrepreneurship and science, and research policy. The top journal was the *Journal of Technology Transfer*, which published 56 scientific contributions. The second was *Technovation,* with 23 papers devoted to the topic, followed by *Industry and Higher Education* with 22 papers*,* and *Research Policy* with 21 papers (see Table 1 for most frequent publication sources).

--- Insert Table 1 here ----

3.2. Multiple Correspondence Analysis

To map the USO research field's trajectory for the data analysis, we performed multiple correspondence analysis to examine the qualitative data (Hoffman and De Leeuw, 1992; Greenacre & Blasius, 2006). Distinct to other methodologies for integrative literature review such as meta-analysis and meta-regression which access the effects of a set of dependent variables on any independent variables (Hansen et al., 2021); bibliographic coupling and co-citation which provide objective account without offering an in-depth perspective on the content of the domain (Zupic & Čater, 2015), the main advantage of this approach lies in its ability to integrate fine-grained content analysis while "minimizing the author subjectivity biases and offering a more objective account of the research domain" (Vlacic et al., 2021; p. 188). Next, MCA approach "a*llows the representation of the underlying intellectual structure of the area with a thorough reflection derived from the research team's analysis and interpretation of both the map and the content of the articles*" (López-Duarte et al., 2016; p. 512), providing answers to how's and the what's: the topics addressed, how they interrelate, the methods used and the context where the investigations have been conducted.

The HOMALS analysis identify the associations between dichotomous variables (the occurrence of the defined descriptors in the study) and was performed in SPSS (v. 26) software to identify descriptors in the articles' titles, abstracts, and keywords. The findings of this approach are depicted on a proximity map, with descriptors positioned along the two axes (see Figure 1). Accordingly, the proximity between the descriptors corresponds with the common constituent. Where a large proportion of the articles treat descriptors similarly, the treated descriptors are positioned close to each other, and vice versa. The core of the map represents the average position of all articles within the field (i.e., if the descriptor is positioned close to the centre, then a large number of articles within the field are researching this topic). This approach has been widely used in highly ranked journals and is recognized as useful when it comes to mapping the structure of various research fields, such as cross-border mergers and acquisitions (Kiessling et al., 2019), serial entrepreneurship (Dabić et al., 2020), and artificial intelligence in marketing (Vlacic et al., 2021), etc.

A deeper understanding of the USO intellectual domain could be established by better illustrating the dynamic perspective, the direction of change, and the impact of change on the relationships between the research themes over time (López-Duarte et al., 2016). Advancements in scholarly research and changes in interest over time are revealed by categorizing time into two sub-periods: P1 (1986–2013) and P2 (2014–2020). As presented in Figure 2, a descriptor position relative to P1 enables the trajectory of research from this subperiod to date to be obtained. Accordingly, the "arrows represent the direction of evolution of each theme; their length signals the extent of changes in the themes" (Furrer et al., 2020, p.313). Potential research gaps and fruitful future research avenues are signalled by distance. The lesser the degree of association between the descriptors, the larger the distance (see Figure 2). To inspect the statistical significance of changes in descriptors' relative shares from P1 to P2, a two-tailed z-test was performed (see Table 3).

4 LOOKING INTO THE PAST AND THE PRESENT

In order to outline the intellectual structure of the USO domain and present a more dynamic view, 488 manuscripts were content analysed with the assistance of QDA Miner 5 and Wordstat v.8 software. The computer-aided content analysis resulted in a codebook containing 1,471 keywords, which were categorized into 22 descriptors belonging to theoretical underpinnings, major research themes, geographical contexts, and methodological approaches (the full list of the

articles reviewed, along with the generated codebook, is available from the authors upon request). Although the HOMALS approach allows us to analyse the causal connections between the descriptors by presenting results in a low-dimensional proximity map, the variance estimations tend to be misleading due to the consolidation of multi-dimensional space in only two dimensions (Furrer et al., 2020). As shown in Figure 1, the total variance accounted for is 21.78%. Hence, Hair et al. (1998) noted - and Furrer et al. (2020) later supported - that the overall keyword means per article estimates provide a better indicator of analysis validity. This should be greater than 1. In our case, the general keyword mean per an article is 1.54. With regards to the research setting, the geographical content of the retained articles investigated Europe, North America, South America, the Middle East, Africa, and Asia. Regardless of the diversified distribution, most articles focused on European countries, followed by the US. Very few articles were based in Asian, African, or Middle Eastern contexts. This result is compatible with the findings of previous literature reviews on spin-off research (Miranda, 2018; Hossinger, 2020). Over the last three decades, a relevant pattern has emerged in the research consolidation of this phenomenon in a European context. This concerned the US context. Methodologically, an observable pattern is the balanced use of both qualitative and quantitative methods. It represents a good indicator when considering the complexity of the phenomenon, which has been analysed by single/multiple qualitative cases for many years. It also reveals the efforts of many researchers in conducting surveys and the work of research funders in supporting the generation of datasets.

--- Insert Figure 1 here ----

Following López-Duarte et al. (2016), the first phase in depicting the intellectual domain through a low-dimensional proximity map involves labelling the poles. The poles are labelled based on the vicinity of the descriptors and their frequency of occurrence (see Table 2). The left side of the horizontal axis pole is labelled ‘orchestration and innovation’. The ability of a USO to orchestrate resources and offer innovative solutions to the market is categorized by descriptors such as resource-based view, innovation, innovativeness, and international view (Rodríguez-Gulías et al., 2018; Wright et al., 2012). The analysis shows the importance of the entrepreneurship/innovation field, insights from the resource-based view of the firm, evolutionary theory, and the emerging importance of regional and ecosystem support for snowballing numbers

of spin-offs (Abootorabi et al., 2021). Furthermore, several USO papers in these domains draw on perspicuity from strategy literature, indicating an interesting bridging position of the use of network theory. The right side of the horizontal axis represents the relevance of the quadruple helix within the USO domain, illustrated through the institutional view, knowledge-based view, and technology transfer descriptors. In an era of rapid expansion for USOs, collaboration between government, industry, and academia, as well as societal-based innovation users, represents a quadruple helix perspective. This is considered critical to the enhancement of social and economic development (Miller et al., 2018a; Sinell et al., 2018).

