

Entrepreneurial Universities and Entrepreneurial Ecosystems: Dynamics, Synergies, and Challenges

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Tese para obtenção do Grau de Doutor em
Gestão
(3^o ciclo de estudos)

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13 de novembro de 2023

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Universidade da Beira Interior, Covilhã 28/02/2023

Dedictory

To my daughter, to my son, and to my husband, my ecosystem!

To my family and true friends!

To everyone who somehow made me move forward!

Acknowledgments

Throughout this journey, I have always believed that gratitude should be primarily directed toward myself. This belief stems from the fact that I see myself as a fundamental part of the process, driven by my desire to grow and learn. I discovered a fascinating subject in my study area, which I found to be complex, full of nuances, and context-dependent. Recognizing that we do not exist in isolation, I adopted a biomimetic perspective and an ecosystem thinking approach, expanding my gratitude to include others whose existence has contributed to my current work.

To my academic partner, Nathalie, who understands me as no one else can. I embarked on this journey with you and for you. Regardless of what the future holds, may we remain steadfast, determined, and possess the bravery that defines us as women, mothers, workers, and researchers.

To my supervisor, Professor João Ferreira, I would like to express my gratitude for his knowledge, patience, availability, prompt responses, insight, and encouraging feedback. Amazingly, a researcher of his stature can still connect with the perspective and challenges of a novice researcher like myself. Thank you! I am grateful to know that I have a true friend in you.

To Joana, a talented and brilliant young woman, I extend my admiration. May your future endeavours, both personal and professional, reflect the amazing person you are and bring you the success and happiness you deserve!

To my doctoral class, once referred to as a true adhocacy, I express my gratitude for the invaluable support and camaraderie within the group. The already challenging nature of a doctoral program was made even more difficult by the added stress of navigating a global pandemic. I also thank my colleagues who assisted me in addressing both technical and existential questions, ultimately enabling me to complete this journey.

Finally, to my family and closest friends, particularly my husband and children, I cannot express enough gratitude for their unwavering support. I acknowledge the impact my research had on our lives, with me being absent and less patient.

Nevertheless, I hope my achievements will allow us to make up for lost time and make the most of what is yet to come.

Abstract

The present thesis aims to study the theme of entrepreneurial universities and entrepreneurial ecosystems, exploring the dynamics, synergies, and challenges. Universities face growing pressure to fulfil their third mission, catalyze technological change and innovation, and promote economic and societal development. To address these challenges, universities combine their traditional roles with an entrepreneurial approach, fostering a collaborative partnership with government and industry to create an environment conducive to innovation. This entrepreneurial academic mindset leads to the rise of the entrepreneurial university. In this scenario, it is crucial to comprehend the relationship between universities, their activities, and entrepreneurship within entrepreneurial ecosystems. By exploring how universities can be better prepared to utilize existing synergies and overcome their challenges, we can better understand the dynamics at play.

This thesis uses a methodological pluralism based on a mixed approach involving the elaboration of a Systematic Literature Review (SLR), quantitative methods - use of descriptive statistics methods, linear regression, discriminant analysis, exploratory factor analysis, and confirmatory factor analysis - and qualitative methods - Fuzzy Set Qualitative Comparative Analysis (fsQCA) models. The SLR (Chapter 2) unveils six main research paths upon which the subsequent chapters are based. This chapter explores how universities' dynamics and initiatives are related to entrepreneurship and entrepreneurial ecosystems. Based on the bibliographic coupling of document references performed in Bibliometrix, a spectrum of six main research topics was identified better to understand the dynamics of the Ent_Uni and Ent_Eco concepts. In Chapter 3, we examined the relevance of higher education institutions in the subsequent development of university graduates' entrepreneurial activity. In this chapter, we analyse the relationship between the Total Early Stage Entrepreneurial Activities of graduate individuals (TEAed4) and their entrepreneurial attitudes and social values towards entrepreneurship. In Chapter 4, we sought to deepen the existing knowledge about the entrepreneurial anatomy of universities necessary to face a significant increase in the need to monetize the knowledge generated by universities. In this chapter, we approached the issue from an institutional perspective, seeking to determine if the dimensions included in the HEInnovate self-assessment tool are aligned with the subsequent development of university entrepreneurial activity. The essay conducted in Chapter 5 discusses how

entrepreneurial universities may train their graduates to develop entrepreneurial activities through investment in entrepreneurial education and a strong link between theoretical and practical aspects, thereby incorporating greater cooperation with industry and the government. The findings convey how entrepreneurial graduates are aware of the need for university-industry collaboration and the dependence on government policy and funding. The findings generate implications. This study provides a framework that illustrates the articulation among formulated research propositions and underlines their positioning within the mutual engagement of triple-helix (TH) dynamics. Chapter 6 explores how the HEInnovate digital transformation and capability (DTC) dimension effectively reflects a university's vital characteristics that promote entrepreneurship and foster optimal TH dynamics and impacts. The findings identify three critical areas of focus that are all crucial for ensuring successful digital transformation (DT) processes – (a) focus on overcoming the barriers; (b) focus on capitalizing on knowledge; (c) focus on coping with change – facets essential to understanding the role of DTC in securing the overall success of DT processes.

The present thesis uncovered new insights and a clearer understanding of the university entrepreneurial complexities. The entrepreneurial university concept is inherently complex and requires a definition of its specific characteristics beyond merely commercializing generated knowledge. It is essential to explore the dynamic characteristics of university outcomes and how they can be transformed into economic impact to address the challenges posed by society. This integration of different missions promotes innovation within an entrepreneurial ecosystem within and from university contexts, a challenging task due to the diversity of participating partners and the inherent difficulties of knowledge economy environments. While individually meaningful, the chapters offer significant contributions to entrepreneurial universities and ecosystems, serving as a stepping stone for future research endeavours and acknowledging their dynamics, synergies, and challenges.

Keywords

Entrepreneurial University; Entrepreneurial Ecosystems; Entrepreneurship; Ecosystems; Entrepreneurship Education; Entrepreneurial Activity; Entrepreneurial Attitudes; fsQCA; Triple Helix; Digital Transformation Capacity; HEInnovate.

Resumo Alargado

A presente tese tem como objetivo estudar o tema das universidades empreendedoras e dos ecossistemas empreendedores, explorando as dinâmicas, sinergias e desafios subjacentes. Num contexto de elevada imprevisibilidade, as instituições de ensino superior emergem como parte da resposta organizacional aos desafios e pressões que lhe vão sendo colocados pela sociedade. Assim, as instituições de ensino superior assumem um papel preponderante no desenvolvimento social e económico regional, apoiando de forma direta e indireta todos os estádios do processo empreendedor.

A correta articulação das missões tradicionais – ensino e investigação – com o desenvolvimento de um espírito académico empreendedor, faz com que as instituições de ensino superior se posicionem enquanto parceiros igualitários nas relações com a indústria e o governo, criando condições para a inovação, sendo este um fator essencial para o sucesso das economias baseadas no conhecimento.

É atribuído às instituições de ensino superior o papel de catalisadoras de conhecimento e de educadoras de potenciais empreendedores, enfatizando a necessidade de conjugarmos a experiência das instituições de ensino superior com o desenvolvimento de atividade empreendedora oferece um vasto e aliciante leque de possibilidades de investigação. Deste modo, torna-se claro o interesse em contribuir para o desenvolvimento destas temáticas explorando a relevância do empreendedorismo.

Apesar de serem conceitos amplamente explorados, as universidades empreendedoras e os ecossistemas empreendedores são considerados conceitos fragmentados e desorganizados (Urbano & Guerrero, 2013), detendo uma vasta margem de desenvolvimento face à sua teorização (Spigel, 2017). Estes aspetos são ainda mais relevantes se consideramos as repercussões significativas nas suas missões, autonomia, formas de financiamento e administração (Stolze & Sailer, 2021). Esta mentalidade académica empreendedora leva ao surgimento da universidade empreendedora. Ao explorar como as universidades podem estar melhor preparadas para utilizar sinergias existentes e superar os desafios que lhes são colocados, podemos obter uma compreensão mais clara das dinâmicas em subjacentes. Assim, a tese a desenvolver visa contribuir para o estreitamento destas lacunas na literatura no sentido da sua sistematização e desenvolvimento científico. Em termos gerais, a tese proposta visa, como objetivo geral, incidir sobre a temática das universidades empreendedoras e os ecossistemas empreendedores, analisando as dinâmicas, sinergias e desafios de uma

anatomia empreendedora universitária no desempenho empreendedor no contexto das dinâmicas das interações da tripla-hélice.

Decorrente do objetivo geral, são definidos os seguintes cinco objetivos específicos:

- Sistematizar a literatura existente subjacente à temática das universidades empreendedoras e ecossistemas empreendedores;
- Explorar a influência do nível de formação universitária no desenvolvimento de atividade empreendedora dos seus diplomados;
- Analisar a percepção das instituições de ensino superior quanto à sua anatomia empreendedora;
- Analisar de que modo os diplomados universitários percebem a relevância do empreendedorismo da sua instituição de ensino superior considerando o impacto na sua posterior performance empreendedora;
- Explorar as repercussões da transformação e capacidade digitais na dinâmica das interações da tripla hélice.

No seguimento dos objetivos definidos, no Capítulo 2 é realizada uma revisão sistemática da literatura que aborda simultaneamente as temáticas das universidades empreendedoras e ecossistemas empreendedores, visando dar resposta a duas questões de investigação: - Quais são as tendências mais relevantes na literatura sobre universidades empreendedoras e ecossistemas empreendedores?; De que modo a dinâmica da universidade empreendedora é realizada dentro de uma perspetiva de ecossistemas empreendedores?

O acoplamento bibliográfico de referências documentais realizado no Bibliometrix revela seis clusters que denotam a existência de áreas temáticas distintas e interrelacionadas. Este ensaio proporciona uma melhor compreensão da dinâmica dos conceitos de universidades empreendedoras e ecossistemas empreendedores, permitindo que os diferentes *stakeholders* das universidades empreendedoras e dos ecossistemas empreendedores melhorem os processos de decisão, aspeto crucial no âmbito da economia do conhecimento pautada por ambientes extremamente complexos e competitivos. As relações entre universidades empreendedoras e ecossistemas empreendedores emergem como um processo dinâmico mutualista, com fluxos bidirecionais de recursos e capacidades (Schaeffer et al., 2021). Este processo é moldado pelo ambiente académico, reforçando a importância e influência do desenvolvimento do processo e contexto empreendedor no desempenho empreendedor por parte das instituições de ensino superior (Guerrero, Liñán, et al., 2021).

Os resultados da revisão sistemática da literatura permitem a identificação de temas emergentes e ainda pouco explorados nos quais se alicerça o desenvolvimento dos capítulos seguintes. Assim, no Capítulo 3 é estudada a relação entre a taxa de atividades empreendedoras (*Total Early Stage Entrepreneurial Activity* - TEA) de indivíduos diplomados pelas IES e as atitudes empreendedoras e valores sociais em relação à atividade empreendedora. A análise é realizada tendo como base os dados fornecidos pelo relatório *Global Entrepreneurship Monitor* sobre países impulsionados pela inovação. O ensaio utiliza um método de regressão (Estudo 1) e o uma abordagem de *Fuzzy Set Qualitative Comparative Analysis* (fsQCA) (Estudo 2). A combinação de abordagens permite respostas mais extensas do que as possibilitadas pelos resultados dos modelos de regressão, aumentando a informação sobre os níveis explicativos da atividade empreendedora realizados por diplomados universitários. Tanto os modelos de regressão, quanto a análise do fsQCA, sugerem que a possibilidade de um adulto diplomado universitário constituir uma empresa é potencializada quando um indivíduo considera ter os conhecimentos/habilidades necessários para iniciar um negócio. Os resultados enfatizam a importância atribuída pelos media à temática do empreendedorismo, possibilitando a divulgação de aspetos inerentes a uma cultura empreendedora associada à promoção do crescimento económico e à prosperidade.

