Framing the main patterns of an academic innovation ecosystem. Evidence from a knowledge-intensive case study

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Abstract

Purpose – This research aims to shed new lights on the most shared constructs developed on Innovation Ecosystems, Entrepreneurial Ecosystems and Technology Transfer Ecosystem proposing an additional stand-alone ecosystem.

Design/methodology/approach – This research is built upon a qual-quantitative analysis of an empirical case. The latter analysis is performed through a single case study methodology on the San Giovanni Hub of the Federico II University of Naples.

Findings – Evidences show how a technological hub orchestrates three main ecosystems for the knowledge exploitation: the technology transfer ecosystem, devoted to gather knowledge form universities' labs towards industries; the innovation ecosystem, able to manage the exploration and exploitation of new knowledge and techniques; the entrepreneurial ecosystem, that supports startup/spinoff creation process.

Research limitations/implications – Limitations mainly concern the fact that it is centred on just one case study.

Practical implications – Practical implications imply new opportunities of collaboration involving different stakeholders as university administrators, researchers, businesses and policymakers, creating a supportive environment for innovation.

Originality/value – The research offers a new vision about the role of Universities as creators and enablers of ecosystems pursuing diverse value propositions. The Academic Innovation Ecosystem is a new conceptualization of this role played by a university, and it can convey innovation and entrepreneurial attitude within its ecosystem leveraging on the transfer of university knowledge and technology.

Keywords Innovation ecosystems, Entrepreneurial ecosystems, Technology transfer ecosystems, University engagement

Paper type Research paper

Introduction

The conceptualisation of ecosystems in the managerial field embraces diverse categories, namely business, innovation, entrepreneurial and knowledge ecosystems, as described in several contributions from the literature across recent years (Adner, 2017; Beliaeva *et al.*, 2019; Gomes *et al.*, 2021; Granstrand and Holgersson, 2020; Jacobides *et al.*, 2018; Lepore *et al.*, 2019; Nambisan *et al.*, 2019; Ritala and Gustafsson, 2018). Additionally, further transversal concepts are envisaged to link ecosystem and territorial approaches to converge towards a

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theoretical framework that embraces the interconnections among models, theories and emerging concepts (Khlystova *et al.*, 2022; Scaringella and Radziwon, 2018).

Such conceptualisation is enriched by the rising relevance of university engagement (Holland, 2001), as well as of the academia, as suggested by Nicholls-Nixon *et al.* (2021) when they recognise the leading role of universities in fostering entrepreneurial innovation through technology and knowledge transfer to shape "the direction and potential rewards of alternative courses of technological development" (Nicholls-Nixon *et al.*, 2021, p. 4).

The growing emphasis attributed to the existence and implementation of innovation and entrepreneurial ecosystems practices in an academic environment (Longva, 2021; Rippa and Secundo, 2019) is coherent with the triple helix approach and its evolutions (Carayannis *et al.*, 2018; Leydesdorff, 2012). In this vein, the innovation and entrepreneurial ecosystem constructs (Adner, 2017; Lechner *et al.*, 2022) are suitable to track and analyse the advancement of innovation and entrepreneurial ecosystem dynamics (Audretsch *et al.*, 2019) within a technology and knowledge transfer perspective (Good *et al.*, 2019).

The literature on technology transfer, innovation, entrepreneurial and business ecosystems only rarely tends to approach all four constructs together. In fact, such a thorough view is mostly focused on investigating the overlaps between the definitions of the mentioned ecosystems. Nevertheless, the theorisations suggested so far still fail to address the definition of an actionable model describing the relationships and boundaries among said ecosystems (Ghazinoory *et al.*, 2021).

In order to address this less explored aspect of the ecosystems theory, this research moves form the extant literature describing the main features and characteristics of Innovation Ecosystems (IEs) (Oh *et al.*, 2016), Entrepreneurial Ecosystems (EEs) (Audretsch *et al.*, 2019; Lux *et al.*, 2020) and Technology Transfer ecosystems (TTEs) (Good *et al.*, 2019). For this very end, some of the latest constructs developed on EE, IE and TTE are reinforced and the adoption of a holistic approach corroborates the conceptualisation of an Academic Innovation Ecosystem (AIE) itself. The main purpose stands in presenting the nature of the case of the San Giovanni a Teduccio Hub of the Federico II University of Naples representing an ecosystem established in an academic environment, by considering the main scope and features of EE, IE and TTE. Thus, the aim of the research is to frame the way in which the selected case encompasses the most relevant features and characteristics of the comprehensive AIE model deduced from the case study. The AIE embeds the patterns concerning innovation, entrepreneurship within an academic environment, technology and knowledge transfer, mechanisms, and platforms (Nambisan *et al.*, 2019), as well as university engagement (Goddard *et al.*, 2013; Perkmann *et al.*, 2013; Rajaeian *et al.*, 2018). The purpose of this paper is to deepen the discourse on ecosystems by means of an explorative analysis on the structure of an emerging academic ecosystem through a case study methodology. The investigation on the selected case study provides empirical evidence of an additional stand-alone ecosystem characterisation referred to as AIE. Hence the study shows that in an AIE, the academic context assumes the role of focal actor that aligns the goals of all the other actors and stakeholders operating within this very ecosystem to create value for business (Adner, 2017). The contribution also adds further insights to the definition of the boundaries and scope of EE, IE and TTE to provide a better understanding of the ecosystem concept structure (Gomes *et al.*, 2021).

Driven by the need to provide a more holistic conceptualisation of the ecosystems in a managerial context, the study is committed to combine different ecosystem approaches regarding EE, IE and TTE, adopting an academic-centred perspective. Thus, the attempt is to answer to the question concerning whether EE, IE and TTE can be combined to frame the structure of an AIE which is oriented to create value.

Theoretical framework

A recent trend in the entrepreneurship and innovation policy addresses the "holistic" approach to entrepreneurship and innovation (Audretsch and Belitski, 2017; Autio and Thomas, 2014). Early studies on systems were primarily focused on national (Edquist, 1997; Nelson, 1993) or regional (Cooke, 2001) systems settings influencing innovation. Without specific regard to the level of analysis, dating from the first contributions on the subjects, systems of innovation can be seen as a combination of institutional, economic, social, political and organisational factors that can affect both innovation activities and business growth (Edquist, 1997; North, 1990).

More specifically, the holistic approach posits research-based entrepreneurial and innovative activities as an individual behaviour of entrepreneurs embedded within a local context (Szerb *et al.*, 2013) rather than an activity performed in isolation (Wright and Stigliani, 2013). This view is consistent with a recent extension of the ecological systems theory (Bronfenbrenner, 1979) which suggests that the latter model should consider agents and the context simultaneously, rather than either of them or in isolation (Lux *et al.*, 2020). Hence, it provides a thorough theoretical framework to examine the antecedents, the outcomes, the mechanisms as well as the interactions within EE.

Systems of entrepreneurship (or ecosystems) are defined as institutional and organisational as well as other systemic factors that interact and influence identification and commercialisation of entrepreneurial opportunities (Cloitre *et al.*, 2022; Lamine *et al.*, 2021; Lechner *et al.*, 2022; Longva, 2021).

Such a framework implies that a systems approach to innovation can include the setting up of entrepreneurial processes oriented to knowledge transfer and innovation. Thus, entrepreneurship itself needs to be closely linked to the local innovation systems, which includes regions, innovation networks, learning and interaction (Cooke, 2001) and the context in which decisions are adopted (Ács *et al.*, 2010; Szerb *et al.*, 2013).

There are three main types of ecosystems corresponding to the previous conceptualisations: a. Technology Transfer Ecosystems (TTE), b. Entrepreneurial Ecosystems (EE) and c. Innovation Ecosystems (IE). These types of different ecosystems have always been treated as separate entities. In this analysis, the aim is to deduct a new form of ecosystem: the AIE as an ecosystem built around a university or Higher Education Institutions (HEIs) environment. The AIE conceptualises new patterns aimed to transfer the technology and knowledge embedded in the HEIs environment. Such framework would contribute to tailor the HEIs according to the requirements and needs of an innovative business environment. Indeed, the patterns of an AIE are oriented to feed the creation of both entrepreneurial and innovation ecosystems. The latter ecosystems bridge the TTEs, which is focused on exploring new knowledge, and the business ecosystems, whose aim is to exploit the new knowledge through the value capture of innovation (Phillips, 2014; Valkokari, 2015).

Innovation ecosystems

The concept of innovation ecosystem (IE) is extremely broad and originally stems from the theorisation of business ecosystem (Moore, 1993) but with a specific focus on the ability to co-create value rather than capture it (Adner, 2006; Adner and Kapoor, 2010). The value is co-created through the management of networks whose relations could be unstable moving from cooperation to competition and *vice versa* (Adner and Kapoor, 2010).

The attention towards the relationships occurring in networks within IE finds its roots in Adner (2017)'s perspective adopted to investigate IE. Indeed, Adner (2017) considers the "ecosystem as structure" in which the interdependencies emerge among different actors that allow to reach a value proposition: "The ecosystem is defined by the alignment structure of

the multilateral set of partners that need to interact in order for a focal value proposition to materialize" (Adner, 2017, p. 40).

In this perspective, the value proposition is of pivotal relevance because the actors are selected in order to attain said proposition. The alignment structure means that each actor plays a specific role in the innovation process with a different purpose, however all these purposes are aligned to the same value proposition. The emphasis on value proposition and alignment structure implies that the same actors can operate in different IE if the interactions among them are needed to materialize a different value proposition.