--- Insert Table 2 here ----

Vertical axis poles represent manuscripts studying entrepreneurial culture and performance in the upper section, while risk and uncertainty are addressed in the lower section. Essentially, the entrepreneurial view represents the underlying theoretical foundation that dominates both time periods - both P1 and P2 (see Figure 2 and Table 3). Given the increasing efforts to commercialize academic research, the entrepreneurial activity of USOs serves as a foundation for the USO domain and its performance (De Cleyn & Braet, 2010; Walter et al., 2006). The central thematic areas in the cluster on USOs and commercialisation can be characterised by several USOs encountering expansion phases and overcoming various problems associated with critical milestones. In introducing his classification of dynamic capability - seizing opportunities - Teece (2007, p.1326) notes: “once a new (technological or market) opportunity is sensed, it must be addressed through new products, processes, or services. Which almost always requires investments in development and commercialisation activity”. By following Teece’s (2007) view, we assume that the appropriate timing in any decision-making processes related to technology transfer and commercialisation would sustain any competitive advantage. For instance, the spin-off seizing process, which is associated with a new invention, will demand several ingredients, such as the adequate selection of intellectual protection, the attraction of potential investors, the definition of a commercialization strategy, and the implementation of timing (Thomas et al., 2020). Thus, to successfully develop a spin-off, one must recognise that this is a dynamic – and, more notably, a multistage - that demands diverse knowledge and varied resources, pivoting on the practice and position of the policy support system to entrepreneurship. This requires specific short-term and long-term evaluation measures

and benchmarks. A large portion of publications in this cluster pointed this out (Vohara et al., 2004; Ullah et al., 2007; Clarysse et al., 2014; Messina et al., 2022). On the other end of the vertical axis, the research includes notions of risk and uncertainty management, referring to the risks associated with governance and USO initiation and commercialization capabilities, among other factors (McAdam et al., 2010; Meijer et al., 2019).

--- Insert Figure 2 here ----

--- Insert Table 3 here ----

Vertical axis poles also show that the network view has been one of the most frequently adopted approaches to studying this phenomenon. Indeed, the number of manuscripts that have used for this theoretical approach has considerably increased across both periods P1 and P2 (see Figure 2 and Table 3). A plausible explanation has been related to the associated contribution of social networks to USOs' capabilities (Walter et al., 2006; Aaboen et al., 2016), successes, and performance (Hayter, 2015), along with the provision of useful funding for (open) innovation (Soetanto & Van Geenhuizen, 2015). Rasmussen et al. (2015) explored how social networks helped to construct/refine USOs' valuable entrepreneurial competencies according to business development needs. Indeed, Sousa-Ginel et al. (2017) suggested that the knowledge conversion from appropriated industrial network configurations depends on the size and frequency of the contacts that provide the tacit vs. codified character of the USO's knowledge base. Examining success, Hayter (2015) found that academic entrepreneurs' success in New York State research institutions was strongly linked to the type and size of their extra-regional (non-academic) networks, such as investors, advisors, and policymakers. The argument was that these social networks provided a broader basis of knowledge and resources, leading to regional economic development (Hayter, 2015, 2016). Examining access to funding for (open) innovation, Soetanto and Van Geenhuizen (2015) found that the size, density, and multiplexity characteristics of well-connected networks had a positive influence on a USO's ability to attract long-term funding. The role of these well-connected networks varies across emergent sectors, such as biotechnologies (Crispeels et al., 2015).

Another emergent theoretical underpinning observed from P1 to P2 was the sustainability orientation of USOs (see Table 3 and Figure 2). A plausible explanation, along with the emergence

of USOs' sustainability, has been related to the analysis of the development of USOs in emerging/transition economies (Kruss, 2008), as well as the longitudinal focus on USOs' growth patterns (Treibich et al., 2013; van Geenhuizen & Ye, 2014). On the adoption emergence of this theoretical approach, Kruss (2008) explored the sustainability patterns of USOs in South Africa. Specifically, Kruss (2008) identified relevant barriers to promoting USOs' sustainably. These were related to the fragility of national innovation systems, the insufficiency of networks, and the inefficacy of their alignment with competitiveness. On sustainability transition, Treibich et al. (2013) evidenced the initial insights of sustainable dynamism through different modes of interaction between USOs and parent universities, along with their relative roles in sustainable modes of knowledge creation. Likewise, van Geenhuizen and Ye (2014) paid attention to how small USOs transition towards sustainability by connecting micro-level (networks) and meso-level (open innovation) conditions. With regards to this particular issue, Geenhuizen and Ye (2014, p.28) state that "product market and selectivity in the choice of partners connected to professional (venture) capital, market access, credibility, and complementary assets are highly relevant when it comes to influencing change in socio-technical systems". Therefore, we assume that these elements could guarantee the success of the definition and the implementation of a sustainable commercialisation strategy.