Posteriormente, visando a análise da relevância de uma anatomia empreendedora das instituições de ensino superior, baseámos os Capítulos 4, 5 e 6 na HEInnovate, um instrumento autoanálise. Resultante de um esforço conjunto da Comunidade Europeia e da Organização para a Cooperação e Desenvolvimento Económico, a HEInnovate possibilita a reflexão das instituições de ensino superior e sobre a forma como estas desenvolvem a sua atividade empreendedora. Deste modo, as instituições de ensino superior podem identificar, priorizar e estabelecer um plano de ação tendo por base oito dimensões específicas – Liderança e Governação, Capacidade Organizacional: Financiamento, Pessoas e Incentivos; O Ensino e a aprendizagem do Empreendedorismo; Preparação e Suporte aos Empreendedores; Transformação e Capacidade Digital; Transferência de Conhecimento e Colaboração; A Instituição Internacionalizada e Medição do Impacto.

Assim, no Capítulo 4, visamos a análise do impacto das dimensões HEInnovate na perceção empreendedora e na legitimação das missões das instituições de ensino superior com vista à apresentação de recomendações práticas baseadas nas dimensões HEInnovate, ou numa combinação destas dimensões que possam conduzir a um nível mais elevado de legitimação das missões. O ensaio foi realizado com base em dados

recolhidos através de um questionário online destinado a presidentes/reitores de instituições de ensino superior portuguesas. Os dados recolhidos permitiram conhecer a perceção dos inquiridos face ao posicionamento da instituição de ensino superior onde estão inseridos relativamente a cada uma das oito dimensões do HEInnovate. Foi analisada a perceção empreendedora das instituições de ensino superior como função discriminante das dimensões do HEInnovate complementado com uma abordagem qualitativa utilizando fsQCA. A análise possibilitou o estabelecimento de possíveis soluções alicerçadas nas dimensões ou combinações de dimensões do HEInnovate para alcançar uma legitimação da missão, onde é possível destacar a importância da dimensão transformação digital e capacidade. Em primeiro lugar, é explorada e demonstrada a aplicabilidade e adequação prática das dimensões HEInnovate para as instituições de ensino superior. Em segundo lugar, reforçaremos a Teoria Baseada nos Recursos, enfatizando a necessidade de compreender melhor os parâmetros empreendedores que poderão ser cruciais e que devam integrar o desenvolvimento de métricas mais eficazes para medir a performance empreendedora das instituições de ensino superior.

No Capítulo 5, tendo por base entrevistas a empreendedores com formação universitária, foi explorada a relevância da instituição de ensino superior frequentada pelo entrevistado na sua posterior performance empreendedora. Esta investigação revela os múltiplos aspetos envolvidos nas estruturas empreendedoras universitárias abordadas pela dimensão da escala HEInnovate. Explorámos três dimensões do HEInnovate - (1) Ensino e Aprendizagem Empreendedora, (2) Preparar e Apoiar Empreendedores, e (3) Transformação e Capacidade Digital – que, de acordo com a OECD/EC (2022) requerem priorização por parte das instituições de ensino superior. Esta investigação explora, com base numa abordagem centrada nos diplomados universitários, de que forma as instituições de ensino superior podem capacitar seus diplomados para o desenvolvimento de atividades empreendedoras investindo numa educação para o empreendedorismo, suportando o empreendedorismo e capacitando para a transição digital. Os resultados sugerem a necessidade de um maior investimento numa educação para o empreendedorismo com um forte vínculo entre aspetos teóricos e práticos, o que seria tão mais viável quanto maior for a aposta na cooperação entre os agentes da tripla hélice. Os resultados revelam a consciencialização, por parte dos entrevistados, da necessidade de uma estreita colaboração entre instituições de ensino superior e indústria e da forte dependência das instituições de ensino superior face ao financiamento e às políticas governamentais. O ensaio contém implicações para a teoria e para a prática, bem como, sugere uma *framework* que ilustra a articulação entre as diversas proposições de investigação

formuladas evidenciando o seu posicionamento num contexto de mutualismo das relações estabelecidas no âmbito da tripla hélice.

No Capítulo 6 é explorado de que modo a dimensão da Transformação e Capacidade Digital do HEInnovate reflete efetivamente as características vitais para que uma instituição de ensino superior possa promover o empreendedorismo e as otimizar as dinâmicas e impactos da tripla hélice. O ensaio foi alicerçado em 15 entrevistas com agentes da tripla hélice - universidade, indústria, governo e outras entidades híbridas envolvidas nas suas dinâmicas. Foi possível identificar três áreas fulcrais para o sucesso de um processo de transformação digital, designadamente – (1) Foco em ultrapassar as barreiras; (2) Foco na capitalização do conhecimento; (3) Foco em manter-se a par com a mudança - focos essenciais para compreender a relevância do papel da transformação e capacidade digital no sucesso do processo de transformação digital.

A articulação dos cinco ensaios desenvolvidos visa contribuir de forma concreta e relevante para o aprofundar do conhecimento existente sobre a temática do empreendedorismo das instituições de ensino superior e dos ecossistemas empreendedores. Para tal consideramos crucial que se conheçam as dinâmicas existentes entre as instituições de ensino superior e os respetivos ecossistemas empreendedores. A realização do primeiro ensaio, uma revisão sistemática da literatura, possibilitou a identificação de 6 linhas de investigação distintas e que ilustram as dinâmicas existentes na literatura. Nessas dinâmicas é possível identificar vários aspetos que se revelam potenciadores de sinergias - como é o caso da existência de uma anatomia universitária empreendedora e que procuramos explorar via HEInnovate, bem como, aspetos que beneficiam das sinergias criadas pelo desempenho empreendedor - como é exemplo a legitimação das missões universitárias e as relações de cooperação estabelecida entre os agentes da tripla hélice. Quer no desenvolvimento das dinâmicas, quer na potenciação e desenvolvimento das sinergias, são visíveis desafios emergentes, os quais é, antes de mais, necessário identificar para que possam ser exploradas mais e melhores formas de os ultrapassar.

Palavras-chave

Universidades Empreendedoras; Ecossistemas Empreendedores; Empreendedorismo; Ecossistemas; Educação para o Empreendedorismo; Atividade Empreendedora; Atitude Empreendedora; Tripla Hélice; HEInnovate; fsQCA; Transformação Digital.

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List of Acronyms

APS	Adult Population Survey
DigTranCap DTC	Digital Transformation and Capability
DT	Digital Transformation
EC	European Community
Ent_Act	Entrepreneurial Activity
Ent_Eco	Entrepreneurial Ecosystem
Ent_Uni	Entrepreneurial University
EnTeaLearn	Entrepreneurial Teaching and Learning
EP	Entrepreneurial Performance
fsQCA	Fuzzy Set Qualitative Comparative Analysis
GEM	Global Entrepreneurship Monitor
HEI	Higher Education Institution
HEIEP	Higher Education Institution Entrepreneurial Performance
KnExColl	Knowledge Exchange and Collaboration
LeadGov	Leadership and Governance
MeasImp	Measuring Impact
ML	Mission Legitimation
OECD	Organization for Economic Cooperation and Development
OrgCap	Organizational Capacity: Funding, People and Incentives
PrepSuppEn	Preparing and Supporting Entrepreneurs
SLR	Systematic Literature Review
TEA	Total Early Stage Entrepreneurial Activity
TEAed4	Total Early Stage Entrepreneurial Activity of Graduate Individuals
TH	Triple Helix
TIntInst	The Internationalized Institution
Uni_Ind	University-Industry
WoS	Web of Science

Part I

Chapter 1. General Introduction

1.1 Statement of the problem

Higher Education Institutions (HEI) assume paramount importance as catalysts for regional economic and societal development (Bedó et al., 2020). Given the significance of the role played by HEI in entrepreneurial ecosystems (Ent_Eco), many countries have embarked on reforms of their higher education systems, with significant impact on the missions, autonomy, public financing, and governance of HEI (Stolze & Sailer, 2021). In a globalization reality (Kim & McLean, 2015), characterized by knowledge-intensive companies (Tenkasi & Boland, 1996), it is crucial to recognize knowledge as a critical resource (Liu & Lin, 2012). In this highly unpredictable environment for higher education, Entrepreneurial University (Ent_Uni) emerges as an organizational response to environmental challenges and pressures (Voolaid et al., 2019). As producers and disseminators of knowledge (Kirby, 2006), contributing to economic development, innovation, and competitiveness of companies, regions, and countries (Huggins, Johnston, & Stride, 2012; Fernandes & Ferreira, 2013), enabling the existence of sustained competitive advantages (Teixeira, Veiga, & Fernandes, 2019).

Pursuing entrepreneurial pathways unveil opportunities and risks to HEI and Ent_Eco stakeholders (Stolze & Sailer, 2021). It also represents the emergence of institutional tensions, creating a necessity for a legitimation in which the new objective was tied to the old task (Etzkowitz, 2013).

The Triple Helix (TH) of university-industry-government interactions highlights the role of the Ent_Uni in the transition from an industrial to a knowledge-based society (Cai & Etzkowitz, 2020). TH underlying dynamics are crucial to economic progress, where universities represent the enablers of qualified and specialized labour (Chen et al., 2016). It is essential to align university research, education, and training priorities with the goals of organizations active in the region to achieve an appropriate balance (Hewitt-Dundas, 2012). The dynamics of Ent_Uni reflect the preponderant role that academic organizations play in shaping the aggregate capabilities (Audretsch, Cunningham, Kuratko, Lehmann, & Menter, 2019) prevailing and building bridges between sources of innovation and Ent_Eco (Autio et al., 2014a).

Ent_Uni and the TH model are two deeply related concepts based on the existence of HEI that assume a more predominant role in technology transfer, company formation, and renewal of regional spaces, with a primordial role in the knowledge-based society

(Cai & Etzkowitz, 2020). The increase in the dynamics of interaction between universities and industry leads to a shift in universities' focus toward knowledge transfer (Miller, McAdam, & McAdam, 2018). By combining their traditional teaching and research missions with an entrepreneurial academic spirit, universities can position themselves as equal partners in relationships with industry and government, creating the conditions for innovation essential for success in knowledge-based economies (Etzkowitz, 2003a). In this scenario, Ent_Uni creates various employment opportunities for its students, including self-employment, academic entrepreneurship, and intrapreneurship (Guerrero, Urbano and Gajón 2020).

The framework highlights universities' crucial role in regional development and knowledge transfer, emphasising their third mission and the emergence of Ent_Uni (Rubens, Spigarelli, Cavicchi, & Rinaldi, 2017). Successful interaction between entrepreneurial activity and entrepreneurship education can create optimal conditions for the growth of entrepreneurial ecosystems (Lu & Li, 2016).

Recently Ruiz et al. (2020) proposed a conceptual integration of the definition of an Ent_Uni, identified as an institution integrated into an entrepreneurial and innovation ecosystem, being able to change, innovate, recognize, and create opportunities. Thus, Ent_Uni activities must have a structural organization underlying them that allows their articulation toward the intended entrepreneurial performance (Ruiz et al., 2020). In this context, it is necessary to accurately replicate all the changes and adaptations that occur in universities within an adequately structured ecosystem (Carayannis et al., 2018).

Despite being widely explored concepts, Ent_Uni and entrepreneurial ecosystems (Ent_Eco) are considered fragmented and disorganized concepts (Urbano & Guerrero, 2013), with a vast margin of development in their theorization (Spigel, 2017). Thus, this thesis aims to contribute to narrowing these gaps through its systematization and scientific development. The thesis generally focuses on Ent_Uni and Ent_Eco, assessing the dynamics, synergies, and challenges of a university entrepreneurial anatomy on entrepreneurial performance within the dynamics of TH interactions.