Adner's perspective is also supported by Granstrand and Holgersson (2020). The authors review all definitions of IEs, leading to the following definition encompassing the sharing features owned by most of the aforementioned definitions:

> An innovation ecosystem is the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors (Granstrand and Holgersson, 2020).

Combining the two definitions, some selected patterns attributable to an IE can be detected. First, actors are located in specific and different positions along the flow of activities needed to create value for customers and other stakeholders (Ritala *et al.*, 2013). Through these relations, actors within an IE can share any kind of artefacts such as materials, information, influence, funds. The actors can establish collaborative relations (complementary) or competitive ones (substitute) with or without the focal firm. The focal firm represents the entity that orchestrates the ecosystem (Pocek, 2022). The institution refers to policies, regulations, institutions themselves and the authors connect this term to "the rule of the games". In addition, the focus is mainly addressed to value creation rather than to the capture of such value. Indeed, this attitude is coherent with the view of innovation as "the translation of a discovery or a new creative idea into tangible technology or a new method" (Ghazinoory *et al.*, 2021, p. 573). The IE is not a stand-alone ecosystem, in fact it bridges the knowledge ecosystems, aimed at exploration new knowledge, and the business ecosystems, aimed at exploitation the new knowledge through the value capture of innovation (Phillips, 2014; Valkokari, 2015).

Entrepreneurial ecosystems

The concept of IEs tends to overlap with other similar concepts. The EE is one among those concepts, and previous studies have highlighted that EEs support business model development that facilitates the growth of new ventures (Autio *et al.*, 2018). The EE framework determines the subjects eligible to become entrepreneurs, the way in which an individual's perception can support entrepreneurial decision-making in the area, and how various domains affect entrepreneurial actions and outcomes of the considered ecosystem (Autio and Thomas, 2014; Lux *et al.*, 2020).

The concept of university-based entrepreneurship ecosystem also falls within the EEs discourse. Universities or HEIs play a critical role in the growth of a local and regional economic ecosystem, as they are recognised as important knowledge and technological sources for innovation and venture creation processes (Meyer *et al.*, 2020). Primary stakeholders in the university-based EE are entrepreneurs, teaching faculty, professional staff, venture investors, government and institutions. Within the educational system, Meyer *et al.* (2020) also include students, alumni, administrators, as primary stakeholders, whereas mentors, managers, service providers, foundation directors and the industry are considered as external stakeholders. In this perspective, the ecosystem derives and is enhanced to grow from the interaction logic among those actors, making the ecosystem a highly complex and dynamic environment (Isenberg, 2010; Spigel, 2020). The way in which actors within an EE

(and in a university-based EE) interact, and what dynamics emerge from these interactions represent an open debate in the literature. The dynamics of the interactions can be analysed through the formal and informal rules of the game in a certain environment (Bawnol, 1990; North, 1990).

Formal institutions are represented by the set of regulations in a given context, while informal institutions are guided by rules concerning culture, social norms and values (North, 1990).The adoption of an institutional perspective to analyse the interactions and the dynamics is helpful, since interactions can be considered on the basis of the type of institutions that are involved (Bawnol, 1990; North, 1990; Scott, 2013). To this regard, this work also takes into account recent contributions providing elements to identify institutional trust as a facilitator in the formal institution – productive entrepreneurship nexus (Khlystova *et al.*, 2022), as well as the introduction of the concept of legitimacy as a necessary condition to be gained for all actors involved in EE (Lechner *et al.*, 2022).

Technology transfer ecosystems

The label of TTE (Good *et al.*, 2019) emerges to describe activities related to university technology transfer offices (TTOs) and the whole set of actors involved in technology and knowledge transfer activities primarily within academic environments, shifting from incubators, accelerators, science parks, venture funds to TTOs. For the purpose of this study, academic TTOs are considered as structures in charge of facilitating the transfer of technology developed by researchers and academics to the market by acting as a bridge between the university and the private sector (Siegel *et al.*, 2003). Indeed, the actors of the TTE are seen as components supporting university technology and knowledge transfer activities, thus embedding some of the core elements framing the third mission and university engagement perspective (Audretsch, 2014; Audretsch and Belitski, 2017; Goddard *et al.*, 2013; Holland, 2001; Molas-Gallart and Castro-Martínez, 2007).

However, one of the most relevant challenges brought up by the extant literature on the subject is the tendency to the fragmentation or "atomisation" of the set of organisations acting and interacting in such ecosystems. In fact, a robust literature on the holistic approach to the TTE is extremely limited, whereas it might help tracing the evolutionary path and positive implications for the understanding of innovation and entrepreneurial context within and academic environment (Franco and Haase, 2015). In this direction, the organisational design framework described in Good *et al.* (2019) deploys the basis for a holistic approach to the theorisation of university or academic ecosystems by focusing on all the components of a technology transfer process which ultimately conveys new knowledge shaped around innovation outcomes. Furthermore, the theorisation around the triple, quadruple and n-tuple helix construct also contributes to draw attention to specific attitudes thanks to which individuals and organisations within helices can assume new and additional roles (Carayannis *et al.*, 2018; Leydesdorff, 2012). Given that cross-institutional relationships can facilitate the collection of resources to support technology transfer, entrepreneurship and the development of capital-intensive infrastructures, they engender a transformative impact on the university itself. Hence, such processes enhance the creation of hybridised structures capable of integrating teaching, research and commercialisation activities, within an entrepreneurial orientation (Audretsch, 2014). The rising attention posed on academic-born enterprises leads to frame novel institutional paradigms whereby universities are actively involved in stimulating the economic development of the ecosystem in which they are embedded, through knowledge and technology transfer. The growing need to promote investments in innovation by academic and governmental institutions inevitably produces virtuous effects (Sparrow, 2011) for which universities can claim accountability according to their explicit actions (spin-off

firms' promotion, technology parks, etc.), as well as in terms of the absorptive and the desorptive capacity of the actors involved in technology and knowledge transfer processes influencing their very ecosystem (Dell'Anno and Del Giudice, 2015). According to these theoretical premises, the paper highlights the need to move from an atomistic towards a holistic approach to ecosystems, being them defined as innovation, entrepreneurial or academic in nature.

Conceptual framework

Some of the suggestions provided by Audretsch *et al.* (2019) frame the research concerning the investigation of the nature and extent of actual boundaries of both entrepreneurial and IE with TTE. The common purpose of IE, EE and TTE is to facilitate the processes related to the transformation of knowledge into innovative technology for business; however, the focus of each ecosystem is different. The TTE specifically focuses on the knowledge and technology created within university and research centres and its action is mainly addressed to understanding the most appropriate ways to commercialise such outputs. The connection with the IE and EE emerges as a need to exploit the knowledge and technologies produced by university and research centres which are not necessarily driven by the demand of the market. Hence, the IE aims at managing the processes of exploration and exploitation of new knowledge and techniques, involving the actors that can contribute to match the needs of the external environment (i.e. the business or specific industry). The IE acts as a bridge between the TTE, and the business ecosystems (or EE) considered as a specific business ecosystem, aimed at exploiting the new knowledge through the value capture of innovation. The EE is devoted to generating new ventures based on the creation of startup/spinoff firms stemming from the knowledge explored in university and research centres.

The conceptual framework is addressed toward a holistic view of the entire exploration-exploitation process of knowledge and technologies in a business environment. According to Good *et al.* (2019), the provided framework encompasses all the component of these three ecosystems: 1. The exploration of knowledge and technologies in university departments; 2. The transfer of such knowledge and technologies in IEs or new ventures; and 3. The management of mechanisms or relationships needed to the exploitation of knowledge and technologies useful for the existing business or new venture. Said conceptual framework is designed on the following theoretical pillars:

(1) The interconnection among Knowledge, Innovation and EE is viewed as a structure of relationships among interacting actors (Weber and Hine, 2015). The same actors can play in multiple ecosystems, creating cross-fertilization among artefacts shared in different ecosystems, hence facilitating collective learning and increasing the speed of innovation diffusion.

(2) According to Valkokari (2015), interconnections among these ecosystems let to explore new knowledge through a knowledge-intensive ecosystem that can be exploited in business or EEs. In this interaction, IE is the buffer between knowledge and business or EEs.

Figure 1 provides a description of the conceptual framework encompassing all the components of the three ecosystems according to a holistic perspective.