5 LOOKING FORWARD TO THE FUTURE

5.1. Implications for Theory

Our literature review has two main contributions. The first contribution of this study lies in its efforts to analyse a consolidated research field (USOs) by implementing a robust qualitative methodological design. This methodological design provides insights into how researchers could reduce the number of critics/debates related to the ongoing boom in literature reviews that only focus on describing basic elements by ignoring the quality of contents of the revised publications (Rauch, 2020). Consequently, literature review methods are an interesting topic of academic debate that should be considered in the management and entrepreneurship research agenda. This paper's second contribution is manifest in the ways in which it provides a better understanding of the evolutionary patterns of USO literature by disaggregating publications into two sub-periods: P1 (1986–2013) and P2 (2014–2020). This categorisation facilitates a better understanding of the

dynamics of the themes and theoretical approaches that have consolidated the field. Indeed, this analysis does not only look to the past/present, but also helps with multiple implications for the academic community.

With regards to this paper's implications for theory, we propose a research agenda that advocates for extending USO research in the future. *Conceptually*, researchers should re-focus on the single used approach towards a multidisciplinary theoretical approach (e.g., economic, sociological, historical, managerial, technological). This demands the study of the most complex/contemporary USOs' strategic management focus (e.g., economic, sustainable, or societal engagement); dynamic configurations of USOs' governance and organisational composition (e.g., management of talent, conflicts of researchers' identities); shares of risks/resources via open-digital-international collaboration patterns (e.g., efficient allocation of resources, capabilities, and geographies); USO's scaling up evolutionary processes (e.g., creation, consolidation, diversification, and failure); and the positive/negative relationship USOs have with industrial, university-based, and regional ecosystems. *Methodologically*, this study evidences the lack of secondary sources of USO information that facilitate the analysis of the aforementioned contemporary themes. Therefore, methodological commitments in future research should seek to go one step further, by generating quality data using mixed-method and replication methods. This implies the combination of robust qualitative approaches (e.g., narratives, ethnographies, experiments, single/multiple cases) and robust quantitative approaches (e.g., longitudinal and cross-sectional). *Geographically*, this study has highlighted the relevant role of context on USOs. Due to a lack of information sources, it was difficult to document the USO phenomenon in less-disadvantaged economies based in Asian, African, or Middle Eastern contexts. Context matters and, as such, future researchers need to extend our understanding of USO literature in the aforementioned contexts.

5.2. Implications for Practitioners

This research presents key implications for policymakers and university managers. It is important that policymakers understand that an entrepreneurial university ecosystem supports existing businesses because USOs are able to interact with them. They can also contribute to their growth by introducing innovative technologies, and they integrate themselves into existing business ecosystems. The evidence suggests that there is a high concentration of USOs in

technology-based industries (e.g., biopharmaceutical, health and medical devices, consumer electronics) in developed economies. This reveals USO evolution across industries/context boundaries, offering several implications for the main actors related to this study.

For USO CEOs, the accumulation of knowledge has revealed some characteristics associated with productivity and performance: specifically, the importance of networking with triple helix agents and continuous learning-knowledge transfer with the parent university. Given the recent unexpected events arising as a result of the COVID-19 pandemic, USO CEOs have experimented by collaborating with multiple actors in the face of internal financial challenges. Indeed, the trends observed in the accumulated literature provide insights into an evolutionary view of the strategies adopted by multiple CEOs. Therefore, this study could be useful when benchmarking analysis.

For parent university managers, the accumulated literature provides insights into the critical role of entrepreneurial orientation and its understanding of different university faculties, departments, and centres. University managers are currently facing severe pressure from multiple different groups (e.g., university community, government agencies, policymakers, and society). Therefore, without a clear entrepreneurial orientation, it would be difficult to satisfy stakeholders' needs by stimulating the entrepreneurial culture, innovation, and spirit in a university community. Directly/indirectly, the evidenced trends provide insights into how university managers could manage conflicts of identity among a USO's talent (e.g., academics, students, alumni, advisors), as well as how they could implement several strategies/incentives to reduce uncertainty and conflict.

For policymakers, the accumulated research reveals the importance of implementing effective public policies and programs that support the emergence of USOs, connecting them with current societal challenges. This could be a good way to follow-up on successful public policy interventions that might be adaptable in disadvantaged economies, promoting academic entrepreneurship and connecting inventions to reduce societal challenges.

For other ecosystem stakeholders, the accumulated research offers relevant insights into knowledge transfer benefits via interactions with regional USOs and their parent universities, presenting the most critical challenges pertaining to managing uncertainty and other types of risks associated with the nature of their inventions. Consequently, potential investors or partners could observe different trends and implement successful actions to reduce existing barriers. For instance, after the COVID-19 pandemic, multiple actors from the local/international innovation system and entrepreneurship ecosystem have reinforced their relationships with universities and their USOs.

5.3. Limitations and future research avenues

While this approach has produced a list of useful results, it does have limitations, which present certain opportunities for future researchers.

With regards to the limitations of our integrative literature review, we highlight the critical components of identifying current spin-off themes. However, machine learning components and the application of cutting-edge computational procedures could additionally shed light on this research area. Indeed, from a geographical perspective, it would be prudent for researchers to focus on developing and transitional countries, investigating divergence and convergence in the priorities of stakeholders. Furthermore, from a methodological perspective, building upon the trajectory presented, we call for longitudinal studies on USOs. This line of inquiry could offer helpful information concerning the growth process, the possible reasons for failure, and the recognition of risk at different stages. Ultimately, focusing on several sectors and investigating the primary building blocks for each sector could provide new insights into this body of knowledge.