As a result of the general objective, five specific objectives are also defined:

- Systematize the existing literature on the topic of Ent_Uni and Ent_Eco;
- Analyse the influence of university education on the development of entrepreneurial activity;

- To assess the university perception of its entrepreneurial anatomy;
- Understand how students perceive the importance of entrepreneurial activities (Ent_Act) developed by their HEI, given the impact that these had on their subsequent entrepreneurial performance (EP);
- Explore the repercussions of digital transformation and capability on the dynamics of TH interactions.

Recognizing universities as facilitators of contemporary knowledge and as the educators of potential entrepreneurs for society (Coduras et al., 2008), considering how the interactions between university and entrepreneurial activities open up vast and exciting research possibilities, there is a clear interest in contributing by exploring the complexity of entrepreneurship, examining the relevance of promoting entrepreneurship within and from university contexts (Coduras et al., 2016). Furthermore, it is essential to invest in responsible metrics as an essential element of responsible innovation (Etzkowitz, 2016). Primarily, the Ent_Uni development would benefit from developing existing metrics (Etzkowitz, 2016; Henry, 2015) – as the HEInnovate self-assessment tool, an initiative of the European Commission in partnership with the Organization for Economic Cooperation and Development (OECD) (www.heinnovate.eu), enables HEI to evaluate different components of entrepreneurial capacity for further entrepreneurial developments. The development of entrepreneurial metrics works as a guiding framework for the Ent_Uni (Voolaid et al., 2019), leveraging the evolution of the Ent_Uni, enabling the exploration and exploitation of Ent_Act with repercussions on economic and social development (Etzkowitz, 2016).

1.2 Unit of analysis and conceptual model

The unit of analysis in this investigation, which centres on the interaction between Ent_Uni and their ecosystems within a TH perspective, can take one of three forms: the entrepreneurial university, its ecosystem, or the connections between the two. As the research progresses, the unit of analysis may change and evolve to align with the defined research questions of each chapter. This thesis examines the Ent_Uni and Ent_Eco, assessing the dynamics, synergies, and challenges of a university entrepreneurial anatomy on entrepreneurial performance within the dynamics of TH interactions. The exact unit of analysis will be determined based on the research questions and objectives.

The investigation is structured in 5 chapters that we consider sequential and interrelated. We started with systematising the literature under the theme of Ent_Uni and Ent_Eco. In this way, we establish the theoretical basis that guides the development of the following chapters. Subsequently, the thesis focused on the relationship between the TEA of graduated individuals and variables that explore adults' entrepreneurial attitudes and entrepreneurial social values towards Ent_Act. The investigative path revealed the need to analyse university entrepreneurial performance in more detail and explore ways to measure it. The approach focused on the HEInnovate self-assessment tool. At a later stage, and based on the same tool, we sought to assess, among entrepreneurs with university education, the extent to which HEI considered dimensions a, b and c in their academic career and whether they are relevant for the subsequent performance of Ent_Act. Subsequently, and considering the relevance of the presence of the digital world in today's societies, we sought to assess the relevance of the HEInnovate dimension - Capacity and Digital Transformation in the dynamics of TH. Figure 1.1 presents the thesis's conceptual structure.

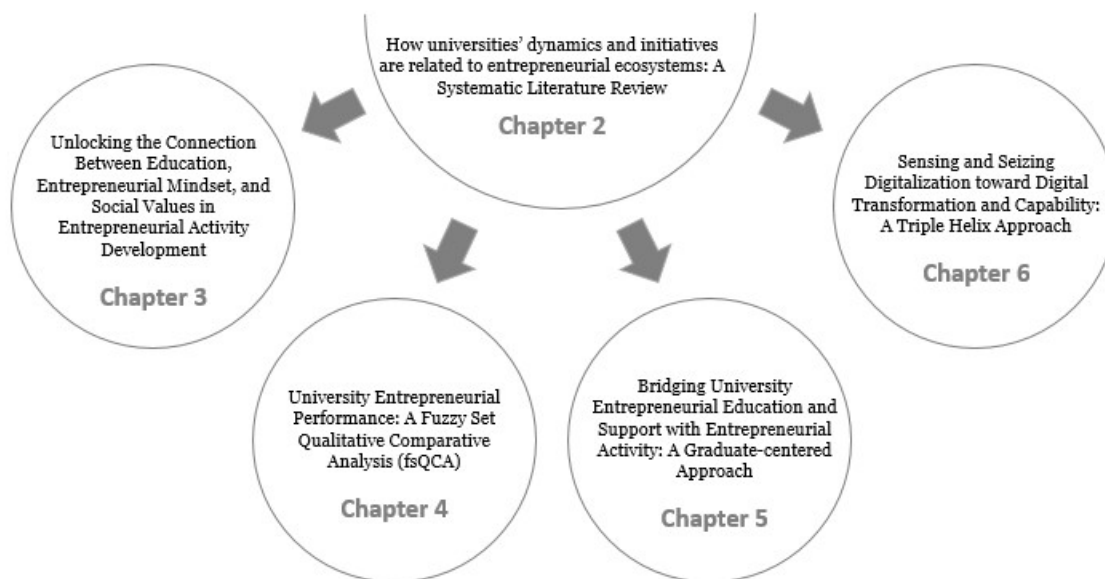


Figure 1.1 Thesis conceptual structure

Table 1.1 – Articulation between research questions and research goals

		Research specific objectives				
		Objective 1	Objective 2	Objective 3	Objective 4	Objective 5
Research general objective		<p>Objective 1 Systematize the existing literature on the topic of entrepreneurial universities and entrepreneurial ecosystems;</p> <p>Objective 2 Analyse the influence of university education on the development of entrepreneurial activity;</p> <p>Objective 3 To assess the university's perception of its entrepreneurial anatomy;</p> <p>Objective 4 Understand how students perceive the importance of entrepreneurial activities developed by their higher education institution, given the impact that these had on their subsequent entrepreneurial performance;</p> <p>Objective 5 Explore the repercussions of digital transformation and capability on the dynamics of TH interactions.</p>				
Focus on the theme of Ent_Uni and Ent_Eco, assessing the dynamics, synergies, and challenges of a university entrepreneurial anatomy on entrepreneurial performance within the dynamics of TH interactions.						
Research Questions Purpose	Which are the most relevant trends in the literature on Ent_Uni and Ent_Eco?	Chapter 2				
	How Ent_Uni' dynamics are performed within an Ent_Eco perspective?	Chapter 2				
	How can we explain the levels of Ent_Act performed by individuals with graduate experience?	Chapter 3	Chapter 3			
	Analyse the influence of the HEInnovate dimensions on entrepreneurial self-perception and ML of HEI	Chapter 4		Chapter 4		
	How relevant are the HEInnovate dimensions under analysis for the further development of entrepreneurial activity?	Chapter 5			Chapter 5	
	What aspects are still not being in the HEInnovate dimensions under analysis, and which are essential for further development of entrepreneurial activity?	Chapter 5			Chapter 5	
	Does the Digital Transformation and Capability (DTC) HEInnovate dimension represent the key characteristics of an entrepreneurial HEI for optimal TH dynamics?	Chapter 6				Chapter 6
	How can an entrepreneurial HEI use these features to leverage TH dynamics and ecosystem economic and social impacts?	Chapter 6				Chapter 6

Based on the thesis objective, Table 1.1 provides a synthetic view of the specific objectives underlying each of the developed chapters, as well as the research question(s) they aim to answer.

1.3 Research Methodology

In a dialectic of two distinct but complementary disciplinary areas - epistemology and methodology - it becomes essential to philosophically guide the research we intend to develop to define better the research design (e.g. data typology, data collection, and data analysis) (Easterby-Smith et al., 2008). Epistemologically and given the defined objectives, we consider the predominant use of a deductive approach based on a general theoretical framework for further analysis of particular investigation cases (Mahootian & Eastman, 2009). In this way, researchers observe the phenomenon under analysis and perform its interpretation in the light of existing theory, establishing a set of conjunctures and refutations enabling the advancement of scientific knowledge (Popper, 1999).

The present thesis is based on the theories underlying the study of Ent_Uni and Ent_Eco to corroborate the propositions and hypotheses established throughout its development. Based on an articulation of quantitative and qualitative methodologies, we aim to deepen the existing knowledge about entrepreneurial universities and entrepreneurial ecosystems in a TH context, aiming at questioning the existing dynamics and the respective outputs and outcomes.

1.3.1 Method

Using a methodological pluralism (Feyerabend, 1993), the research to be developed is based on a mixed approach involving the elaboration of a Systematic Literature Review (SLR), quantitative methods - use of descriptive statistics methods, linear regression, discriminant analysis, exploratory factor analysis, and confirmatory factor analysis - and qualitative methods – fsQCA models.

Table 1.2 briefly presents the methodology adopted in each chapter, referring to the software underlying each analysis performed.

Table 1.2 - Systematization of the method adopted

Chapter	Design	Sample	Method
Chapter 2	Systematic Literature Review	116 articles from WoS and SCOPUS databases	Merge database results on Bibliometrix an R tool software - Version 3.0.4 of package Bibliographic Coupling Parameters
Chapter 3	Empirical Essay	Global Entrepreneurship Monitor (GEM) 2017 Adult Population Survey (APS) Global National Data for Innovation-driven countries.	Mixed methodological approach: Qualitative - Regression method performed in IBM SPSS Statistics - Version 26 – and qualitative – Fuzzy Set QCA method performed in fsQCA software – version 3.0.
Chapter 4	Empirical Essay	Online survey applied to the dean/president of Portuguese HEI. Our questionnaire was performed on the LIME platform - Version 2.73.1 – and involved 92 institutions representing 296 faculties/schools. Data collection - LIME platform - Version 2.73.1	Mixed methodological approach: Qualitative – discriminant analysis performed in IBM SPSS Statistics - Version 26 – and qualitative – Fuzzy Set QCA method performed in fsQCA software – version 3.0.
Chapter 5	Empirical Essay	Based on interviews with graduate entrepreneurs	Qualitative Software: NVIVO 12 PRO software – version 12.6.1
Chapter 6	Empirical Essay	Based on 15 interviews with triple helix institutional actors - university, industry, government, and other hybrid entities involved in their networks	Qualitative – Case Study Software: MAXQDA Analytics Pro 2022

1.3.2 Approaches in the Chapters

Chapter 2 aims to systematise the most relevant literature, trends, and dynamics of the Ent_Uni on Ent_Eco. Pursuing this purpose, a systematic Literature review (SLR) was carried out, using an objective and rigorous research protocol to minimize the researcher bias (Tranfield et al., 2003). The search was carried out on Web of Science and Scopus databases, justified in its scope and relevance in the management areas.

To gather a set of articles that allowed the articulation of the themes of Ent_Uni and Ent_Eco, we conducted a search considering the keywords ("entrep* universit*" AND "entrep* ecosystem*") OR ("entrep* universit*" AND "entrep* activit*") OR "universit* entrep* ecosystem*" OR ("Entrep* higher education" AND "Entrep* Ecosystem*") as search topics, exploring titles, abstracts and keywords. The results first present a descriptive characterization of the Ent_Uni and Ent_Eco existing literature based on version 3.0.4 of package Bibliometrix, an R tool software mapping analysis (Aria & Cuccurullo, 2017). Afterward, we present bibliometric maps and identify bibliographic coupling on document references.

The results from the SLR allow the identification of six distinct research paths, which establish a theoretical basis that guides the development of the following chapters.