According to Figure 1, TTE is based on the knowledge and technologies created (the blue circles) and only a subset of them feeds the IE (orange circles) or matches the business needs or marked needs with the creation of new ventures (green circles). In fact, IE activates connection between knowledge and technologies (blue circles) with the business. In particular, the innovation can serve to an existing company (business ecosystem not

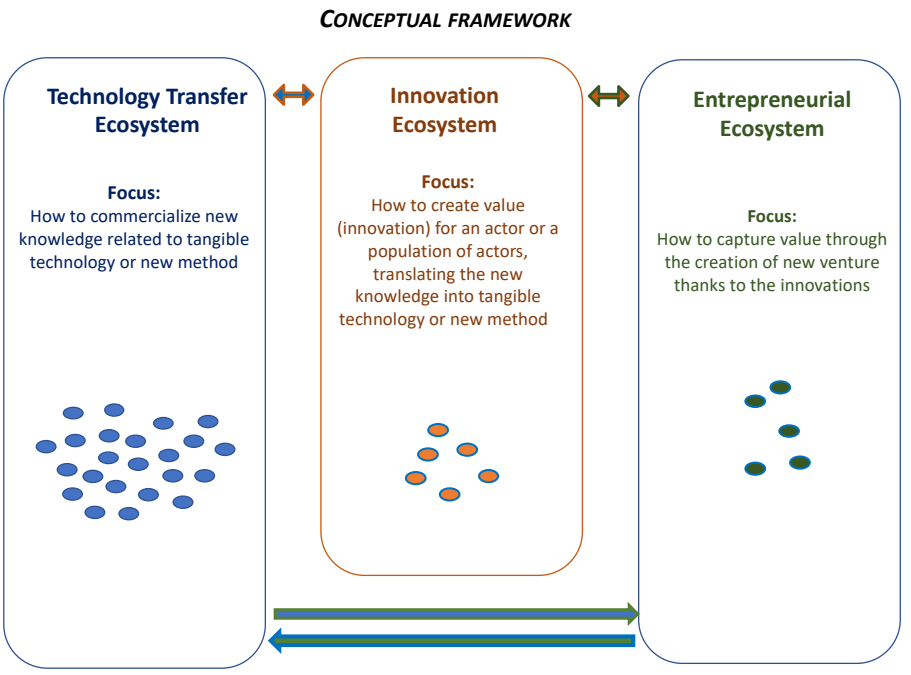

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Figure 1.
Interconnections of IE and EE with the TTE

represented in the figure) or to create a new venture (EE). The green circles represent the new ventures. Finally, the EE considers only the green circles, and its attention is devoted to the knowledge and technologies matching a demand of the related market or industry.

The rationale underpinning the study resides in suggesting new elements framing the scope of EE, IE and TTE to describe the holistic evolving nature of ecosystems established in an academic environment, such as the one analysed in this paper. Following a deductive research approach (Bryman and Bell, 2015) the research builds on the analysis of the intersections among Innovation, Entrepreneurial, TTEs to highlight a novel conceptualisation of Academic Entrepreneurship. The holistic approach adopted for this study provides a further construct referred to as AIE. Considering academic entrepreneurship constructs (Rippa and Secundo, 2019) within innovation and TTEs, more thorough insights are developed to provide adequate elements to the emergence of an AIE.

Given such premises, the research question guiding the study is the following:

RQ1. How can EE, IE and TTE be combined to frame the structure of an AIE?

In order to support the research question, the investigation is guided by a specific proposition, namely: What are the main patterns of an AIE?

Research methodology

As anticipated in the introduction, the paper aims at enriching the discourse on ecosystems by means of an analysis on the structure of an emerging university ecosystem through a case study methodology.

The case study method of inquire (Yin, 2009) is suitable to investigate a new phenomenon where diverse dimensions interact with a specific context (Patton and Appelbaum, 2003). The description of a new model based on an academic context with a holist view of EE, IE and TTE represents a new phenomenon. In addition, it is affected by diversity (the presence of actors with different competencies, forms of expertise and belongs to different organizations). The explorative nature of the approach allows us to infer valuable insights on the mechanisms enabled by the three ecosystems taken into account, to create value.

The research builds upon a qual-quantitative analysis of a single case study methodology on the San Giovanni Hub (SGH) of the Federico II University of Naples (herein also referred to as the Hub). The selected case represents a suitable empirical setting to understand the AIE construct that will be proposed. Indeed, the choice of the unit of analysis is motivated by the fact that the SGH hosts a University Campus, research centres and laboratories, firms, the industry 4.0 MedITech centre, and a hybrid form of advanced professional education programs (also referred to as "professional academies") co-organised and managed with global-scale companies thus, giving space to a diverse community of actors and stakeholders.

The SGH represents a unique context in which academic activities and outcomes meet the needs and interests of worldwide companies and large multinationals that have drawn up multi-year collaboration agreements with the support of the local government institutions (the Campania Region). Furthermore, in 2019 the Hub was labelled as best practice by the European Commission, which every year rewards the best practices in the use of the European Regional Development Fund FESR [1]. In the same year, the SGH was also shortlisted for the Regiostars award, always granted by the EU Commission to the most effective EU project accomplishments. Thanks to such characteristics, the SGH has become a government benchmark to be replicated in other realities and context across Italy.

Considering its core features and characteristics, the SGH responds to the appropriateness and adequacy criteria used for the choice of the case study (Shakir, 2002). According to the latter, the case study criteria for adopting a case study methodology are met if the case selected appropriately falls in with both the phenomenon under investigation and the aim of the study. The case study refers and applies to "cross-industry, cross-societal research designs" (Audretsch *et al.*, 2019, p. 320), in so that it combines and involves multiple focal actors who are also part of the in IE and EE interacting within it. The adequacy criterion concerns the number of case studies included in the analysis. In this case, the analysis can be based on just one case study as the purpose of the research is to design a new model through an empirical analysis of a real case.

Research context

The San Giovanni Hub (SGH) represents a university engagement model also referred to as an Innovation community (Angrisani *et al.*, 2022). This University settlement is identified as a knowledge-intensive Hub in which innovation, technology and knowledge transfer processes occur simultaneously.

The SGH is an example of an urban upgrading process implemented by means of local, national and EU policies acting in a synergic way. The Hub is settled in a former industrial area dismissed for nearly 20 years. Owing to efficient policy choices at both local, national and European institutional level, the area has been requalified through a strategic urban regeneration process which is still ongoing and is succeeding in replacing an abandoned industrial site with a University Hub (the SGH) devoted to foster innovation, knowledge, entrepreneurial and digital skilling, and upskilling.

Thanks to such a regenerative effort, the SGH is gaining rising attention and recognition from governmental institutions to the extent to which it is acknowledged as an attractor on both a global and a local scale. Indeed, local and (especially) international firms have decided

to invest in the Hub on different levels of involvement. The structure and interactions occurring within the Hub can be described by combining elements related to industrial districts, clusters or science parks although the latter categorisations are oriented towards a marked territorial and industrial focus on the demand side (i.e. the market). The SGH embodies a reverse perspective since it intersects the supply side, made up by producers of knowledge in terms of basic or applied research, IP, Spin-Off firms, collaborative research, contract research and Professional Academies funded by global economic players leaders in their respective sectors, such as: Apple (software house); Deloitte, Accenture, Capgemini, KPMG (consultancies and services); Cisco and TIM (telecommunication), Ferrovie dello Stato (FS) and Autostrade per l'Italia (infrastructures). The Hub reflects combined efforts and coordination in terms of national and local government policies. Indeed, the local government (Campania Region) actively contributed to funding the campus and some of the professional academies, in a collaborative way for the pursuit of the university's missions.

For the purpose of this study, an IE taxonomy adapted by Angrisani *et al.* (2022) has been adopted, which enriches the contribution from Oh *et al.*, (2016) with observations provided by Good *et al.* (2019) in the attempt to describe a synthesis of the SGH main characteristics, in comparison with those of other prominent IEs "types", as illustrated in Table 1.

Data collection

For the inquire on the case study method, data were gathered through an iterative process involving a desk research phase in which an updated documentation and narratives provided by the university administration and TTO concerning the evolution of the settlement and the actors located in the Hub until April 2022 had been deeply analysed. Subsequently, it was performed an empirical observation on the state of the art of the actors and dynamics occurring in the SGH in order to structure a survey and select the appropriate respondents. The survey was meant to collect qual-quantitative pieces of information on the types of activities performed by the actors considered for the inquiry and the linkages coming to the fore among them and with other stakeholders inside and/or outside the Hub. Additionally, part of the survey was intended to explicate the objective or purposes carried out by the respondents to implement the selected activities and linkages. For the survey sample, actors belonging to the Hub were identified according to a purposive criterion concerning the functions and roles assumed by such actors for the fulfilment of one or more of the three missions of the university (education, research and engagement), as well as the relations with

Taxonomy of production/ business/ entrepreneurial /Innovation ecosystems options	Main features and characteristics					
	Industrial production activities	Knowledge production activities	Presence of Firms	Presence of Research Centre	Presence of Higher Education Institutions	Presence of Company-University joint educational programmes
Science Parks	✓	✓	✓	✓	✓	
Clusters	✓	✓	✓	✓		
Industrial Districts	✓	✓	✓			
"SGH-like" model		✓	✓	✓	✓	✓

Source(s): Angrisani *et al.*, 2022, drawing from the taxonomy provided by Oh *et al.*, 2016, p. 3, and from Good *et al.*, 2019, p. 39

Table 1. Why SGH? comparison of main patterns and features

the stakeholders of the hub involved in innovation and entrepreneurial processes. For the reconstruction of the stakeholder map, the study relies on previous research on the SGH (Angrisani *et al.*, 2022; Angrisani and Dell'Anno, 2020) updated with the empirical observation and the documents analysis performed during the first phase of the case study. The quantitative data collected through the survey mainly concern the number of formal agreements among the selected actors of the Hub. An online questionnaire was sent to the selected actors of the Hub. The questionnaire was intended to collect information on formal agreements mainly concerning the scope, the typology, the involved partners, the duration and a brief description of such activities. The scope and typologies items contributed to explain the way in which knowledge is exploited (for industrial applications, basic research and education purposes). The details on the involved partners contributed to define whether the knowledge comes from the university, feeding the knowledge and TTEs, or alternatively from other actors within SGH. Secondly, it was possible to infer the features of the external environment that interacts with the business ecosystem in terms of the variety of involved firms, as well as of the breadth of the spatial dimension involved (i.e. regional, national, international). Finally, information on the duration and the description of the activities adds further details on the nature of the formal agreements and linkages occurring within the SGH. Then, all the data gathered by means of the survey were analysed by the research team and combined with follow-up semi-structured interviews to some of the SGH actors to better understand some specific aspects of the collected information.