By considering our limitations/findings, future literature reviews should investigate the position of digital transformation (Garcez et al., 2021) and higher education when it comes to developing the new skills needed for future job creation, establishing the role of digital technologies in supporting spin-offs (Rippa & Secundo, 2019). This is related to the emerging USO forms that require future investigation, including alumni start-ups. Another interesting perspective that could be adopted in future literature reviews involves the assessment of trends in investigations across multiple research fields, as well as the current/future role of venture capital in each research field. For instance, we know that the USA's venture capital is more interconnected with the university sector, and that the commercialization of research results is evident from its recorded development. However, in Europe or Africa, these ties are much weaker, primarily because of the unproductive entrepreneurial spirit in universities and, more frequently in the case of transition countries, the unwillingness of entrepreneurs to take risks. Additionally, another perspective that could be investigated in future literature reviews could be the recognition and nurturing of business talent, along with its importance for USOs and requests stronger involvements and exploration in which the role of higher education is essential. Moreover, tied in with the quadruple helix axis, future research demands more holistic and interdisciplinary investigations in order to form a better understanding of USOs' connections with stakeholders' needs.

6 CONCLUSIONS

The purpose of this paper was to synthesize the growing amount of literature on the USO phenomenon, portray the evolution of the domain, and propose future research avenues. By adopting a methodological design (an integrative literature review and multiple correspondence analysis), based on our results, our main conclusion is as follows. Despite the maturity of USOs as a research line, the complexity of the numerous dimensions of USOs still demand considerable re-thinking in academic debates. We hope this study inspires future researchers to continue analysing the complexities of USOs, their relationships with their parent universities, and their links with multiple socio-economic agents.

It is crucial that the setup of an entrepreneurial spirit among faculty be expanded as a driver of entrepreneurial initiatives, so that a continuous flow of resources/capabilities and transferring knowledge can manifest under the umbrella of parent universities (Walter et al., 2006; Guerrero & Urbano, 2009a). USOs revealed different connections with parent universities with regards to their involvement in the quadruple helix. Indeed, the intensity of this connection depended on the sector and the country. Likewise, all USOs demonstrated good relationships with funders and stakeholders, as shown in the results of previous empirical studies (Miller et al., 2018a; Sinell et al., 2018). Consequently, university-industry relationships can be considered emerging actors in the revised literature, linking the institutional analysis of intermediaries. More specifically, in developed economies, USOs are strongly connected with multiple intermediaries enrolled in the innovation system (e.g., national innovation agencies, R&D collaborators, and policymakers) and entrepreneurship ecosystems (e.g., advisors from local agencies, investors, incubators/accelerators, or other infrastructures). This explains how the notion of entrepreneurial innovation, which is strongly derived from university-industry projects, has made a difference in terms of competitiveness and regional development (Guerrero & Urbano, 2019ab).

It is still not clear why business creation and innovation through spin-offs are established in some ecosystems and universities much more frequently than in others, and what the essential ingredients are when it comes to supporting and developing the invention's goals. Thus, it would be beneficial to investigate how we might replicate such ecosystems in various environments (Audretsch et al., 2019). In this regard, Messina et al. (2020) investigated the influence of premarket support mechanisms, revealing that premarket USO development and strategic

outcomes, such as the timing of the USO's first market entry, could be indispensable. These findings showed that the university surroundings and ecosystem performers have produced positive/negative impacts on USO founders. Regarding positive insights, the evidence suggests that USO inventors/academics closely involved with more than one actor from the innovation and entrepreneurship ecosystems are more likely to be successful in their scaling-up processes (Messina et al., 2020). One plausible explanation is that these USO inventors/academics receive/perceive favourable support/conditions when introducing their technologies, inventions, or entrepreneurial initiatives to the market at the most appropriate time. Consequently, the accumulated research has recognized that USOs' success depends on the interplay between USOs and ecosystem intermediaries. As the context conditions matter, in less-developed economies, USOs could take advantage of the resources/capabilities of intermediaries to reduce their country's barriers and ensure a sustainable performance (Wright et al., 2008; Gibson et al., 2019; Khodaei, et al., 2020; Temel et al., 2021; van Rijnsoever, 2022). With regards to negative insights, the accumulated literature has provided very limited evidence on USOs' failures or negative outcomes. A plausible explanation is due to the social perception of failure, which limits inventors or entrepreneurs when sharing experiences. This paper has three main implications for university managers. Firstly, the second implication reveals that more proactive technology transfer offices are needed and, in turn, less bureaucracy. Secondly, championing and promoting USOs has been revealed to be the most important mechanism when it comes to bringing research to the market and instigating innovation in universities. This affirms the role of the entrepreneurial university as a hub of regional development. The third implication pertains to public and private university venture capital; both of which are important when it comes to supporting and financing the entrepreneurial university ecosystem. There are also managerial implications regarding entrepreneurial universities' governance, and it is worth noting that commercially orientating human resources, endorsing international and multidisciplinary knowledge, and forming alliances between science and technology parks could substantially enhance the entrepreneurial university ecosystem's effectiveness. We hope this study inspires and motivates researchers to extend the USO research line by considering our proposed research agenda.

REFERENCES

Aaboen, L., Laage-Hellman, J., Lind, F., Öberg, C., & Shih, T. (2016). Exploring the roles of university spin-offs in business networks. *Industrial Marketing Management*, 59, 157-166

Abootorabi, H., Wiklund, J., Johnson, A. R., & Miller, C. D. (2021). A holistic approach to the evolution of an entrepreneurial ecosystem: An exploratory study of academic spin-offs. *Journal of Business Venturing*, 36(5), 10614.