Chapter 3 uses Global Entrepreneurship Monitor (GEM) 2017 Adult Population Survey (APS) Global National Data for Innovation-driven countries. In this chapter, our focus is to examine if possessing the capability to identify opportunities, having the necessary skills and knowledge to start a business, knowing someone who has started a business recently, having no fear of failure, considering entrepreneurship as a desirable career option, and associating it with high social status, attention, and recognition have a positive impact on the TEA rate. Entrepreneurial attitudes and values have a positive effect on the TEA rate (Coduras et al., 2016). Within this assumption, we intend to analyse the attitudes - capability to identify opportunities, detain the skills and knowledge to start up a business, and values - knowing someone that started a business in the last two years, the absence of fear of failure, and face entrepreneurship as a good career choice, associate entrepreneurship to high social status, attention, and recognition have an influence on Ent_Act development. The Adult Population Survey (APS) aims to assess the role of individuals in the entrepreneurial process focusing on business characteristics, people's motivations, and entrepreneurial-related actions and attitudes. GEM APS makes available the TEA rate to measure Ent_Act. The educational level allows identifying the individuals with higher degree studies and makes it possible

to analyse the TEA of graduate experience academic level. We aim to investigate the relationship between the TEA of graduated individuals (TEAed4) and variables that explore adults' entrepreneurial attitudes and entrepreneurial social values towards Ent_Act. We choose to present two complementary approaches to complement the multilinear regression model results and explore the question of attitudes and social values as causal conditions to achieve an outcome of Ent_Act level performed by individuals with graduated experience.

Subsequently, to assess the entrepreneurial university aspects, we based Chapters 4, 5, and 6 on the HEInnovate self-assessment tool. Resulting from a joint effort of the European Community and the Organization for Economic Cooperation and Development (OECD), the HEInnovate tool allows the stimulation of HEI reflection on its Ent_Act, allowing the identification, prioritization, and action planning in eight key areas - Leadership and Governance; Organizational Capacity: Funding, People and Incentives; Entrepreneurial Teaching and Learning; Preparing and Supporting Entrepreneurs; Digital Transformation and Capability; Knowledge Exchange and Collaboration; The Internationalized Institution; Measuring Impact. According to Etzkowitz (2016), the process of self-knowledge enables HEI to maintain an independent perspective as a creative player in economic and social development and, simultaneously, be responsive to government and industry priorities, combining university autonomy and greater involvement of external stakeholders.

To analyse university entrepreneurial perception based on the HEInnovate scale, Chapter 4 analysed data gathered from an online survey applied to the dean/president of Portuguese HEI. Our questionnaire was performed on the LIME platform - Version 2.73.1 – and involved 92 institutions involving 296 faculties/schools. It made it possible to send a personalized e-mail to the institutions involved in the study. The platform also allows for the centralization of responses for further data processing. Our questionnaire enabled the collection of the self-assessment of Portuguese HEI, responding to the questionnaire running through the eight dimensions of the HEInnovate scale.

Chapter 5 is based on several interviews with graduate entrepreneurs; this study reveals the multiple aspects involved in the university entrepreneurial structures approached by the dimension of the HEInnovate scale. We explore three HEInnovate dimensions - (1) Entrepreneurial Teaching and Learning, (2) Preparing and Supporting Entrepreneurs, and (3) Digital Transformation and Capability – that, according to the OECD/EC (2022), require prioritizing by HEI in keeping with their relevance to

graduate Ent_Act development. This study discusses how entrepreneurial universities may train their graduates to develop entrepreneurial activities through investment in entrepreneurial education and a strong link between theoretical and practical aspects, thereby incorporating greater cooperation with industry and the government.

Based on the general objective of our study, seeking to fulfil our fifth specific objective in Chapter 6, it is to enhance our comprehension of how the HEInnovate digital transformation and capability (DTC) dimension effectively reflects the vital characteristics of a university that promotes entrepreneurship, fostering optimal TH dynamics and impacts. Based on 15 interviews with TH institutional actors - university, industry, government, and other hybrid entities involved in their networks, we developed a qualitative inductive study that integrates inputs of TH networks, intended to shed a practical perspective on this theme.

1.4 Thesis contributions

Based on the general objective of our study, seeking to fulfil our first specific objective, in Chapter 2, a Systematic Literature Review (SLR) is carried out, which simultaneously addresses the themes of entrepreneurial universities and entrepreneurial ecosystems, trying to answer two research questions - What are the most relevant trends in the literature on entrepreneurial universities and entrepreneurial ecosystems? And how are the dynamics of the entrepreneurial university realized within a perspective of entrepreneurial ecosystems?

The bibliographic coupling of documentary references in Bibliometrix reveals six clusters that denote distinct and interrelated thematic areas. This study provides a better understanding of the dynamics of entrepreneurial universities and entrepreneurial ecosystems, allowing the different stakeholders of entrepreneurial universities and entrepreneurial ecosystems to improve the decision process, which is very important when immersed in a knowledge economy guided by extremely complex and competitive environments. The relationships between entrepreneurial universities and entrepreneurial ecosystems emerge as a dynamic mutual process with two-way flows of resources and capabilities (Schaeffer et al., 2021b). This process is shaped by the academic environment, reinforcing the importance and influence of the development of the entrepreneurial process and context on entrepreneurial performance (Guerrero, Liñán et al., 2021).

Considering the general objective of our study, the systematization of the literature carried out in Chapter 2 and seeking to fulfil our second specific objective, in Chapter 3, the relationship between Total Early Stage Entrepreneurial Activity of graduates and entrepreneurial attitudes and social values towards entrepreneurial activity. The analysis is based on data from the Global Entrepreneurship Monitor report on innovation-driven countries. The research uses a regression method (Study 1) and fsQCA (Study 2). The combination of approaches allows for more extensive responses than those made possible by the results of the regression models, increasing information on the explanatory levels of entrepreneurial activity carried out by individuals with graduated experience. The results of this research show that both the regression models and the analysis of the fsQCA show that the possibility of an adult with postgraduate experience setting up a company or owning a young company is enhanced when an individual considers the knowledge/skills needed to start a business. The results also emphasize the importance of devoting great media attention to entrepreneurship, creating an entrepreneurial culture that promotes economic growth and prosperity.

Based on the general objective of our study, seeking to fulfil our third specific objective, in Chapter 4, we aim to analyse the impact of the HEInnovate dimensions on the entrepreneurial self-perception and mission legitimization (ML) of HEI. We aim to present practical recommendations based on the HEInnovate dimensions or a combination of these dimensions that can lead to a higher ML level. This study will provide important theoretical contributions to the field. Firstly, it will demonstrate the practical applicability and suitability of the HEInnovate dimensions for HEI. Secondly, it will reinforce the Resource-Based Theory by emphasizing the need to understand further the key entrepreneurial parameters to develop more effective metrics for measuring EP.

Based on the general objective of our study, seeking to fulfil our fourth specific objective, Chapter 5 aims to understand how entrepreneurial teaching and learning, preparing and supporting entrepreneurs, and digital transformation and capabilities (HEInnovate dimensions) influence the development of entrepreneurial activities. The findings convey how entrepreneurial graduates know the need for university-industry (Uni_Ind) collaboration and the dependence on government policy and funding. The findings generate implications. This study contributes to theory and practice as well as a framework illustrating the articulation among formulated research propositions and underlining their positioning within the mutual engagement of triple-helix dynamics.

Based on the general objective of our study, seeking to fulfil our fifth specific objective in Chapter 6, it is to enhance our comprehension of how the HEInnovate digital transformation and capability (DTC) dimension effectively reflects the vital characteristics of a university that promotes entrepreneurship, fostering optimal Triple Helix (TH) dynamics and impacts. In our research, we have identified three key areas of focus that are crucial for ensuring a successful digital transformation (DT) process – (a) focus on overcoming the barriers; (b) focus on capitalizing on knowledge; (c) focus on coping with change – essential areas for understanding the role of DTC in the overall DT success.

1.5 Thesis Structure

The thesis is structured in three distinct but complementary parts. The first part - Chapter 1: General introduction – contextualises the subject under study based on the existing literature. This way, we present the main concepts in the following chapters. The unit of analysis, the objectives, and the research questions that we intend to see answered are presented, and the methods underlying their pursuit are also presented. Afterward, the second part of the thesis consists of five chapters - Chapter 2 to Chapter 6 - which can be read individually. In Chapter 2, we developed a SLR, and Chapters 3 to 6 are dedicated to empirical studies. In the third part – Chapter 7 – we present the final considerations, implications, contributions, and future lines of research. The thesis will follow the structure presented in Figure 1.2.

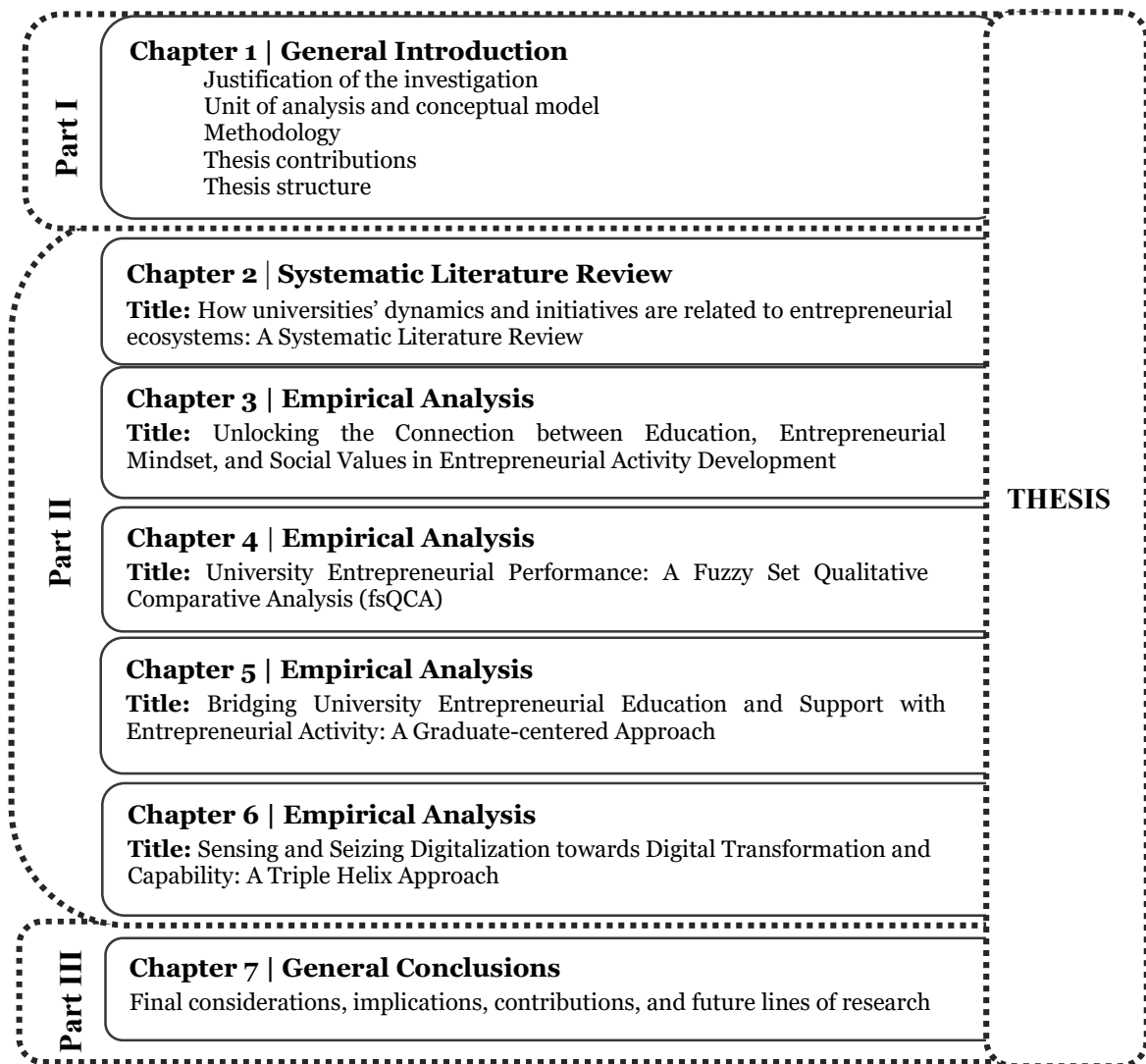


Figure 1.2 Structure of the Thesis

In Table 1.3 we can see the publication status of each chapter comprising the thesis.