Data analysis

In Figure 2 a picture of the interconnections among university departments, research laboratories and professional academies is highlighted. Currently, the university departments belonging to the Federico II University of Naples provide knowledge and competencies within the Cesma Centre (Centro Servizi Metrologici e Tecnologici Avanzati). The knowledge provided by the centre can be grouped in five areas: a) Qualification of processes and industrial products; b) Monitoring of the environment and the territory; c) Measures for the quality of life and health; d) Microbiological evaluation of water; e) Measurements and Monitoring on Networks and Plants. These laboratories are organised according to the needs of the firms that require specific research and testing services. In addition, members of the Federico II supervise the professional academies, higher and specialised education programs conceived and managed in partnership with leading international private companies.

The Hub is recently opening also to non-STEM domains. Since 2021, SGH hosts the master's programme in Social Innovation managed by the Federico II Department of Social Sciences, together with the Societing Lab, a transdisciplinary program of research-action for the social digital transformation that considers social and technological innovation together. The Labs develop projects and theoretical knowledge, for a Mediterranean model of innovation. It creates bridges among disciplines, players, meanings, methods, territories, tradition and innovation generating ideas, experiences and solutions able to produce a common value.

All the professional academies system are located within the SGH campus thus, providing a geographical proximity among all the actors (Figure 2).

Furthermore, the research environment also involves spin-off and knowledge-based firms that interact with the on-site research labs. This bulk of knowledge is exploited in the external environmental through different typologies of agreements with local, national and international companies.

Based on the collected data, in the 2020–2021 SGH campus has activated 126 agreements that can be articulated into contracts (66 out of 126) and formal collaborations (57 out of 126).

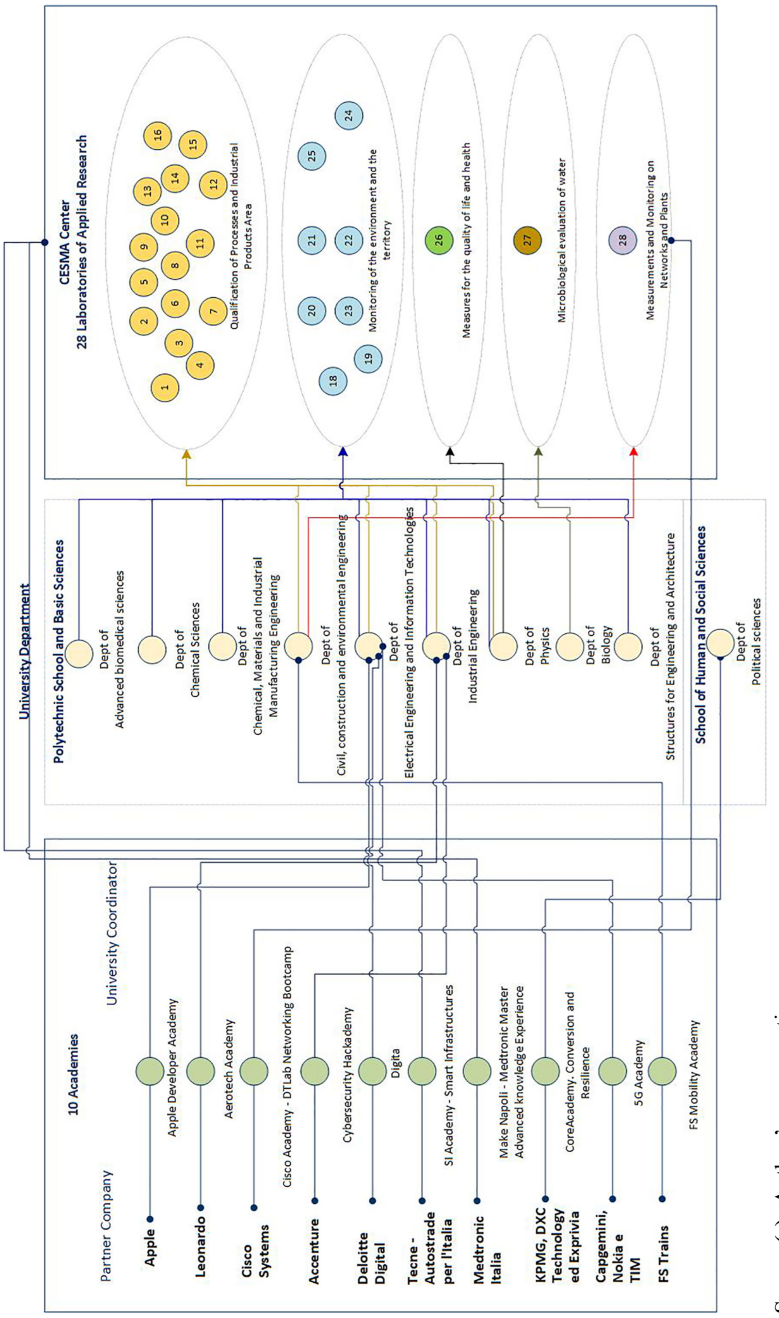

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Figure 2.
Connections between university departments and SGH (Research Laboratories and Academies)

Each contract refers to the exploitation of the knowledge, services, or competencies of the actors of SGH for business purpose jointly to economic revenues. The formal collaboration encompasses all relationships among actors aimed to explore new knowledge oriented to create innovative value for the external context. In some cases, these collaborations can give rise to relationships based on contracts. The scope of these agreements spans from industrial applied research to education, to basic research, to service supplier, to joint laboratories until to no profit activities (Figure 3).

The agreements reported in Figures 3 and 4 involve different actors. In reference to the actors within the SGH, it emerged two sets of main actors: Cesma Centre and two Business accelerators. Cesma Centre gathers all the laboratories managed by university researchers. The Business accelerators encompass two start-ups oriented to transfer digital technologies and innovative materials to firms and to supply service needed to support the digital transformation and the birth of new ventures based on innovative and digital technologies. Additionally, Cesma Centre carries out activities oriented to education, basic research and non-profit initiatives coherently with its university imprinting. Instead, the business accelerators focus on business-oriented activities, solely.

According to the analysis, 80 national private partners interact with the Hub, as shown in Figure 4. Said partners include private firms (23 out of 80), consulting firms (21 out of 80), universities (17 out of 80), and public organisations, start-up firms, academic spin-offs, business accelerators, incubators, venture capitals, banks, and employees and professionals'

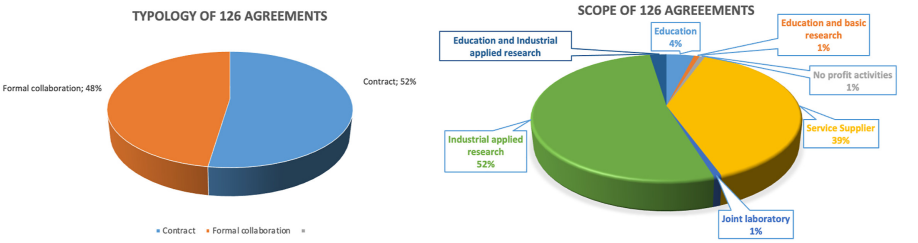


Figure 3.
Typology and scope of SGH agreements

Source(s): Author's own creation

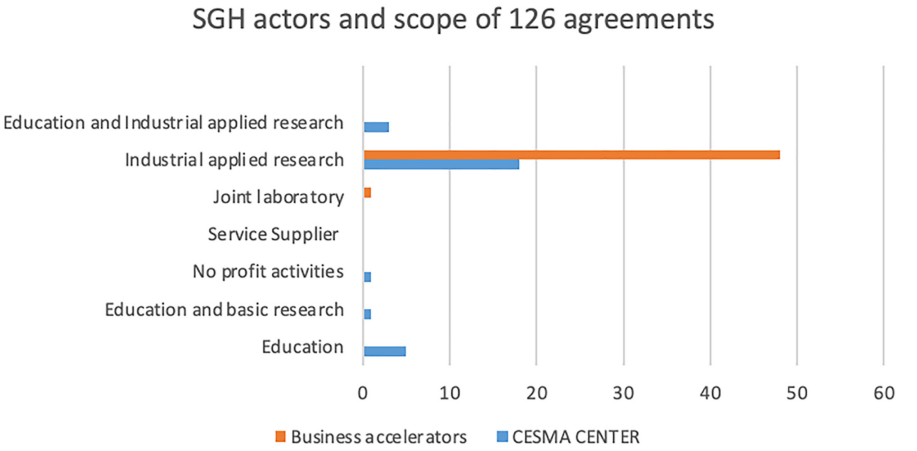


Figure 4.
SGH actor and scope of their agreements

Source(s): Author's own creation

associations. In particular, the business accelerators are both actors of SGH and partners in the agreements with other actor of SGH (in this case with research laboratories of Cesma Centre) (Figure 5).

According to the analysis performed on the questionnaires concerning the agreements among partners within and outside the SGH, most of these agreements were activated in 2021 with a significant growth compared to previous years (the first agreements date back to 2019). The duration of the agreements varies from 6 months to five years, although most of them do not exceed 3 years.