Aldridge, T. T., & Audretsch, D. (2017). *The Bayh-Dole act and scientist entrepreneurship*. In: Audretsch, D. B., & Link, A.N. (Eds.) Universities and the entrepreneurial ecosystems, Edward Elgar Publishing. Cheltenham, the UK & Northampton, USA, https://doi.org/10.4337/9781786432797

Audretsch, D. B., Cunningham, J. A., Kuratko, D. F., Lehmann, E. E., & Menter, M. (2019). Entrepreneurial ecosystems: economic, technological, and societal impacts. *The Journal of Technology Transfer*, 44(2), 313–325. https://doi.org/10.1007/s10961-018-9690-4

Callahan, J. L. (2010). Constructing a manuscript: distinguishing integrative literature reviews and conceptual and theory articles. *Human Resource Development Review*, 9(3), 300–304.

Callan, B. (2001) Generating Spin-offs: Evidence from across the OECD. *Science Technology Industry Review. Special issue on fostering high tech spin-offs: A public strategy for innovation*, 26, 13-55.

Carayannis, E. G., Rogers, E. M., Kurihara, K., & Allbritton, M. M. (1998) High-technology spin-offs from government R&D laboratories and research universities*, Technovation*, 18(1), 1–11.

Clarysse, B., Wright, M., Bruneel, J., & Mahajan, A. (2014). Creating value in ecosystems: Crossing the chasm between knowledge and business ecosystems. *Research Policy*, 43(7), 1164–1176

Crispeels, T., Willems, J., & Brugman, P. (2015). The relationship between organizational characteristics and membership of a biotechnology industry board-of-directors-network. *Journal of Business & Industrial Marketing*. 30(3/4), 312-323. https://doi.org/10.1108/JBIM-11-2012-0222

Dabić, M., Švarc, J., & Gonzalez-Loureiro, M. (2016). *Entrepreneurial Universities in Innovation –Seeking countries Challenges and Opportunities*, Palgrave Macmillan, New York.

Dabić, M., Vlačić, B., Kiessling, T., Caputo, A., & Pellegrini, M. (2021). Serial entrepreneurs: A review of literature and guidance for future research. *Journal of Small Business Management*, 1-36.

De Cleyn, S. H., & Braet, J. (2010). The evolution of spin-off ventures: An integrated model. *International Journal of Innovation and Technology Management*, 7(1), 53-70.

De Coster, R., & Butler, C. (2005). Assessment of proposals for new technology ventures in the UK: characteristics of university spin-off companies. *Technovation*, 25(5), 535-543.

Etzkowitz, H. (1983). Entrepreneurial scientists and entrepreneurial universities in American academic science. *Minerva*, Vol 21. No 2/3: 198-233.

Furrer, O., Kerguignas, J. Y., Delcourt, C., & Gremler, D. D. (2020). Twenty-seven years of service research: a literature review and research agenda. *Journal of Services Marketing*, 34(3), 299-316.

Garcez, A., Silva, R., & Franco, M. (2021). Digital transformation shaping structural pillars for academic entrepreneurship: A framework proposal and research agenda. *Education and Information Technologies*, 1-24. https://doi.org/10.1007/s10639-021-10638-5.

Gibson, E., Daim, T. U., & Dabić, M. (2019). Evaluating university industry collaborative research centers. *Technological Forecasting and Social Change*, 146, 181-202.

Greenacre, M., & Blasius, J. (Eds.) (2006). *Multiple correspondence analysis and related methods*. Chapman and Hall/CRC. Routledge, Taylor Francis Group, New York

Grimaldi, R., Kenney, M., Siegel, D. S., & Wright, M. (2011). 30 years after Bayh–Dole: Reassessing academic entrepreneurship. *Research Policy*, 40(8), 1045-1057.

Guerrero, M., & Urbano, D. (2019a). A research agenda for entrepreneurship and innovation: the role of entrepreneurial universities. In: Audretch, D., Lehnman, E., Link, A. (Eds.). *A Research Agenda for Entrepreneurship and Innovation*. Edward Elgar Publishing. Cheltenham, the UK & Northampton, USA

Guerrero, M., & Urbano, D. (2019b). Effectiveness of technology transfer policies and legislation in fostering entrepreneurial innovations across continents: an overview. *The Journal of Technology Transfer*, 44(5), 1347-1366.

Guerrero, M., & Urbano, D. (Eds.) (2021). *Technology Transfer and Entrepreneurial Innovations, Policies Across Continents*. Serial International Studies in Entrepreneurship, Vol 51, Springer. Switzerland

Hansen, Christopher, Holger Steinmetz, and Jörn Block. (2021). How to conduct a meta-analysis in eight steps: a practical guide. *Management Review Quarterly*, 1-19.

Hayter, C. S. (2015). Social networks and the success of university spin-offs: Toward an agenda for regional growth. *Economic Development Quarterly*, 29(1), 3-13.

Hayter, C. S. (2016). Constraining entrepreneurial development: A knowledge-based view of social networks among academic entrepreneurs. *Research Policy*, 45(2), 475-490.

Hoffman, D. L., & De Leeuw, J. (1992). Interpreting multiple correspondence analysis as a multidimensional scaling method. *Marketing Letters*, 3(3), 259-272.

Hossinger, S. M., Chen, X., & Werner, A. (2020). Drivers, barriers and success factors of academic spin-offs: a systematic literature review. *Management Review Quarterly*, 70(1), 97-134.

Kiessling, T., Vlacic, B., & Dabić, M. (2019) Mapping the future of cross-border mergers & acquisitions, *IEEE Transactions on Engineering Management*, available online ahead of print: https://doi.org/10.1109/tem.2019.2954799.