Table 1.3 Chapters publication status

Chapter 2 - How universities' dynamics and initiatives are related to entrepreneurial ecosystems: A Systematic Literature Review

Status: Published

- Patrício, L.D. & Ferreira, J.J. (2022), How Universities' Dynamics and Initiatives Are Related to Entrepreneurial Ecosystems: A Systematic Literature Review, *International Review of Entrepreneurship*, 20(1), 87-136.

[ABS-2; WoS - ESCI -Emerging Sources Citation Index]

Chapter 3 - Unlocking the Connection Between Education, Entrepreneurial Mindset, and Social Values in Entrepreneurial Activity Development

Status: Published

- Patrício, L.D., & Ferreira, J. J. (2023). Unlocking the connection between education, entrepreneurial mindset, and social values in entrepreneurial activity development. *Review of Managerial Science*, 1-23.

[2021 JCR: 5.435 (Q2); ABS-2; Scimago: Q1]

Chapter 4 - University Entrepreneurial Performance: A Fuzzy Set Qualitative Comparative Analysis (fsQCA)

Status: Published

- Patrício, L. D., & Ferreira, J. J. (2023). University entrepreneurial performance: A Fuzzy Set Qualitative Comparative Analysis. *Higher Education Quarterly*, January, 1–21. <https://doi.org/10.1111/hequ.12424>.

[WoS - ESCI -Emerging Sources Citation; ABS2; Scimago: Q1]

Chapter 5 – Bridging University Entrepreneurial Education and Support with Entrepreneurial Activity: A Graduate-centered Approach

Status: Submitted to *The International Journal of Management Education*

[2021 JCR: 4.564 (Q1); ABS-1; Scimago: Q1]

Chapter 6 – Sensing and Seizing Digitalization towards Digital Transformation and Capability: A Triple Helix Approach

Status: Submitted to *Entrepreneurship & Regional Development*

[2021 JCR: 6.408; ABS-3; Scimago: Q1].

Part II

Chapter 2. How universities' dynamics and initiatives are related to entrepreneurial ecosystems: A Systematic Literature Review

Abstract

Universities are increasingly being pressured to perform their third mission, playing as a catalyst of technological change, innovation, and societal and economic development. Universities respond to the emerging challenges combining their traditional roles with an entrepreneurial agenda. This entrepreneurial academic spirit allows a collaboration, as equal partners, with government and industry, creating the conditions for innovation and the emergence of the Entrepreneurial University (Ent_Uni). This scenario is crucial to address how universities' dynamics and initiatives are related to entrepreneurship and entrepreneurial ecosystems (Ent_Eco). Despite being widely explored concepts, the Ent_Uni and Ent_Eco are still fragmented and muddled in the literature, holding a wide margin of theorization development. Based on the bibliographic coupling of document references performed in Bibliometrix, a spectrum of six main research topics were identified better to understand the dynamics of the Ent_Uni and Ent_Eco concepts.

Lastly, we offer a future research agenda that could deepen the scientific knowledge on entrepreneurial settings.

Keywords

Entrepreneurial Universities, Entrepreneurship Ecosystems, Systematic Literature Review, Bibliometrix, Bibliographic-coupling analysis.

2.1 Introduction

Globalization is a reality (Kim & McLean, 2015), characterized by an emergent global economy composed of knowledge-intensive organizations (Tenkasi & Boland, 1996). It is crucial to acknowledge knowledge as a critical resource (Liu & Lin, 2012). Knowledge will be possible based on cooperation relationships that potentiate innovation,

particularly technological innovation (Fischer and Varga, 2002).

The establishment of partnerships will make possible the existence of new and unique knowledge (Nonaka & Takeuchi, 1995) that makes innovation possible (Lockett *et al.*, 2009; Gallego, Rubalcaba, and Suárez, 2013; Fernández-López, Calvo and Rodeiro-Pazos, 2019). One of the main pillars of an ecosystem is the university (Guerrero, Urbano, and Gajón, 2017). In this context, universities seek to respond to emerging challenges, assuming a key role as producers and disseminators of knowledge (Kirby, 2006), contributing to economic development, innovation, and competitiveness of companies, regions, and countries (Fernandes and Ferreira, 2013; Huggins, Johnston, and Stride, 2012) enabling the existence of sustained competitive advantages (Teixeira, Veiga, and Fernandes, 2019).

It is in the increase of the dynamics of interactions between university and industry (Uni_Ind) that universities start to be oriented towards the latest knowledge transfer (Miller, McAdam, and McAdam, 2018). Knowledge transfer between Uni_Ind is widely recognized and stimulated by governments to enhance a knowledge-intensive economy (Jackson *et al.*, 2013). It is now recognized the importance of the Bayh-Dole Act of 1980, which gives universities financial incentives and enables universities to support and monitor technology commercialization activities (Crow, Whitman, and Anderson, 2020).

Combining its traditional mission, based on teaching and research, and the emergence of an entrepreneurial academic spirit, it is possible to position universities as equal partners in industry and the government, creating the necessary conditions for innovation based on knowledge-based economies (Etzkowicz, 2003a).

Government-University-Industry cooperation is usually aggregated in the concept of Triple Helix (TH), which proves to be fundamental for economic progress, where universities emerge as inventors of new technologies, as enablers of the existence of qualified and specialized labour also assuming the role of mediation between economy and society (Chen, Wu, and Yang, 2016). The results may be significantly enhanced by the correct alignment of research and training priorities by universities with organizations' goals in the region (Hewitt-Dundas, 2012).

The whole framework reinforces the fact that in the last decades, universities have shown themselves in the role they play in regional development and knowledge transfer, resulting in an emphasis on the universities' third mission and the emergence of entrepreneurial universities (Ent_Uni) (Rubens *et al.*, 2017), even when they face

highly state-regulatory constraints (Yoshioka-Kobayashi, 2019). The Ent_Uni develops multiple efforts (Kirby et al., 2011), and it is possible to observe cases in which the correct interaction between entrepreneurial activity (Ent_Act) and education for entrepreneurship creates very favourable conditions for the development of entrepreneurial ecosystems (Ent_Eco) (Lu & Li, 2016). In this innovation dynamic, the TH model works as a moderator of communications and negotiations between the various institutional partners, creating a constant interaction that continuously reorganizes subliminal agreements (Etzkowitz & Leydesdorff, 2000). The Ent_Eco dynamics develop and evolve over time, which is fundamental to analysing the dynamics of an Ent_Eco trajectory and future performances (D. Audretsch et al., 2021).

Within a transformation into competitive organizational actors (Kosmützky & Krücken, 2015), the Ent_Uni is seen as a catalyst for regional economic and social development, considering the generation and exploitation of knowledge as entrepreneurial opportunities (Urbano & Guerrero, 2013). Promoting entrepreneurial opportunities requires an ecosystem where universities have a fundamental role in the collaboration between all the stakeholders (Wadee and Padayachee, 2017). Despite being widely explored concepts, the Ent_Uni and Ent_Eco are still considered fragmented and muddled, holding a wide margin of development in the face of their theorization (Forliano et al., 2021; Spigel, 2017). The themes Ent_Uni and Ent_Eco have been deepened in the last year, being explored from different perspectives. It is possible to identify the emergence of the university approach as an entrepreneurial ecosystem (Prokop, 2021; Wang et al., 2021) and the conceptualization of Ent_Uni concept (Radko et al., 2022). Also focusing on the analysis of Ent_Uni, there have been developments in the analysis of the transformation process of universities into Ent_Uni with the need for articulation of university missions (Audretsch & Belitski, 2021), the Uni_Ind collaboration (Johnston et al., 2022), and entrepreneurial architecture of Ent_Uni (Cunningham et al., 2021). Within the concept of Ent_Eco, Schaeffer *et al.* (2021) explore the interrelation between universities and ecosystem in a mutualistic perspective where it is possible to identify a bidirectional flow of resources and capabilities. Therefore, according to Fernandes and Ferreira (2021), it is important to explore the role of universities, particularly the Ent_Uni, in the growth, evolution, and outcomes of Ent_Eco. This study aims to narrow these gaps by systematizing the most relevant literature, trends, and dynamics of Ent_Uni on Ent_Eco. This study can be a relevant contribution for the actors of TH - Universities, Industry, and Government - since it can prove to be important in the reasoning of future decisions.

Considering that we have not identified Systematic Literature Reviews (SLR) that approach the concepts of Ent_Uni and Ent_Eco, the research purpose is to systematize the existing studies and address the need for an SLR that approaches both concepts simultaneously, characterizing the existing literature and identifying the current trends and future research agenda.

Since an SLR seeks to address specific research questions (Snyder, 2019; Torracco, 2016), in this study, we attempt to answer the following research questions: Which are the most relevant trends in the literature on Ent_Uni and Ent_Eco? And how Ent_Uni' dynamics are performed within an Ent_Eco perspective?

A systematic approach was carried based on a rigorous and predefined protocol. The articles were obtained within the SCOPUS and Web of Science databases. The sampled studies were then statistically analysed to characterize the existing literature based on Bibliometrix software. Afterward, and from the 114 selected articles, the software allowed the formation of six clusters, which are classified as follows: (1) University Entrepreneurial Anatomy and Ent_Eco, (2) Universities Third Mission Performance and Impacts, (3) Balance Ent_Uni Different Roles, (4) Entrepreneurial Education and Ent_Uni Support, (5) University Entrepreneurial Mindset, and (6) Entrepreneurial Orientation and Knowledge Capitalization.

This study intends to contribute to a better understanding of the Ent_Uni and Ent_Eco, the most relevant literature, trends, and dynamics of Ent_Uni on Ent_Eco throughout a systematization of existing literature and presenting how Ent_Uni' dynamics are performed within an Ent_Eco perspective. This knowledge could represent a stakeholders' competitive advantage considering the complexity of the knowledge economy environments.

This article is structured as follows. After this Introduction (Section 1), Section 2 presents the theoretical background. Section 3 describes the research methodology. Section 4 shows the results of Bibliometrix software and systematizes the main themes of the clusters. Section 5 offers a discussion of the results. Finally, Section 6 presents conclusions, contributions, limitations, and future research agenda.

2.2 Theoretical Background

The institutions have shaped and ruled the human interactions throughout economic history, creating a political, socio-cultural, and economic context to respond to special forces: managed economy or entrepreneurial economy (Guerrero et al., 2015a). Knowledge capital is the dominant production factor in the entrepreneurial economy, seen as a source of competitive advantages, that when complemented with entrepreneurship capital, provides the capacity to engage in and generate Ent_Act through the exploration and exploitation of knowledge economic opportunities (Guerrero et al., 2015a). In this context, the Ent_Uni is recognized as catalysts for social development and regional economic growth by creating and exploiting entrepreneurial opportunities identified in the knowledge they generate (Santos & Caseiro, 2017). In addition to their traditional mission, centered on teaching and research, the Ent_Uni is characterized by seeking to place graduates on the labour market who are destined for existing jobs or assume the creation of new jobs (Schulte, 2004).

There are many existing contributions towards theorizing the Ent_Uni concept, as we can see in publications such as Ruiz, Martens, and da Costa (2020) that sought to bring together some of the existing definitions. The definition of Ent_Uni, which is still the subject of discussion, can be based on factors of a formal or informal nature. Formally, they are characterized by the development and implementation of a training offer in the area of entrepreneurship, by the creation of a support structure for the transfer of technology, support for the formation of start-ups, flexible organizational structures, and a commitment to the design of links with the industry (Kirby et al., 2011). Informally, it depends on students' and teachers' entrepreneurial attitudes, on the presence of entrepreneurs who can serve as an example, and on the existence of a reward system (Kirby, Guerrero, and Urbano, 2011). Other criteria may also be considered, namely that universities are involved in large-scale scientific projects, carry out research that is contracted to them, consultancy, patenting, licensing, spin-offs,

external education, development of new products (Bernasconi, 2005; Jacob, Lundqvist, and Hellsmark, 2003; Klofsten and Jones-Evans, 2000; Zhao, 2004).