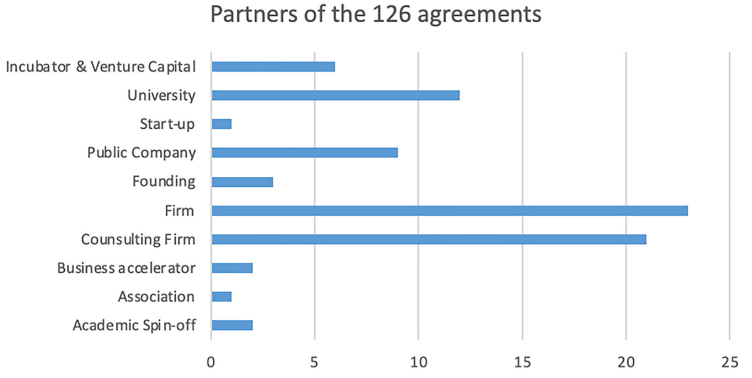
The relations unfolding among the actors of the Hub are mostly dyadic. Hence, an investigation on the networks connecting such actors cannot be performed given the data collected for the purpose of the present study. The dyadic relations emerging from the study represent a knowledge base upon which further investigation can be addressed on the potential growth of the role of the SGH and the university itself as orchestrator of the interactions. Indeed, more specific analysis on the relations and knowledge transfer dynamics within and outside the SGH would help addressing the description of the network among the stakeholders of the Hub more effectively.

Concerning the higher education system, SGH hosts 10 Professional Academies to date, involving industrial partners such as Apple, Deloitte, Cisco, Capgemini and Accenture. These Professional Academies allow to address university education towards digital and high-level competencies required by these firms.

Findings

According to the analysis performed through the case study, it can be evidenced how SGH orchestrates three main ecosystems for the knowledge exploitation. More specifically, the TTE is devoted to gather knowledge coherently with the business environment and to select the knowledge and innovations developed within research labs and suitable to be transferred to the industry. The IE is able to manage the exploration and exploitation of new knowledge and technologies developed within it, also through training and education programmes conceived and implemented in partnership with firms in order to provide specialised skills (mainly digital) requested by the private sector. Finally, the EE supports the start-up process involving spin-off firms deriving from university technology and knowledge transfer ventures (Figure 6).

SGH allows all these actors to be embedded within the same context, fostering the creation of collaborative and competitive relationships. Data collected through the survey served the



Source(s): Author's own creation

Figure 5.
Partners of the agreements

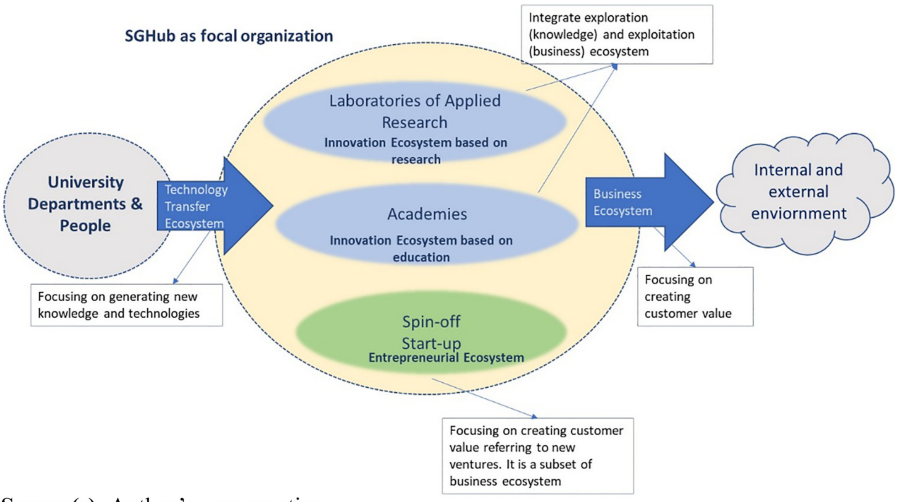


Figure 6.
SGH as orchestrator between knowledge and business ecosystem

Source(s): Author's own creation

intent to provide a more complete picture of the Hub, by detecting and classifying the activities and linkages existing among its very stakeholders.

SGH represents a unique research environment that pools together education and research activities to be oriented to industrial needs, while carrying out engagement actions, thus complying with the suggestions offered by Nicholls-Nixon *et al.* (2021) in reference to the enhancement of entrepreneurial innovation through technology and knowledge transfer actions. Said environment gathers together researchers with complementary competencies that usually perform their education and research activities in different university departments.

The analysis has provided grounds to demonstrate that SGH creates and supports innovation and education ecosystems aimed at exploiting knowledge that induce external actors to create value in terms of knowledge and technology transfer. The analysis carried out in this paper points out that the collaborations within the Hub are dyadic: this effect reinforces the role of SGH in creating an environment that is an IE itself, and able to participate to other ecosystems or partnerships with external actors, at the same time.

The academic innovation ecosystems: the ecosystem orchestrator role of the university

Against this backdrop and according to the research questions emerged by the analysis of the literature, the main patterns of the AIE are as follows:

(1) An AIE is a physical environment in which university knowledge feeds the innovation and higher education coherently with the following value proposition: the creation of knowledge to be exploited outside the boundaries of the system. In such an environment, TTE, IE and EE are woven in a twofold way. On the one hand knowledge is tailored on the needs of IE and EE, on the other one IE, EE and TTE exploit this knowledge to attain a specific value proposition. The empirical case study analysed in this paper shows the emergence of an environment in which the boundaries among research, education and innovation are blurry.

(2) In an AIE each actor plays a specific role linked to the three aims of a HEIs or universities: education, research and engagement (third mission).

(3) The university acts as an ecosystem orchestrator, guiding the ecosystem effectuation process (Radziwon *et al.*, 2022). The ecosystem effectuation is an approach to making decisions and performing actions in the ecosystem emergence and legitimization process when the ecosystem orchestrator (the University of Naples Federico II with SGH in the analysis) identifies the best next step by assessing the available resources, which could help to achieve the ecosystems' goal.

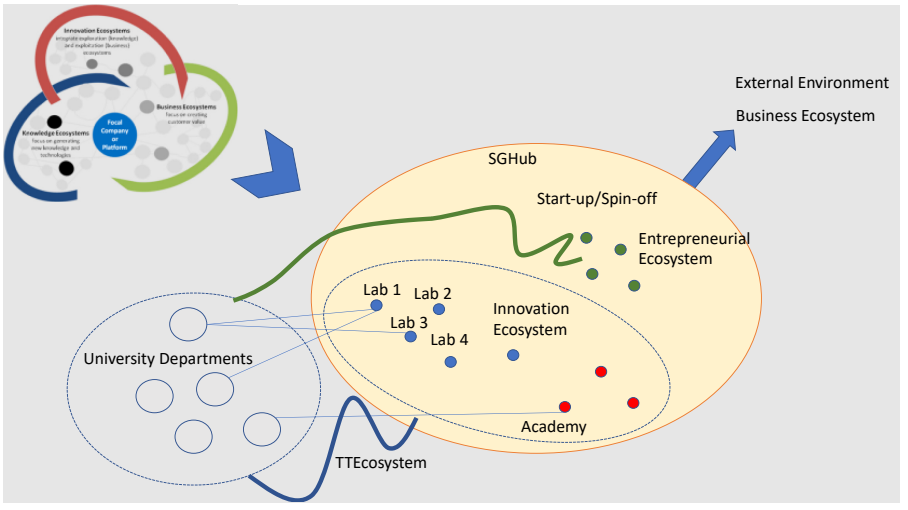
Discussion

The case study performed for this research represents a new innovation and entrepreneurial model developed around some key aspects deriving from EE, IE and TTE constructs. The insights drawn from the empirical analysis contribute to characterize the case of SGH as a self-standing model of AIE which also embeds a multifaceted set of systems (Adner, 2017), thus taking the shape of a "meta-ecosystem" structure. Indeed, in order to present the reflections presented in this section herein after the identification of the AIE with the patterns of the SGH is revealed.

Gleaning from the relationships between overlapping ecosystem types proposed by Valkokari (2015), it emerged the following characteristics of the AIE model (Figure 7):

In the AIE model, the University represents the focal actor that connects the knowledge producers (university departments) with more business-oriented research laboratories and specialised education. These connections among sources of knowledge and business actors are the pillars for the creation of IEs orchestrated by a focal organisation or platform (Autio and Thomas, 2014; Ritala *et al.*, 2013; Rohrbeck *et al.*, 2009; West and Bogers, 2014).

Operationally, the technology and knowledge transfer platform is therefore managed within the Academic environment, in this research, the Federico II University. The knowledge acquired by laboratories and professional academies shapes the IE in order to produce knowledge or specialised skills tailored on the needs of the firms. The value created by such innovations is captured within the business ecosystem to be exploited in the external environment. Furthermore, the AIE creates a favourable environment for the start-ups coherently with the EE.



Source(s): Authors' elaboration based on Valkokari, 2015, p.20

Figure 7.
Moving from Valkokari (2015) to academic innovation ecosystem

The AIE allows to create different knowledge and technology relationships. Most agreements within the AIE occur in the form of business contracts, although the laboratories are also devoted to establishing scientific cooperation or partnership with the external environment. These latter relationships feed a knowledge ecosystem based on a collective knowledge search involving users and producers of knowledge (Järvi *et al.*, 2018).

Given such attitude, the knowledge created within the AIE contributes to enhance the value propositions of the other actors, showing an ability to employ exploration strategies in balance with exploitation. In doing so inter-organisational knowledge transfer emerges that leads the organisations to reciprocally share and acquire knowledge (Dayan *et al.*, 2017; Del Giudice and Maggioni, 2014).