Klofsten, M., Lindell, P. Olofsson, C., & Wahlbin, C. (1988). Internal and External Resources in Technology-Based Spin-Offs: A Survey. In: Kirchhoff, B. A., Long, W. A., McMullan, W., Vesper, K. H., & Wetzel William Jr, W. E. (Eds.), *Frontiers of Entrepreneurship Research,* 430-443. Babson Park, MA: Babson College.

Kruss, G. (2008). Knowledge-intensive university spin-off firms in South Africa: Fragile network alignment? *Industry and Higher Education*, 22(4), 233-243

Lerner, J. (2004). The University and the Start-Up: Lessons from the Past Two Decades. *The Journal of Technology Transfer*, 30(1-2), 49–56.

Lockett, A., & Wright, M. (2005) Resources, capabilities, risk capital and the creation of university spin-out companies. *Research Policy*, 34(7), 1043-1057.

Lockett, A., Siegel, D., Wright, M., & Ensley, M. D. (2005). The creation of spin-off firms at public research institutions: Managerial and policy implications. *Research Policy*, 34(7), 981-993.

López-Duarte, C., González-Loureiro, M., Vidal-Suárez, M. M., & González-Díaz, B. (2016). International strategic alliances and national culture: Mapping the field and developing a research agenda. Journal of World Business, 51(4), 511-524.

McAdam, M., McAdam, R., Galbraith, B., & Miller, K. (2010). An exploratory study of Principal Investigator roles in UK university Proof-of-Concept processes: an Absorptive Capacity perspective. *R&D Management*, 40(5), 455-473.

Meijer, L. L. J., Huijben, J. C. C. M., Van Boxstael, A., & Romme, A. G. L. (2019). Barriers and drivers for technology commercialization by SMEs in the Dutch sustainable energy sector. *Renewable and Sustainable Energy Reviews*, 112, 114-126.

Messina, L., Miller, K., & Hewitt-Dundas, N. (2020). USO imprinting and market entry timing: Exploring the influence of university ecosystems. *IEEE Transactions on Engineering Management*. DOI: 10.1109/TEM.2020.2979181.

Messina, L., Miller, K., Galbraith, B., & Hewitt-Dundas, N. (2022). A recipe for USO success? Unravelling the micro-foundations of dynamic capability building to overcome critical junctures. *Technological Forecasting and Social Change*, 174, 121257.

Miller, K., Alexander, A., Cunningham, J. A., & Albats, E. (2018b). Entrepreneurial academics and academic entrepreneurs: A systematic literature review. *International Journal of Technology Management*, 77(1-3), 9-37.

Miller, K., McAdam, R., & McAdam, M. (2018a). A systematic literature review of university technology transfer from a quadruple helix perspective: toward a research agenda. *R&D Management*, 48(1), 7-24.

Miranda, F. J., Chamorro, A., & Rubio, S. (2018). Re-thinking university spin-off: A critical literature review and a research agenda. *The Journal of Technology Transfer*, 43(4), 1007-1038.

Mustar, P., Renault, M., Colombo, M. G., Piva, E., Fontes, M., Lockett, A., Wright, M., Clarysee, B., & Moray, N. (2006). Conceptualising the heterogeneity of research-based spin-offs: A multi-dimensional taxonomy. *Research Policy*, 35(2), 289-308.

Ndonzuau, F. N., Pirnay, F., & Surlemont, B. 2002. A Stage Model of Academic Spin-Off Creation. *Technovation*, 22(5), 281–289.

O'Shea, R. P., Chugh, H., & Allen, T. J. (2008). Determinants and consequences of university spin-off activity: a conceptual framework. *The Journal of Technology Transfer*, 33(6), 653-666.

Pirnay, F., Surlemont, B., & Nlemvo, F. 2003. Toward a Typology of University Spin-Offs. *Small Business Economics*, 21(4), 355–369.

Podsakoff, P., Mackenzie, S., Bachrach, D., & Podsakoff, N. (2005). The influence of management journals in the 1980s and 1990s. *Strategic Management Journal*, 26(5), 473-488.

Rasmussen, E., Mosey, S., & Wright, M. (2015). The transformation of network ties to develop entrepreneurial competencies for university spin-offs. *Entrepreneurship & Regional Development*, 27(7-8), 430-457.

Rauch, A. (2020). Opportunities and threats in reviewing entrepreneurship theory and practice. *Entrepreneurship Theory and Practice*, 44(5), 847-860.

Rippa, P., & Secundo, G. (2019). Digital academic entrepreneurship: The potential of digital technologies on academic entrepreneurship. *Technological Forecasting and Social Change*, 146, 900-911. https://doi.org/10.1016/j.techfore.2018.07.013.

Rodríguez-Gulías, M. J., Rodeiro-Pazos, D., Fernández-López, S., Corsi, C., & Prencipe, A. (2018). The role of venture capitalist to enhance the growth of Spanish and Italian university spin-offs. *International Entrepreneurship and Management Journal*, 14(4), 1111-1130.

Rothaermel, F. T., Agung, S. D., & Jiang, L. (2007). University entrepreneurship: A taxonomy of the literature. *Industrial and Corporate Change*, 16(4), 691–791.

Shafique, M., 2013. Thinking inside the box? Intellectual structure of the knowledge base of innovation research (1988–2008). Strategic Management Journal, 34(1), pp. 62-93.

Siegel, D. S., & Wright, M. (2015). Academic entrepreneurship: time for a rethink? *British Journal of Management*, 26(4), 582-595.

Sinell, A., Iffländer, V., & Muschner, A. (2018). Uncovering transfer – a cross-national comparative analysis, *European Journal of Innovation Management*, 21(1), 70-95.