In a very contemporary perspective, Ruiz et al. (2020) proposed a conceptual integration of the Ent_Uni definition. It is identified as an institution integrated into an entrepreneurial and innovation ecosystem, skilled in altering, innovating, recognizing, and creating opportunities. In this context, the Ent_Uni has an academic community - administrators, teachers, students - who are characterized by their proactivity, a propensity to deal with risk and deal with challenges, with a view to internal and external development through the creation of value originated in knowledge (Ruiz, Martens, and da Costa, 2020).

After 1980, there was a recognition of the importance of universities' participation in economic and social development as an integral part of their third mission (Etzkowitz, 1983). The third mission's motivation is based on internal and external factors (Rhoades, 2006). Factors such as scientific progress, the emergence of new forms of collaborative research, the change in social expectations regarding the role to be played by universities, and the decrease in the funding allocated to them have made it possible for many universities to become more entrepreneurial (Guerrero et al., 2014). Universities are now oriented towards the development of an entrepreneurial culture (Kirby, 2006), with a clear focus on the development of incubators that can help in the creation of new businesses (Etzkowitz, 2003b) and assist academics in the process of commercializing results of their investigations (Dill, 1995; Jacob et al., 2003).

In developing universities as entrepreneurs, we will identify three phases that may not happen exactly in the order that we present below (Etzkowitz, 2013). Etzkowitz (2013) recognized the designation University Entrepreneur One that characterizes when the academic institution has a strategic vision that allows it to define the direction to follow, a stage in which some skills in setting priorities and obtaining forms of financing. Concerning the University Entrepreneur Two, this concerns when the academic institution takes an active role in commercializing intellectual property resulting from the activities developed by its collaborators, researchers, and students (Etzkowitz, 2013). The University Entrepreneur Three refers to a proactive role for the academic institution that involves improving regional innovation's effectiveness involving collaboration with industry and the government (Etzkowitz, 2013). Following this perspective initiated by Etzkowitz (2013), Carayannis et al. (2018) present an Ent_Uni "MODE 3". However, in their viewpoint, these only show some entrepreneurial qualities, transcending the conventional concept of an Ent_Uni. They

present a real potential that needs to be accompanied by contextual changes in business sectors and branches. According to Carayannis et al. (2018), there is a need to reproduce in an adequately structured ecosystem – based on the accessibility of markets, the existence of human capital and workforce, the capacity for investment and financing, the existence of support systems, and the availability of mentors, government intervention and existing regulations, the existence of education and training programs, considering universities as the main catalysts and the existence of cultural support – all movements and adaptations that have occurred in universities.

According to the study developed by Ruiz et al. (2020), Ent_Uni activities – management, creation of infrastructures, internationalization, financing, and the entrepreneurial ecosystem and partnerships – must have an underlying structural organization that allows their articulation in the sense of the intended entrepreneurial performance. It is in this entrepreneurial anatomy that, according to Etzkowitz (2013), it is possible to create a game of legitimation between university roles – teaching, research, and entrepreneurship – which makes it possible, as the university increases its entrepreneurial incursions, to manage tensions emerging between the performance of their roles enabling the improvement of previously existing functions.

It is increasingly common to see reciprocity between universities and industries, witnessing an exchange of knowledge (Ahmad et al., 2018). There is an increase in the number of projects that count simultaneously with university and industry participation and articulation of Ent_Act with education for entrepreneurship (Lu & Li, 2016). The development of Ent_Eco is visible, with changes attributed to the shift in roles assumed by the various TH actors and how individual differences are reflected in the rest's evolution (Pique, Berbegal-Mirabent, and Etzkowitz, 2018).

2.3. Methodology

2.3.1 Systematic Review Protocol

This study aims to systematise the most relevant literature, trends, and dynamics of the Ent_Uni on Ent_Eco. Pursuing this purpose, an SLR was carried out, using an objective and rigorous research protocol to minimize the researcher bias (Tranfield et al., 2003). The SLR is developed based on a systematic, transparent, replicable, and structured summarized process, giving it a scientific character (Briner & Denyer, 2012). Since this study aims to systematize the most relevant literature, trends, and dynamics

of Ent_Uni on Ent_Eco, identifying literature clusters, and presenting a future research agenda, we choose to apply Tranfield et al. (2003) methodology, based on PRISMA method (Moher et al., 2009), which includes four steps—identification of studies, screening, eligibility, and inclusion.

The search was carried out on January 6th, 2021, on WoS and Scopus databases and enabled a base of 116 articles included in the bibliometric analysis without any temporal limitations. The option for both databases was justified in its scope and relevance in the management areas. Figure 2.1 visualizes the research protocol where the articles' inclusion and exclusion criteria are presented. According to the defined research protocol, the search for relevant articles to the topic in the study took place on the Web of Science (WoS) and SCOPUS databases.

To gather a set of articles that allowed the articulation of the themes of Ent_Uni and Ent_Eco, we conducted a search considering the keywords ("entrep* universit*" AND "entrep* ecosystem*") OR ("entrep* universit*" AND "entrep* activit*") OR "universit* entrep* ecosystem*" OR ("Entrep* higher education" AND "Entrep* Ecosystem*") as search topics, exploring titles, abstracts and keywords. The returned articles were 151 from SCOPUS and 137 from WoS. We also refined the search to consider only articles as the document type and English as the language. The option for “article” as document type relies on the fact that articles published in a journal, due to the peer revision process, where they were critically reviewed peer-approved, can be considered certified knowledge (Ramos-Rodríguez & Ruíz-Navarro, 2004). The English language was chosen considering that most scientific journals are published in English, representing 98% of publications (Ramírez-Castañeda, 2020). In this scenario, the English language emerges as almost universal in scientific interactions and scientific literature production (Gordin, 2017). The results after filter application were 102 from SCOPUS and 87 from WoS. Seventy-three articles were present in both databases.

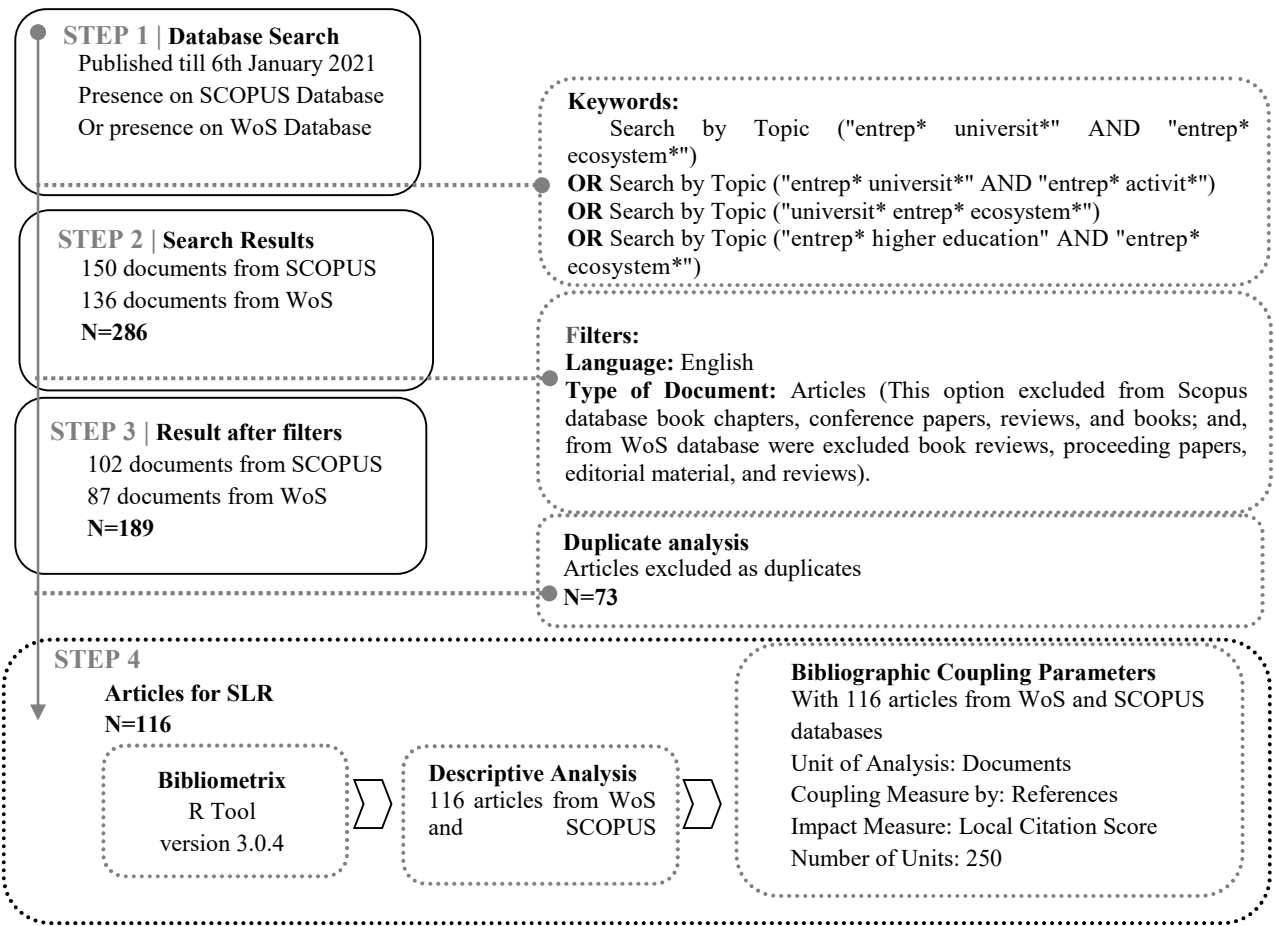


Figure 2.1 Search Protocol

2.3.2 Approaches Selection

The results are presented in two distinct but complementary approaches. In its first approach, we show a descriptive characterization of the Ent_Uni and Ent_Eco existing literature based on version 3.0.4 of package Bibliometrix, an R tool software mapping analysis (Aria & Cuccurullo, 2017). In the second approach, we present bibliometric maps and identify bibliographic coupling on document references. Kessler (1963) proposed the bibliographic coupling method where two documents are considered bibliographic coupled when they use the same item of reference.

Bibliometrix is usually used to analyse and map bibliographic data, presenting the advantage of operating in R, an open-source environment ecosystem that runs in Windows and Linux operating system environment, with a graphical user interface RStudio – which makes it user-friendly for novice or expert users. It also presents the advantage of encompassing statistical algorithms, mathematical functionalities, and visualization capabilities suitable for bibliometric analysis. Bibliometrix emerges as

software data combines the conceptual Factorial Analysis through a Text Mining approach with science mapping (Dervis, 2019).

To merge the two databases retained in the PRISMA method's inclusion step (Moher et al., 2009), we follow the first two steps of the procedure proposed by Echchakoui (2020), which involved four steps. The first step - convert WOS and Scopus databases to bibliography files – we save each database separately “*.bib” files. In step two - convert both WOS.bib and Scopus.bib to “Bibtex” files – we use RStudio by loading the Bibliometrix package and the biblioshiny library.

When we process cited references to construct bibliographic coupling networks based on WoS or SCOPUS, we need to process the cited references in these database files. Considering that cited references of both databases are in different formats, we merged both database results and removed duplicates. The bibliographic coupling analysis was performed with the 116 articles included in the initial sample. The documents were submitted to the Bibliometrix, where we first select “documents” as the unit of analysis and “references” as coupling measure criteria. After, we choose “local citation score” as an impact measure and consider 250 as the number of units under analysis and five as the minimum cluster frequency.