In addition, knowledge can also be conveyed and transferred through the advanced education paths located in the AIE and provided by the professional Academies. The latter consist of higher education programs conceived and implemented jointly with industrial partners in order to meet their needs. The high number of firms involved in the AIE context, together with the participation of academics belonging to all STEM departments witness the relevant role of this model in the business environment.

Lastly, the analysis shows that an academic environment fosters collaborative or sometimes coopetitive dynamics (Ratten, 2020) rather than competitive ones, thus framing the scope and key patterns of an AIE. Indeed, the value created is mostly attributable to knowledge transfer mechanisms operating through public–private partnerships (PPPs) to support entrepreneurship and innovation in a systematic way involving the actors interacting within the AIE.

Such evidence conveys two further concepts. The first one concerns the idea of collective intelligence (Levy, 1994). The collective intelligence approach states that multiple independent actors who work together may perform better (more intelligently) than any individual actor working alone (Marinelli *et al.*, 2022). In this sense, a collective approach model pushes agents of a system working to foster participative forms of collaboration enhancing innovation. A collective intelligent approach requires the system to meet three requirements: i. Diversity (the presence of actors with different competencies and forms of expertise), ii. Independence (among actors) and iii. Aggregation (the use of mechanisms to combine individual contributions). For the purpose of the analysis, a collective intelligence generation process is guaranteed by the supervision of a knowledge hub (the university) interacting with several actors in an orchestrated way.

The second concept regards the institutional theory (Scott, 1995, 2013), according to which formal and informal institutions impact on the behaviours, and the decisions actors have to make to operate in the ecosystem. Indeed, this theory provides evidence that organisations are influenced by normative pressures, governmental and regulative rules. Those rules, namely regulative, structure economic processes at the national level (property rights, contracts, patent laws, tax structures). Organisations are also influenced by a system of normative rules, covering rules that confer values, norms, role expectation and responsibilities (Hodgson, 1998; Khlystova *et al.*, 2022; Scott, 1995).

Finally, some of the stakeholders of the Hub are involved in the ecosystem effectuation process orchestrated by the university, and normative rules as well as economic pressures influence the evolution process of the AIE.

Conclusion and implications

The study enriches the role of universities as both creators and enablers of ecosystems pursuing diverse value propositions, thus allowing the presence of multiple ecosystems embedded in an academic environment. Such a theoretical contribution emphasises the

concept of ecosystem environment to convey a broader set of components, as suggested by Nicholls-Nixon *et al.* (2021).

The AIE model proposed hitherto is consistent with the concept of entrepreneurial university coined by Etzkowitz (1998) and Clark (1998) in so that it conveys the idea that the knowledge spawned by university research and education programs can be exploited for business applications and revenue generation. This process is associated with the theorisation of Academic Entrepreneurship (O'Shea *et al.*, 2004) which focuses on the activities undertaken by industrial partners and universities jointly, to commercialise the outcomes of the research. The academic entrepreneurship model stems from the ability to implement scientific research for business profits. Nevertheless, only part of the results of the academic research performed within university departments and labs can be transferred to the industry (Wood, 2011). Additionally, partner companies attribute rising attention to the protection of know-how and intellectual property (IP) rights (Aloini *et al.*, 2017) of the products or services provided as outcomes of the university research process. The AIE welcomes and endorses the concept of academic entrepreneurship, giving more emphasis on the creation of value for the environment in which it is embedded, hence overcoming the traditional goal of economic returns deriving from research commercialisation (Siegel and Wright, 2015).

The knowledge environment of an AIE represents a viable solution to facilitate the exploitation of external knowledge sources by the firms and to improve their innovative performances (Laursen and Salter, 2006; Scuotto *et al.*, 2017), becoming vital for organisations, especially in a digital context (Del Giudice *et al.*, 2017).

Indeed, the AIE model embraces consistently the challenges brought by the advent of digital technologies that require a new form of collaboration based on IE for the cocreation of technological solutions for the business (Rong *et al.*, 2015; Yildirim and Tuncalp, 2021). Hence, the AIE allows the interdependency of competences and technological complementarity needed for the development and implementation of digital and innovation technological technologies (Cannavacciuolo *et al.*, 2023; Dalenogare *et al.*, 2018; Reischauer, 2018; Rüßmann *et al.*, 2015). This new form of collaboration is relevant above all in context characterised by small- and medium-sized enterprises (SMEs) because the latter do not own all the capabilities for the adoption of innovative technologies (Aloini *et al.*, 2011; Dallasega *et al.*, 2018; Lux *et al.*, 2020). However, SMEs can find the resources they need to succeed in the research process in the ecosystem formed by actors, such as HEIs, R&D centres, business and professionals' associations (Yildirim and Tuncalp, 2021). The university incorporates a pivotal function in promoting the development of new digital solutions as well as in the creation of new ventures. In fact, what is ultimately at stake is the understanding of the new roles that AIE can play, together with their actors, to overcome their strategic priorities and missions (Yildirim and Tuncalp, 2021) to sustain and support technological and digital transformation. Despite the importance of this issue for policymakers, still very few studies have explored such topic adopting a case study approach (Bedford *et al.*, 2018; Heaton *et al.*, 2019).

The research effort performed for the present paper would help to provide elements for the analysis of the value created in terms of innovation performance within the selected case thus, to set a general framework to be replicated and scaled in further cases and contexts.

Regarding useful theoretical implications, the empirical case described in this paper represents an effective example of the ways in which different ecosystems can be combined and analysed to allow a university context to transfer its knowledge in an environment oriented towards innovation and exploitation of technology (Good *et al.*, 2019; Valkokari, 2015). Hence, the paper contributes to reinforce the literature focused on approaching the different components of an IE (Granstrand and Holgersson, 2020) in an integrated way, as well as the relevance of its interrelations (Adner, 2017).

The framework provided by the AIE model can be applied to an innovation context involving public, private and institutional sectors to boost technology and knowledge transfer as well as entrepreneurial mechanisms. Additionally, the framework presents practical implications for various stakeholders, including universities administrators, researchers, businesses and policymakers. By fostering collaboration and creating a supportive environment for innovation, the AIE framework has the potential to drive economic growth and address the challenges in the academic innovation landscape.

Limitations of the study mainly concern the fact that it is centred on just one case study mainly analysed in a qualitative way. Further elaborations are needed through a benchmark analysis with other similar cases or to infer quantitative outcomes related to innovation and knowledge transfer performance indexes. Additionally, future research trajectories can investigate the ways in which actors and stakeholders within an AIE contribute to create and share value by resorting to a network analysis of more quantitative data analysis concerning performance evaluations.

Note

1. See the dedicated webpage https://porfesr.regione.campania.it/it/news/primo-piano/polo-universitario-di-san-giovanni-a-teduccio-inaugurato-il-cisco-digital-transformation-lab

References

Ács, Z.J., Márkus, G. and Szerb, L. (2010), "Measuring the entrepreneurial behavior of the established businesses: an individual and a country-level investigation", *4th GEM Research Conference*, London Imperial College Measuring.

Adner, R. (2006), "Match your innovation strategy to your innovation ecosystem", *Harvard Business Review*, Vol. 84 No. 4, pp. 11-29.

Adner, R. (2017), "Ecosystem as structure: an actionable construct for strategy", *Journal of Management*, Vol. 43 No. 1, pp. 39-58, doi: 10.1177/0149206316678451.

Adner, R. and Kapoor, R. (2010), "Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations", *Strategic Management Journal*, Vol. 31 No. 3, pp. 306-333, Wiley Online Library.

Aloini, D., Martini, A. and Pellegrini, L. (2011), "A structural equation model for continuous improvement: a test for capabilities, tools and performance", *Production Planning and Control*, Vol. 22 No. 7, pp. 628-648, Taylor & Francis.

Aloini, D., Lazzarotti, V., Manzini, R. and Pellegrini, L. (2017), "IP, openness, and innovation performance: an empirical study", *Management Decision*, Vol. 55 No. 6, pp. 1307-1327, Emerald Publishing.

Angrisani, M. and Dell'Anno, D. (2020), "Trasferimento tecnologico e University engagement come interpretazione dei processi locali di innovazione. Un'analisi esplorativa", *Rivista Economica Del Mezzogiorno, Societā Editrice Il Mulino*, Vol. 34 Nos 1-2, pp. 187-216.

Angrisani, M., Dell'Anno, D. and Hockaday, T. (2022), "From ecosystem to community. Combining entrepreneurship and university engagement in an open innovation perspective", *International Journal of Technology Management*, Vol. 88 No. 1, pp. 71-92, Inderscience Publishers (IEL).

Audretsch, D.B. (2014), "From the entrepreneurial university to the university for the entrepreneurial society", *The Journal of Technology Transfer*, Vol. 39 No. 3, pp. 313-321, Springer.

Audretsch, D.B. and Belitski, M. (2017), "Entrepreneurial ecosystems in cities: establishing the framework conditions", *The Journal of Technology Transfer*, Vol. 42 No. 5, pp. 1030-1051, Springer.

Audretsch, D.B., Cunningham, J.A., Kuratko, D.F., Lehmann, E.E. and Menter, M. (2019), "Entrepreneurial ecosystems: economic, technological, and societal impacts", *The Journal of Technology Transfer*, Vol. 44 No. 2, pp. 313-325, Springer.

Autio, E., Nambisan, S., Thomas, L.D.W. and Wright, M. (2018), "Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems", *Strategic Entrepreneurship Journal*, Vol. 12 No. 1, pp. 72-95, Wiley Online Library.