Skute, I., Zalewska-Kurek, K., Hatak, I., & de Weerd-Nederhof, P. (2019). Mapping the field: a bibliometric analysis of the literature on university-industry collaborations. *The Journal of Technology Transfer*, 44(3), 916-947.

Smilor, R. W., Gibson, D. V., & Dietrich, G. B. (1990). University Spin-Out Companies: Technology Start-Ups from UT-Austin. *Journal of Business Venturing*, 5(1), 63–76.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104, 333-339.

Soetanto, D., & Van Geenhuizen, M. (2015). Getting the right balance: University networks' influence on spin-offs' attraction of funding for innovation. *Technovation*, 36-37, 26-38, https://doi.org/10.1016/j.technovation.2014.10.008

Sørheim, R., Widding, L. Ø., Oust, M., & Madsen, Ø. (2011). Funding of university spin-off companies: a conceptual approach to financing challenges. *Journal of Small Business and Enterprise Development*. 18(1), 58-73.

Sousa-Ginel, E., Franco-Leal, N., & Camelo-Ordaz, C. (2017). The influence of networks on the knowledge conversion capability of academic spin-offs. *Industrial and Corporate Change*, 26(6), 1125-1144.

Steffensen, M., Rogers, E. M., & Speakman, K. (2000). Spin-offs from research centers at a research university. *Journal of Business Venturing*, 15(1), 93-111.

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of sustainable) enterprise performance. *Strategic Management Journal*, 28(13), 1319-1350.

Temel, S., Dabić, M., Ar, I. M., Howells, J., Mert, A., & Yesilay, R. B. (2021). Exploring the relationship between university innovation intermediaries and patenting performance. *Technology in Society*, 66, 101665.

Thomas, V. J., Bliemel, M., Shippam-Brett, C., & Maine, E. (2020). Endowing university spin-offs pre-formation: Entrepreneurial capabilities for scientist-entrepreneurs. *Technovation*, available online ahead of print: https://doi.org/10.1016/j.technovation.2020.102153.

Treibich, T., Konrad, K., & Truffer, B. (2013). A dynamic view on interactions between academic spin-offs and their parent organizations. *Technovation*, 33(12), 450-462

Ullah, F., Akbar, S., & Taylor, P. (2007). Spin-offs, stages of growth and funding issues: some UK evidence. *International Journal of Entrepreneurship and Innovation Management*, 7(6), 524-540.

van Geenhuizen, M., & Ye, Q. (2014). Responsible innovators: open networks on the way to sustainability transitions. *Technological Forecasting and Social Change*, 87, 28-40, https://doi.org/10.1016/j.techfore.2014.06.001

van Rijnsoever, F. J. (2022). Intermediaries for the greater good: How entrepreneurial support organizations can embed constrained sustainable development startups in entrepreneurial ecosystems. *Research Policy*, 51(2), 104438.

Vlačić, B., Corbo, L., e Silva, S. C., & Dabić, M. (2021). The evolving role of artificial intelligence in marketing: A review and research agenda. *Journal of Business Research*, 128, 187-203.

Vohora, A., Wright, M., & Lockett, A. (2004). Critical junctures in the development of university high-tech spinout companies. *Research Policy*, 33(1), 147–175.

Walter, A., Auer, M., & Ritter, T. (2006). The impact of network capabilities and entrepreneurial orientation on university spin-off performance. *Journal of Business Venturing*, 21(4), 541-567.

Wright, M., Clarysse, B., & Mosey, S. (2012). Strategic entrepreneurship, resource orchestration, and growing spin-offs from universities. *Technology Analysis & Strategic Management*, 24(9), 911-927.

Wright, M., Clarysse, B., Lockett, A., & Knockaert, M. (2008). Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries. *Research Policy*, 37(8), 1205-1223.

Wright, M., Lockett, A., Clarysse, B., & Binks, M. (2006) University spin-out companies and venture capital. *Research Policy*, 35(4), 481-501.

*Z*upic, I., & Čater, T. (2015). Bibliometric Methods in Management and Organization. *Organizational Research Methods*, 18(3), 429–472.

Table 1: Overview of most frequent journal source by the number of articles.

No.	Publications	Frequency of articles
1	Journal of Technology Transfer	56
2	Technovation	23
3	Industry and Higher Education	22
4	Research Policy	21
5	International Entrepreneurship and Management Journal	14
6	Small Business Economics	13
7	Journal of Technology Management and Innovation	11
8	International Journal of Entrepreneurship and Small Business	10
9	Technology Analysis & Strategic Management	10
10	Journal of International Entrepreneurship	8

Table 2: Descriptors that represent the poles of the axes.

Axes	Descriptor	Origin of the axes descriptor	Representative studies
Axis X Left	Orchestration & Innovation	Resource-Based View; Innovation & Innovativeness; International View.	Wright et al., 2012; Rodríguez-Gulías et al., 2018.
Axis X Right	Quadruple Helix	Institutional View; Knowledge-Based View; Technology Transfer.	Miller et al., 2018a; Sinell et al., 2018.
Axis Y Upper	Entrepreneurial Culture & Performance	Entrepreneurial View; HR & Culture; Performance.	Walter et al., 2006; De Cleyn & Braet, 2010.
Axis Y Lower	Risk & Uncertainty Management	Risk & Uncertainty; Social & Psychological View; Governance View.	McAdam et al., 2010; Meijer et al., 2019.

Table 3: Key descriptors listed by change in % from P1 (1986-2013) to P2 (2014–2020).