The research uses version 3.0.4 of package Bibliometrix to present bibliometric maps and identify bibliographic coupling of document references. According to cited references, this approach recognizes the relations between authors, allowing identifying the most proactive research and giving a dynamic perspective of the area covered (Zhao and Strotmann, 2008). Boyack and Klavans (2010) demonstrated that considering the existent pure citation-based approaches, bibliographic coupling reveals accuracy advantages compared to other approaches.

Afterward, we read the papers to identify the significant teams that emerge in each cluster formed in Bibliometrix - biblioshiny. The reading results also originated a table to identify the top 10 articles' objectives in each cluster. The analysis also inspires the name given to each one of the clusters.

Finally, we can classify our study as a bibliometric review. Bibliometric reviews are characterized by analysing an extensive amount of existing literature using statistical tools to figure out trends (Paul & Criado, 2020). Bibliometric review can be developed using Viewer software programs, ordinarily available such as VoS (Visualization of Similarities), widely used to carry out such a bibliometric review. Many bibliometric analyses are valuable when, given the number of existing articles, a relatively small

number of articles represent a significant part of the analysis's total citations (Paul & Criado, 2020).

2.4 Results

2.4.1 Descriptive Analysis – Bibliometrix

The 116 articles were published in 72 journals. Regarding source level, it is possible to identify the most productive journals. Table 2.1 presents the sources with a production level greater than two articles and their number of publications. We stand out the *Industry and Higher Education* journal and the *Small Business Economics* journal with ten and six publications, respectively.

Table 2.1 Source Articles Production

Sources	Articles
INDUSTRY AND HIGHER EDUCATION	10
SMALL BUSINESS ECONOMICS	6
INTERNATIONAL JOURNAL OF TECHNOLOGY MANAGEMENT	5
JOURNAL OF MANAGEMENT DEVELOPMENT	5
JOURNAL OF TECHNOLOGY TRANSFER	5
SCIENCE AND PUBLIC POLICY	4
SCIENTOMETRICS	3
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	3
TECHNOVATION	3
ACTUAL PROBLEMS OF ECONOMICS	2
FOUNDATIONS AND TRENDS IN ENTREPRENEURSHIP	2
HIGHER EDUCATION	2
INTERNATIONAL ENTREPRENEURSHIP AND MANAGEMENT JOURNAL	2
INTERNATIONAL JOURNAL OF ENTREPRENEURIAL BEHAVIOUR AND RESEARCH	2
JOURNAL OF ENTERPRISING COMMUNITIES	2
MANAGEMENT DECISION	2
RESEARCH POLICY	2
SUSTAINABILITY (SWITZERLAND)	2

We also analysed the source dynamics, graphically representing the time evolution of the nine most productive sources. The figure emphasizes the effective performance of the *Industry and Higher Education* journal from 1998 till 2020. It is also observable the existence of five journals that significantly increase their production after 2012. Examples of these journals are *Small Business Economics*, *Journal of Technology Transfer*, *International Journal of Technology Management*, *Journal of Management Development*, and *Technological Forecasting and Social Change*.

The obtained articles were produced in 34 different countries. The most productive countries with an article production level greater than three articles. As a result, the countries in which we stand out are the United Kingdom (18 publications), the United States of America (16 publications), Spain (13 publications), Brazil (11 publications), and Finland (8 publications).

In Figure 2.2, it is possible to observe the trend in the evolution of the number of publications and citations for the 116 articles included in the sample. The data collection retrieved articles published between 1998 till 6th January 2021.

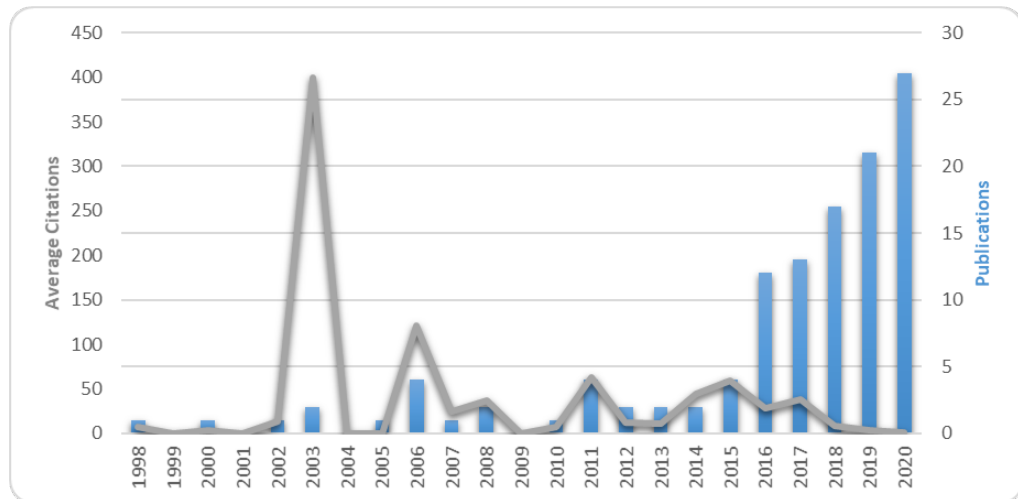


Figure 2.2 Evolution of average citation per article and publications numbers.

The average medium citation per article reached its maximum in 2003 with 399 incidences. The maximum verified in 2003 average citation is associated with an article of paramount importance - Etzkowitz (2003) – with the article entitled “Research groups as 'quasi-firms': The invention of the entrepreneurial university”, which currently has 740 citations.

Table 2.2 briefly presents the ten most cited articles on the analysed topic.

Table 2.2 Top 10 most cited articles.

Authors	Article	Journal	Total Citations	Average Citations per year
Etzkowitz (2003)	<i>Research groups as 'quasi-firms': The invention of the entrepreneurial university.</i>	Research Policy	740	39
Spigel (2017)	<i>The Relational Organization of Entrepreneurial Ecosystems.</i>	Entrepreneurship: Theory and Practice	390	78
Rasmussen & Sørheim (2006)	<i>Action-based entrepreneurship education.</i>	Technovation	238	15
Philpott, Dooley, Oreilly, & Lupton (2011)	<i>The entrepreneurial university: Examining the underlying academic tensions.</i>	Technovation	213	19
Guerrero, Cunningham, & Urbano (2015)	<i>Economic impact of entrepreneurial universities' activities: An exploratory study of the United Kingdom.</i>	Research Policy	185	26
Phan & Siegel (2006)	<i>The effectiveness of university technology transfer.</i>	Foundations and Trends in Entrepreneurship	160	10
Guerrero, Urbano, Fayolle, Klofsten, & Mian (2016)	<i>Entrepreneurial universities: emerging models in the new social and economic landscape.</i>	Small Business Economics	110	18
Guerrero, Urbano, & Fayolle (2016)	<i>Entrepreneurial activity and regional competitiveness: evidence from European entrepreneurial universities.</i>	Journal of Technology Transfer	81	14
Guerrero & Urbano (2014)	<i>Academics' start-up intentions and knowledge filters: An individual perspective of the knowledge spillover theory of entrepreneurship.</i>	Small Business Economics	70	9
Coduras, Urbano, Rojas, & Martínez (2008)	<i>The relationship between university support to entrepreneurship with entrepreneurial activity in Spain: A gem data-based analysis</i>	International Advances in Economic Research	63	5

2.4.2 Bibliographic Coupling Analysis

The Bibliographic Coupling of documents' references performed as detailed in the Methodology section – enabled the formation of six clusters that involve 114 articles of

the 116 retrieved from the bibliometric search. This reduction is related to the Bibliographic Coupling parameters, accepting the largest set of connected items.

Figure 2.3 shows the cluster's map. It is possible to observe in the x-axis the cluster centrality, which can be read as the importance of the theme in the entire research field. In the y-axis, it is presented the cluster impact, a measure of the theme's development.

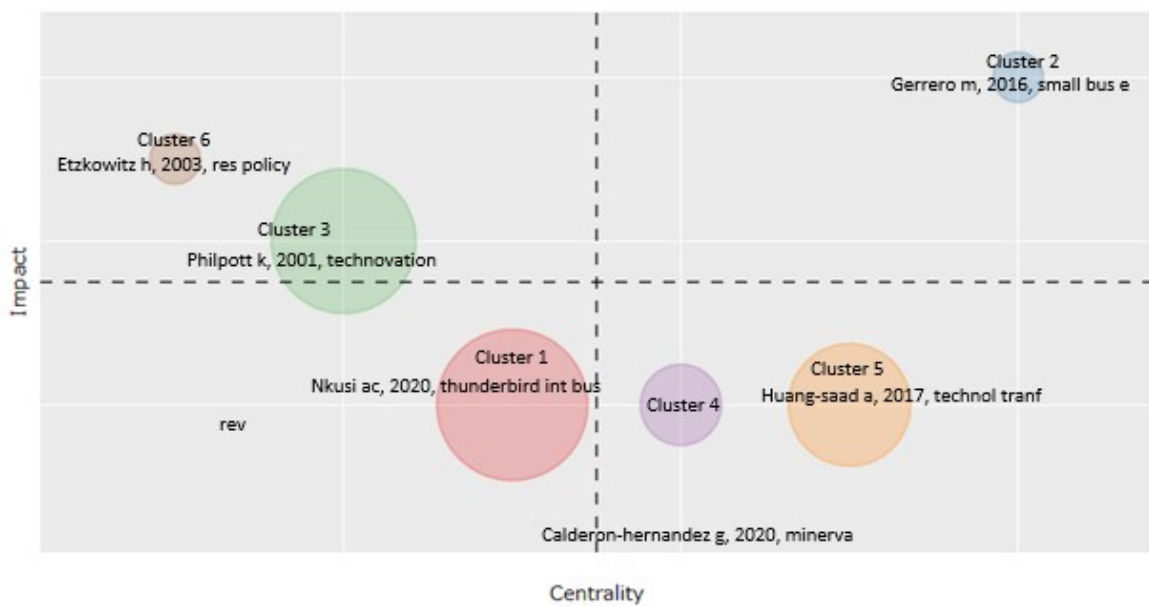


Figure 2.3 Cluster bibliometric map.

The map is divided into four quadrants, and each bubble represents a network cluster where the bubble name is one of the authors of the cluster. The bubble size is proportional to the number of authors integrated into that cluster. The bubble position is calculated according to the cluster Callon centrality and density (Aria & Cuccurullo, 2021).

According to “Biblioshiny–Bibliometrix for no Coders” (2021), cluster 1, represented in Figure 2.3 by the name of the author Nkusi et al. (2020), is on the lower left part, destined for emerging or declining themes. It is visible an eventual transition to the lower right area, destined to basic or transversal themes. In that quadrant are already positioned Cluster 4 – represented by Calderón-Hernández et al. (2020) and Cluster 5 – represented by the author Huang-Saad et al. (2017). The upper left part represents a high density but a lower centrality, are the clusters highly developed but isolated, also called “niches”. In this quadrant are situated the cluster 3 – represented by Philpott et al. (2011) – and cluster 6 – represented by Etzkowitz (2003b). Cluster 2 – represented

by the authors Guerrero et al. (2016) - is positioned in the upper right part, destined to develop and essential themes, named motor themes.

Table 2.3 presents the distribution of all the 114 papers resulting from the bibliometric search according to the assigned cluster, considering the methodological procedures adopted and already described.

Table 2.3 Authors per Cluster.