Autio, E. and Thomas, L. (2014), "Innovation ecosystems", in Dodgson, M., Gann, D.M. and Phillips, N. (Eds), *The Oxford Handbook of Innovation Management*, Oxford University Press, pp. 204-288.

Bawnol, W.J. (1990), "Entrepreneurship, productive, unproductive, and destructive", *Journal of Political Economy*, Vol. 98 No. 5, pp. 98-893.

Bedford, T., Kinnaird, Y., Migueis, R., Paolucci, E., Wijlands, B. and Vos, A. (2018), "Role of universities of science and technology in innovation ecosystems: towards mission 3.1", No. CASAER white paper, p. 32.

Beliaeva, T., Ferasso, M., Kraus, S. and Damke, E.J. (2019), "Dynamics of digital entrepreneurship and the innovation ecosystem: a multilevel perspective", *International Journal of Entrepreneurial Behavior and Research*, Vol. 26 No. 2, pp. 266-284.

Bronfenbrenner, U. (1979), *The Ecology of Human Development: Experiments by Nature and Design*, Harvard University Press, Cambridge, MA, London.

Bryman, A. and Bell, E. (2015), *Business Research Methods*, Oxford University Press.

Cannavacciuolo, L., Ferraro, G., Ponsiglione, C., Primario, S. and Quinto, I. (2023), "Technological innovation-enabling industry 4.0 paradigm: a systematic literature review", *Technovation*, Vol. 124, 102733.

Carayannis, E.G., Grigoroudis, E., Campbell, D.F.J., Meissner, D. and Stamati, D. (2018), "The ecosystem as helix: an exploratory theory-building study of regional co-opetitive entrepreneurial ecosystems as Quadruple/Quintuple Helix Innovation Models", *R and D Management*, Vol. 48 No. 1, pp. 148-162, doi: 10.1111/radm.12300.

Clark, B.R. (1998), *Creating Entrepreneurial Universities: Organizational Pathways of Transformation. Issues in Higher Education*, Elsevier, 665, Avenue of the Americas, 10010, New York, NY.

Cloitre, A., Dos, V., Paulino, S. and Theodoraki, C. (2022), "The quadruple/quintuple helix model in entrepreneurial ecosystems: an institutional perspective on the space case study", *R&D Management*, pp. 1-20, doi: 10.1111/radm.12547.

Cooke, P. (2001), "Regional innovation systems, clusters, and the knowledge economy", *Industrial and Corporate Change*, Vol. 10 No. 4, pp. 945-974, Oxford University Press.

Dalenogare, L.S., Benitez, G.B., Ayala, N.F. and Frank, A.G. (2018), "The expected contribution of Industry 4.0 technologies for industrial performance", *International Journal of Production Economics*, Vol. 204, pp. 383-394, Elsevier.

Dallasega, P., Rauch, E. and Linder, C. (2018), "Industry 4.0 as an enabler of proximity for construction supply chains: a systematic literature review", *Computers in Industry*, Vol. 99 March, pp. 205-225, Elsevier, doi: 10.1016/j.compind.2018.03.039.

Dayan, R., Heisig, P. and Matos, F. (2017), "Knowledge management as a factor for the formulation and implementation of organization strategy", *Journal of Knowledge Management*, Vol. 21 No. 2, pp. 308-329.

Del Giudice, M., Carayannis, E.G. and Maggioni, V. (2017), "Global knowledge intensive enterprises and international technology transfer: emerging perspectives from a quadruple helix environment", *The Journal of Technology Transfer*, Vol. 42 No. 2, pp. 229-235, Springer.

Del Giudice, M. and Maggioni, V. (2014), "Managerial practices and operative directions of knowledge management within inter-firm networks: a global view", *Journal of Knowledge Management*, Vol. 18 No. 5, pp. 841-846, doi: 10.1108/JKM-06-2014-0264.

Dell'Anno, D. and Del Giudice, M. (2015), "Absorptive and desorptive capacity of actors within university-industry relations: does technology transfer matter?", *Journal of Innovation and Entrepreneurship*, Vol. 4 No. 1, pp. 1-20, SpringerOpen.

Edquist, C. (1997), "Systems of innovation approaches–their emergence and characteristics", *Systems of Innovation: Technologies, Institutions and Organizations*, Vol. 1989, pp. 1-35, Pinter London.

Etzkowitz, H. (1998), "The norms of entrepreneurial science: cognitive effects of the new university–industry linkages", *Research Policy*, Elsevier, Vol. 27 No. 8, pp. 823-833.

Franco, M. and Haase, H. (2015), "University–industry cooperation: researchers' motivations and interaction channels", *Journal of Engineering and Technology Management*, Vol. 36, pp. 41-51, Elsevier.

Ghazinoory, S., Phillips, F., Afshari-Mofrad, M. and Bigdelou, N. (2021), "Innovation lives in ecotones, not ecosystems", *Journal of Business Research*, Vol. 135 June, pp. 572-580, doi: 10.1016/j.jbusres.2021.06.067.

Goddard, J., Kempton, L. and Vallance, P. (2013), "Universities and Smart Specialisation: challenges, tensions and opportunities for the innovation strategies of European regions", *Ekonomiaz: revista Vasca de Economia*, Departamento de Hacienda y Administración Pública= Ogasun eta Herri, Vol. 83, pp. 82-101.

Gomes, L.A.de V., Chaparro, X.A.F., Facin, A.F.F. and Borini, F.M. (2021), "Ecosystem management: past achievements and future promises", *Technological Forecasting and Social Change*, Vol. 171 November, p. 120950, Elsevier, 2020, doi: 10.1016/j.techfore.2021.120950.

Good, M., Knockaert, M., Soppe, B. and Wright, M. (2019), "The technology transfer ecosystem in academia. An organizational design perspective", *Technovation*, Elsevier, Vol. 82, pp. 35-50.

Granstrand, O. and Holgersson, M. (2020), "Innovation ecosystems: a conceptual review and a new definition", *Technovation*, Vols 90-91 November, 2019, doi: 10.1016/j.technovation.2019.102098.

Heaton, S., Siegel, D.S. and Teece, D.J. (2019), "Universities and innovation ecosystems: a dynamic capabilities perspective", *Industrial and Corporate Change*, Vol. 28 No. 4, pp. 921-939, Oxford University Press.

Hodgson, G.M. (1998), "Evolutionary and competence-based theories of the firm", *Journal of Economic Studies*, Vol. 25 No. 1, pp. 25-56, doi: 10.1108/01443589810195606.

Holland, B. (2001), "Toward a definition and characterization of the engaged campus: six cases", *Metropolitan Universities*, Vol. 12 No. 3, pp. 20-29.

Isenberg, D.J. (2010), "How to start an entrepreneurial revolution", *Harvard Business Review*, Vol. 88 No. 6, pp. 40-50, New York.

Järvi, K., Almpanopoulou, A. and Ritala, P. (2018), "Organization of knowledge ecosystems: prefigurative and partial forms", *Research Policy*, Vol. 47 No. 8, pp. 1523-1537, Elsevier.

Jacobides, M.G., Cennamo, C. and Gawer, A. (2018), "Towards a theory of ecosystems", *Strategic Management Journal*, Vol. 39 No. 8, pp. 2255-2276, Wiley Online Library.

Khlystova, O., Kalyuzhnova, Y. and Belitski, M. (2022), "Towards the regional aspects of institutional trust and entrepreneurial ecosystems", *International Journal of Entrepreneurial Behavior and Research*, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/IJEBR-02-2022-0108.

Lamine, W., Anderson, A., Jack, S.L. and Fayolle, A. (2021), "Entrepreneurial space and the freedom for entrepreneurship: institutional settings, policy, and action in the space industry", *Strategic Entrepreneurship Journal*, Vol. 15 No. 2, pp. 309-340, doi: 10.1002/sej.1392.

Laursen, K. and Salter, A. (2006), "Open for innovation: the role of openness in explaining innovation performance among U.K. manufacturing firms", *Strategic Management Journal*, Vol. 27 No. 2, pp. 131-150, doi: 10.1002/smj.507.

Lechner, C., Delanoë-Gueguen, S. and Gueguen, G. (2022), "Entrepreneurial ecosystems and actor legitimacy", *International Journal of Entrepreneurial Behavior and Research*, Emerald Publishing, Vol. 28 No. 9, pp. 466-491, doi: 10.1108/IJEBR-03-2020-0165.

Lepore, D., Nambisan, S., Tucci, C.L. and Zahra, S.A. (2019), "Digital transformation and firms' innovative strategies: capabilities, ecosystems, and business models", *Academy of Management Proceedings*, Academy of Management Briarcliff Manor, NY 10510, Vol. 2019, p. 14623.

Levy, J.S. (1994), "Learning and foreign policy: sweeping a conceptual minefield", *International Organization*, Vol. 48 No. 2, pp. 279-312, Cambridge University Press.

Leydesdorff, L. (2012), "The triple helix, quadruple helix, . . ., and an N-tuple of helices: explanatory models for analyzing the knowledge-based economy?", *Journal of the Knowledge Economy*, Vol. 3 No. 1, pp. 25-35, Springer.

Longva, K.K. (2021), "Student venture creation: developing social networks within entrepreneurial ecosystems in the transition from student to entrepreneur", *International Journal of Entrepreneurial Behavior and Research*, Vol. 27 No. 5, pp. 1264-1284.