Descriptors							
	P1(1986-2013)		P2(2014-2020)		E=[(D/B)-1] x 100	F	G=(F/488) x 100
Theoretical underpinnings	A	B=(A/236) x100	C	#D=(C/252) x100			
	#	% (total n=236)	#	% (total n=252)		#	% (total N = 488)
Entrepreneurial View	236	100.0%	252	100.00%	0.00% (n.s.)	488	100.00%
Governance View	93	39.4%	105	41.67%	5.73% (n.s.)	198	40.57%
Institutional View	201	85.2%	222	88.10%	3.44% (n.s.)	423	86.68%
International View	32	13.6%	47	18.65%	37.55% (n.s.)	79	16.19%
Knowledge-Based View	134	56.8%	139	55.16%	-2.85% (n.s.)	273	55.94%
Network View	130	55.1%	170	67.46%	22.47% (*)	300	61.48%
Resource-Based View	158	66.9%	177	70.24%	4.91% (n.s.)	335	68.65%
Social-Psychological View	44	18.6%	52	20.63%	10.68% (n.s.)	96	19.67%
Major Research themes							
HR & Culture	91	38.6%	82	32.54%	-15.61% (n.s.)	173	35.45%
Innovation & Innovativeness	139	58.9%	156	61.90%	5.10% (n.s.)	295	60.45%
Performance	173	73.3%	202	80.16%	9.35% (n.s.)	375	76.84%
Risk & Uncertainty	41	17.4%	55	21.83%	25.63% (n.s.)	96	19.67%
Sustainability & Circularity	36	15.3%	67	26.59%	74.29% (*)	103	21.11%
Technology Transfer	171	72.5%	188	74.60%	2.96% (n.s.)	359	73.57%
Methodological approaches							
Qualitative	96	40.7%	135	53.57%	31.70% (*)	231	47.34%
Quantitative	142	60.2%	169	67.06%	11.46% (n.s.)	311	63.73%
Geographical context							
Africa	2	0.8%	3	1.19%	40.48% (n.s.)	5	1.02%
Asia	20	8.5%	15	5.95%	-29.76% (n.s.)	35	7.17%
Europe	126	53.4%	133	52.78%	-1.15% (n.s.)	259	53.07%
North America	27	11.4%	55	21.83%	90.77% (*)	82	16.80%
Oceania	1	0.4%		0.00%	n.a.	1	0.20%
South America	3	1.3%	7	2.78%	118.52%(n.s.)	10	2.05%

(*) two-tailed z-test of difference between P1 and P2 proportions significant at an alpha level of 0.05; (n.s.) z-test not significant; (n.a.) z-test not applicable

Figure 1: Mapping of the field on USO for the full period.

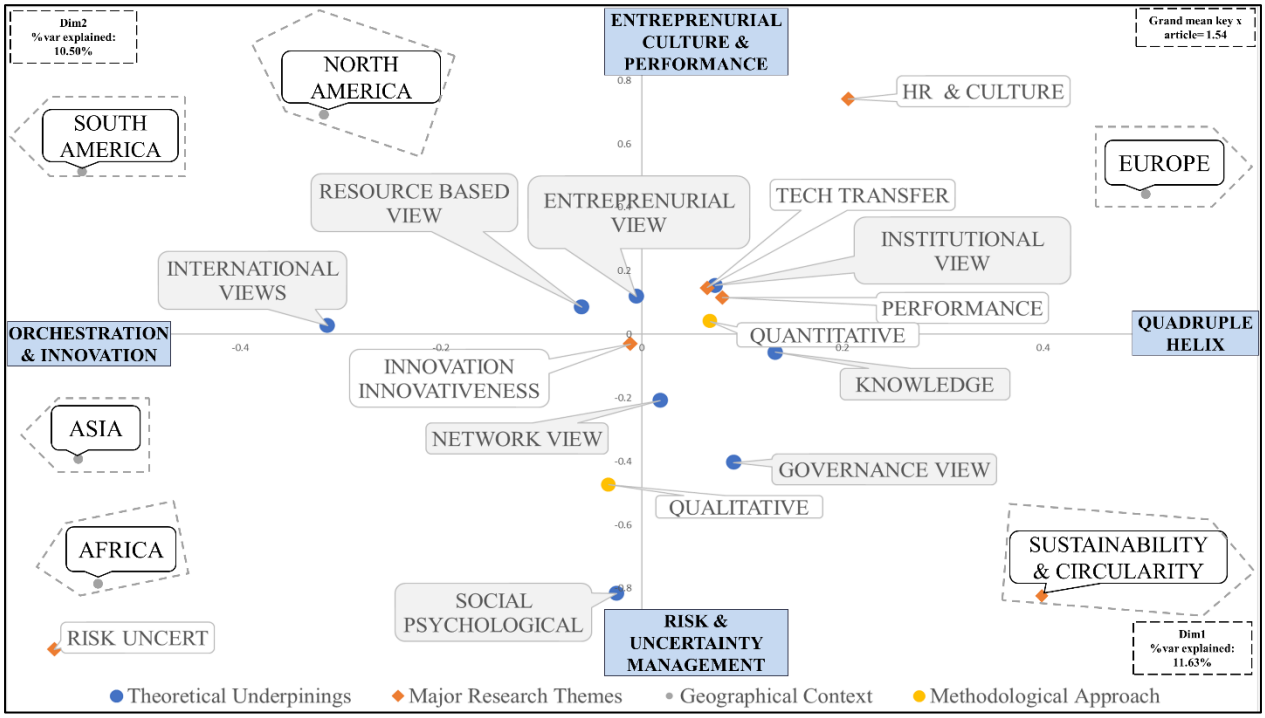

Figure 2: Dynamics of the field and research interest from P1 (1986-2013) to P2 (2014-2020).