Lux, A.A., Macau, F.R. and Brown, K.A. (2020), "Putting the entrepreneur back into entrepreneurial ecosystems", *International Journal of Entrepreneurial Behavior and Research*, Vol. 26 No. 5, pp. 1011-1041, doi: 10.1108/IJEBR-01-2020-0031.

Marinelli, L., Bartoloni, S., Pascucci, F., Gregori, G.L. and Briamonte, M.F. (2022), "Genesis of an innovation-based entrepreneurial ecosystem: exploring the role of intellectual capital", *Journal of Intellectual Capital*, Emerald Publishing, Vol. 24 No. 1, pp. 10-34, doi: 10.1108/JIC-09-2021-0264.

Meyer, M.H., Lee, C., Kelley, D. and Collier, G. (2020), "An assessment and planning methodology for university-based: entrepreneurship ecosystems", *The Journal of Entrepreneurship*, Vol. 29 No. 2, pp. 259-292, SAGE Publications Sage India: New Delhi.

Molas-Gallart, J. and Castro-Martínez, E. (2007), "Ambiguity and conflict in the development of 'Third Mission'indicators", *Research Evaluation*, Vol. 16 No. 4, pp. 321-330, Beech Tree Publishing.

Moore, J.F. (1993), "Predators and prey: a new ecology of competition", *Harvard Business Review*, Vol. 71 No. 3, pp. 75-86, SUBSCRIBER SERVICE, PO BOX 52623, BOULDER, CO 80322-2623.

Nambisan, S., Zahra, S.A. and Luo, Y. (2019), "Global platforms and ecosystems: implications for international business theories", *Journal of International Business Studies*, Vol. 50 No. 9, pp. 1464-1486, Springer.

Nelson, R.R. (1993), *National Innovation Systems: A Comparative Analysis*, Oxford University Press on Demand, New York.

Nicholls-Nixon, C.L., Valliere, D., Gedeon, S.A. and Wise, S. (2021), "Entrepreneurial ecosystems and the lifecycle of university business incubators: an integrative case study", *International Entrepreneurship and Management Journal*, Vol. 17 No. 2, pp. 809-837, Springer.

North, D.C. (1990), *Institutions, Institutional Change and Economic Performance*, Cambridge University Press NY, Cambridge.

Oh, D.S., Phillips, F., Park, S. and Lee, E. (2016), "Innovation ecosystems: a critical examination", *Technovation*, Vol. 54, pp. 1-6, doi: 10.1016/j.technovation.2016.02.004.

O'Shea, R., Allen, T.J., O'Gorman, C. and Roche, F. (2004), "Universities and technology transfer: a review of academic entrepreneurship literature", *Irish Journal of Management*, Vol. 25 No. 2, pp. 11-29.

Patton, E. and Appelbaum, S.H. (2003), "The case for case studies in management research", *Management Research News*, Vol. 26 No. 5, pp. 60-71.

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., Krabel, S., Kitson, M., Llerena, P., Lissoni, F., Salter, A. and Sobrero, M. (2013), "Academic engagement and commercialisation: a review of the literature on university–industry relations", *Research Policy*, Elsevier, Vol. 42 No. 2, pp. 423-442.

Phillips, F. (2014), "Triple helix and the circle of innovation", *Journal of Contemporary Eastern Asia*, Vol. 13 No. 1, pp. 57-68, World Association for Triple Helix and Future Strategy Studies.

Pocek, J. (2022), "Tendencies towards integration and disintegration of the entrepreneurial ecosystem: an institution-based view of the dynamics", *European Planning Studies*, Vol. 30 No. 12, pp. 1-20.

Radziwon, A., Bogers, M.L.A.M., Chesbrough, H. and Minssen, T. (2022), "Ecosystem effectuation: creating new value through open innovation during a pandemic", *R and D Management*, Vol. 52 No. 2, pp. 376-390, doi: 10.1111/radm.12512.

Rajaeian, M.M., Cater-Steel, A. and Lane, M. (2018), "Determinants of effective knowledge transfer from academic researchers to industry practitioners", *Journal of Engineering and Technology Management*, Vol. 47, pp. 37-52, Elsevier.

Ratten, V. (2020), "Entrepreneurial ecosystems", *Thunderbird International Business Review*, Vol. 62 No. 5, pp. 447-455, doi: 10.1002/tie.22164.

Reischauer, G. (2018), "Industry 4.0 as policy-driven discourse to institutionalize innovation systems in manufacturing", *Technological Forecasting and Social Change*, Vol. 132, pp. 26-33, Elsevier.

Rippa, P. and Secundo, G. (2019), "Digital academic entrepreneurship: the potential of digital technologies on academic entrepreneurship", *Technological Forecasting and Social Change*, Vol. 146 July, pp. 900-911, Elsevier, 2018, doi: 10.1016/j.techfore.2018.07.013.

Ritala, P. and Gustafsson, R. (2018), "Q&A. Innovation and entrepreneurial ecosystem research: where are we now and how do we move forward?", *Technology Innovation Management Review*, Vol. 8 No. 7, pp. 52-57.

Ritala, P., Agouridas, V., Assimakopoulos, D. and Gies, O. (2013), "Value creation and capture mechanisms in innovation ecosystems: a comparative case study", *International Journal of Technology Management*, Vol. 63 Nos 3-4, pp. 244-267, doi: 10.1504/IJTM.2013.056900.

Rohrbeck, R., Hölzle, K. and Gemünden, H.G. (2009), "Opening up for competitive advantage - how Deutsche telekom creates an open innovation ecosystem", *R and D Management*, Vol. 39 No. 4, pp. 420-430, doi: 10.1111/j.1467-9310.2009.00568.x.

Rong, K., Wu, J., Shi, Y. and Guo, L. (2015), "Nurturing business ecosystems for growth in a foreign market: incubating, identifying and integrating stakeholders", *Journal of International Management*, Vol. 21 No. 4, pp. 293-308, Elsevier.

Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P. and Harnisch, M. (2015), "Industry 4.0: the future of productivity and growth in manufacturing industries", Boston Consulting Group, Boston, MA, Vol. 9 No. 1, pp. 54-89.

Scaringella, L. and Radziwon, A. (2018), "Innovation, entrepreneurial, knowledge, and business ecosystems: old wine in new bottles?", *Technological Forecasting and Social Change*, Vol. 136 December, 2015, pp. 59-87, doi: 10.1016/j.techfore.2017.09.023.

Scott, W.R. (1995), *Institutions and Organizations. Foundations for Organizational Science*, A Sage Publication Series, London.

Scott, W.R. (2013), *Institutions and Organizations: Ideas, Interests, and Identities*, Sage Publications, London.

Scuotto, V., Santoro, G., Bresciani, S. and Del Giudice, M. (2017), "Shifting intra- and inter-organizational innovation processes towards digital business: an empirical analysis of SMEs", *Creativity and Innovation Management*, Vol. 26 No. 3, pp. 247-255, doi: 10.1111/caim.12221.

Shakir, M. (2002), "The selection of case studies: strategies and their applications to IS implementation cases studies. Maha Shakir", *Research Letters in the Information and Mathematical Sciences*, Vol. 3, pp. 191-198.

Siegel, D.S. and Wright, M. (2015), "Academic entrepreneurship: time for a rethink?", *British Journal of Management*, Vol. 26 No. 4, pp. 582-595, doi: 10.1111/1467-8551.12116.

Siegel, D.S., Waldman, D. and Link, A. (2003), "Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study", *Research Policy*, Vol. 32 No. 1, pp. 27-48, Elsevier.

Sparrow, J. (2011), "Assessing changes in university knowledge transfer capability to support innovation: a knowledge intensive business service perspective", in *Proceedings of the 2nd International Conference on Innovation through Knowledge Transfer*, InnovationKT-2010 held at 7th & 8th December, Coventry, West Midlands, UK 2010, pp. 73-81, Springer.

Spigel, B. (2020), *Entrepreneurial Ecosystems: Theory, Practice and Futures*, Edward Elgar Publishing, Glos.

Szerb, L., Ács, Z., Autio, E., Ortega-Argiles, R. and Komlosi, E. (2013), "The regional entrepreneurship and development index–Measuring regional entrepreneurship", *European Commission*.

Valkokari, K. (2015), "Business, innovation, and knowledge ecosystems: how they differ and how to survive and thrive within them", *Technology Innovation Management Review*, Vol. 5 No. 8, pp. 17-24, doi: 10.22215/timreview919.

Weber, M.L. and Hine, M.J. (2015), "Who inhabits a business ecosystem? The technospecies as a unifying concept", *Technology Innovation Management Review*, Vol. 5 No. 5.

West, J. and Bogers, M. (2014), "Leveraging external sources of innovation: a review of research on open innovation", *Journal of Product Innovation Management*, Vol. 31 No. 4, pp. 814-831, doi: 10.1111/jpim.12125.

Wood, M.S. (2011), "A process model of academic entrepreneurship", *Business Horizons*, Vol. 54 No. 2, pp. 153-161, Elsevier.

Wright, M. and Stigliani, I. (2013), "Entrepreneurship and growth", *International Small Business Journal*, Vol. 31 No. 1, pp. 3-22, Sage Publications Sage UK: London.

Yildirim, N. and Tuncalp, D. (2021), "A policy design framework on the roles of S&T universities in innovation ecosystems: integrating stakeholders' voices for industry 4.0", *IEEE Transactions on Engineering Management*, Vol. early access, pp. 1-18, doi: 10.1109/TEM.2021.3106834.

Yin, R.K. (2009), *Case Study Research: Design and Methods*, Sage, Vol. 5.

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