Cluster 1 N=30 Total Citations: 521	Cluster 2 N=10 Total Citations: 604	Cluster 3 N=28 Total Citations: 653	Cluster 4 N=14 Total Citations: 369	Cluster 5 N=22 Total Citations: 141	Cluster 6 N=10 Total Citations: 797
Allahar & Sookram (2019b)	Abreu et al. (2016)	Ahmad et al. (2016)	Allahar & Sookram (2019a)	Ahmad et al. (2018)	Abdelkafi, Hilbig, & Laudien (2018)
Amadi-Echendu et al. (2016)	Coduras et al. (2008)	Carayannis, Dubina, & Ilinova (2015)	Alves, Fischer, Schaeffer, & Queiroz (2019)	Crow, Whitman, & Anderson (2020)	Abereijo (2015)
Bedó, Erdős, & Pittaway (2020)	Guerrero & Urbano (2014)	Formica (2002)	Calderón-Hernández, Jiménez-Zapata, & Serna-	Davey & Galan-Muros (2020)	Bazan et al. (2019)
Brem & Radziwon (2017)	Guerrero et al. (2015)	Fuller & Pickernell (2018)	Guerrero, Urbano & Gajón (2017)	de Moraes et al. (2020)	Etzkowitz (2003)
Budyldina (2018)	Guerrero et al. (2016)	Genç et al. (2020)	Khassenova (2018)	Duval-Couetil, Ladisch, & Yi (2020)	Ferrandiz, Fidel, & Conchado (2018)
Carayannis et al. (2018)	Guerrero et al. (2018)	Iscaro, Castaldi, & Sepe (2017)	(Markuerkiaga et al., 2018)	Fischer, Moraes, & Schaeffer (2019)	Huezo-Ponce <i>et al.</i> (2021)
De Jager et al. (2017)	Guerrero, Urbano, & Fayolle (2016)	Kochetkov, Larionova, & Vukovic (2017)	Marques, Oliveira, Andrade, & Zambalde (2019)	Fogelberg & Lundqvist (2013)	Lamine et al. (2018)
de Sandes-Guimaraes et al. (2020)	Guerrero, Urbano, & Gajón (2020)	Krücken, Meier, & Müller (2007)	Matt & Schaeffer (2018)	Gianiodis, Markman, &	Rialti et al. (2017)
Huang-Saad, Duval-Coueti, & Park (2018)	Urbano & Guerrero (2013)	Kutinlahti (2005)	Meyer (2006)	Gianiodis, Meek, & Chen (2019)	Sánchez-López & Pedraza (2020)
Johnson, Bock, & George (2019)	Zhang et al. (2016)	Levie (2014)	Meyer, Siniläinen, & Utecht (2003)	Huang-Saad et al. (2017)	Shekhar & Bodnar (2020)
Lahikainen et al. (2019)		Markuerkiaga et al. (2016)	Rasmussen & Sørheim (2006)	Ishizaka et al. (2020)	
Leitner, Bergner, & Rybnicek (2020)		Markuerkiaga et al. (2017)	Ribeiro, Uechi, & Plonski (2018)	Loi & Di Guardo (2015)	
Link & Sarala (2019)		Mathieu, Meyer, & Potterie (2008)	Sambo (2018)	Meusburger & Antonites (2016)	
Maritz (2017)		Pazos et al. (2012)	Shankar & Clausen (2020)	Miller et al. (2018)	
Mason et al. (2020)		Phan & Siegel (2006)		Padilla-Meléndez et al. (2020)	
Mudde et al. (2019)		Philpott et al. (2011)		Ricci, Colombelli, & Paolucci (2019)	
Nkusi et al. (2020)		Ranga et al. (2016)		Sá et al. (2018)	
O'Brien, Cooney, & Blenker (2019)		Reyes (2016)		Skute (2019)	
Pittz & Hertz (2018)		Riviezzo & Napolitano (2010)		Soetanto & van Geenhuizen (2019)	
Prencipe et al. (2020)		Roberts & Eesley (2011)		Tavella & Bogers (2020)	
Pugh <i>et al.</i> (2021)		Romanovskyi (2011a)		Wibowo, Purwana, & Wibowo (2020)	
Rybnicek et al. (2019)		Romanovskyi (2011b)		Wolf (2017)	
Sanadgol & Dadfar (2020)		Ruiz, Martens, & da Costa (2020)			
Scheidgen (2021)		Salamzadeh, Kesim, & Salamzadeh			
Secundo et al. (2020)		Secundo et al. (2019)			
Spigel (2017)		Sułkowski & Patora-Wysocka (2020)			
Stolze and Sailer (2021)		Yokoyama (2006)			
Wynn & Jones (2017)		Yordanova & Filipe (2019)			
Závodská, Šramová, & Liberona (2019)					
Zobnina, Korotkov, & Rozhkov (2019)					

Thematic Clusters: Entrepreneurial Universities and Entrepreneurial Ecosystems

To solidly present each of the six literature clusters on the Ent_Uni and Ent_Eco subject, we have thoroughly analysed each of the 114 articles. This content analysis made it possible to identify which themes were predominant in each cluster and understand each of the authors' contributions to the cluster specified by analyzing the documents' Bibliographic Coupling.

Cluster 1: University Entrepreneurial Anatomy and Ent_Eco

Thirty studies involving 521 citations contribute to the understanding of Cluster 1 – University Entrepreneurial Anatomy and Ent_Eco. In this cluster, multiple aspects are evidenced to consider in the analysis and construction of entrepreneurial anatomy. These aspects involve a collaboration between the concepts of Ent_Uni and Ent_Eco to allow the emergence of an actual entrepreneurial structure capable of dealing with the multiple challenges inherent to entrepreneurship and maximizing the opportunities generated and their benefits. The five most cited articles of Cluster 1 are briefly presented in Table 2.4.

According to Spigel (2017), author of the most cited article of this cluster, despite the popularity of Ent_Eco, where ecosystems represent the merge of localized cultural outlooks, social networks, investment capital, universities, and active economic policies that support innovation-based ventures, ecosystems research still underdeveloped and undertheorized. To a better understanding of Ent_Eco structure and its influence on the entrepreneurship process, Spigel (2017) proposed a set of 11 attributes – supportive culture, histories of entrepreneurship, mentors and role models, investment capital, networks, worker talent, support services, open markets, infrastructure, universities, policies - this attributes relationships' dynamics could originate different ecosystem configurations.

In this cluster, it is easily identifiable and undeniable the leading role played by universities – as knowledge-intensive environments - in the development of a supportive environment, involving the developing of culture, researching, creating incubators, and accelerators, growing co-working spaces, seminars, and teaching entrepreneurship, identifying this institution as the catalyst of the entrepreneurial process (Závodská et al., 2019).

Table 2.4 Top 5 Most cited articles of Cluster 1.

Author(s) Citations	Article	Objective	Methodology	Main Findings
Spigel (2017) 390	The Relational Organization of Entrepreneurial Ecosystems.	Explore the development of the theoretical concept of entrepreneurial ecosystems to clarify how they are structured and their influence on the entrepreneurship process.	Qualitative	The authors argue that ecosystems result from an articulation of 11 attributes of a cultural, social, and material nature from which benefits and resources emerge placed at entrepreneurs' service. It is in the relationships that are established between these attributes that ecosystems emerge.
Brem & Radziwon (2017) 31	Efficient Triple Helix collaboration fostering local niche innovation projects – A case from Denmark.	Approach how an efficient TH collaboration could foster and support the growth of regional entrepreneurial ecosystems.	Qualitative	Networking, win-win situations, and a strong problem orientation were identified as key success factors, particularly in regional entrepreneurial ecosystems. These factors may enhance an efficient future TH collaboration and cooperation for ensuring a higher innovation diffusion success based on the development of students' ideas.
Budyldina (2018) 21	Entrepreneurial universities and regional contribution.	Define the dimensions of entrepreneurial universities and their eventual application to the regional context.	Qualitative	Regional impacts of universities are broader than technology transfer and tangible outputs; however, the transformation of a university into a local entrepreneurial cornerstone demands massive government funding to conciliate innovative university activities without compromising its traditional functions.
Maritz (2017) 13	Illuminating the black box of entrepreneurship education programs: Part 2.	Explore the increasing number of entrepreneurship education programs developed in higher education institutions and the repercussion in empowering individuals to transform and become better entrepreneurs.	Qualitative	Improvement of Dimensions of Entrepreneurship Education framework contributes to the theoretical discussion and builds understanding of generating entrepreneurship education programs considering varied contextual boundaries.
Link & Sarala (2019) 9	Advancing conceptualisation of university entrepreneurial ecosystems: The role of knowledge-intensive entrepreneurial firms.	Contribute to deepening the understanding of university entrepreneurial ecosystems' demand side based on entrepreneurial firms as the university knowledge's key user.	Quantitative	Clarification of universities' economic, societal, and technological contributions, illustrating the role of firm resources and capabilities used as moderators of value in university EE.

Within the same general approach, Huang-Saad et al. (2018) approach the desired outcomes and impacts of university entrepreneurial ecosystems to bring practice closer to research focusing on technology and talent. Despite their relevance, we have to consider the institutionalized logics of universities - education and research – and acknowledge that the development of Ent_Act could cause intentional and unintentional decoupling between logics (Lahikainen et al., 2019)

Zobnina et al. (2019), Pittz and Hertz (2018), and Maritz (2017) described that entrepreneurship education is increasingly growing - entrepreneurship programs, degrees, certificates, and entrepreneurial centers - revealing the universities' aim of creating a mindset that empowers individuals to be more and better entrepreneurs. In this sense, and as a redevelopment of Maritz and Brown (2013) framework on entrepreneurship education, design for understanding and evaluating entrepreneurship education programs, Maritz (2017) present a framework that integrates several components – entrepreneurship ecosystems, outcomes, objectives, audience, assessment, content, and pedagogy – that enable the contextualization of entrepreneurship education ecosystems.

Within the role played by universities in the promotion of student and graduate start-ups, Závodská et al. (2019) and Mason et al. (2020) argues that the entrepreneurial education is not achievable by a single course, there is a need for coordinated programs, with the integration of entrepreneurship education, activities, and infrastructures to support and accelerate the start-up process. There is also a need for integrated learning - involving action learning, masterclasses, peer-to-peer learning, and experimental workshops – with evidence of the need to include a reflexivity dimension in their everyday practice (Pugh et al., 2021). To address entrepreneurial ecosystem stakeholders' preoccupation, clarifying universities' role in pursuing entrepreneurial pathways – managing opportunities and risks - Stolze and Sailer (2021) propose five future scenarios presenting as key drivers internationalization, digital transformation, collaborative networks, and co-creation processes will condition future entrepreneurial pathways.

Furthermore, multiple studies approach the concept of University-centered entrepreneurial ecosystems (Brem and Radziwon, 2017; Johnson et al., 2019; Secundo et al., 2020), involving complex webs of entrepreneurs, researchers, institutional support structures, and the built environment that is a result of the dynamics of their relationships and responsible for the performance of ecosystem agents in the evolution of University-centered entrepreneurial ecosystems. Bedó et al. (2020) explore the

same concept within a resource-constrained environment (e.g., ecosystems in small cities, underpopulated rural areas, and university towns) and conclude building an entrepreneurship ecosystem in such contexts would be highly challenging. According to De Jager et al. (2017), the South Africa case is also challenging, presenting the lowest youth entrepreneurial propensity. The authors defend the need for a new philosophy of education, particularly in technology universities, to lead to work opportunity-enhancing outcomes. The article published by O'Brien et al. (2019) approaches a particular type of Ent_Eco challenges, presenting a framework to support their expansion to under-represented communities.

Another perspective of the challenges to building an Ent_Eco is brought by Nkusi et al. (2020), who undertook an exploratory study in a post-conflict economy where the pre-existent Ent_Eco was destroyed. The author argues that in this scenario, several institutional factors (e.g., structures, systems, leadership, strategies, and culture) constrain the Ent_Eco development, which evolves through several stages - embryonic, destruction, formation, and capacity building stages.

According to Scheidgen (2021), it is also essential to know how entrepreneurs acquire resources from an Ent_Eco, considering the two distinct subsystems – spin-off or start-up – generating heterogeneity between Ent_Eco and within Ent_Eco. The author argues that this heterogeneity compromises the comparability and comprehension of Ent_Eco and, consequently, the correct design of political instruments to promote entrepreneurship effectively.

Even while adopting another approach, according to students with international exchange experience, de Sandes-Guimaraes et al. (2019) argue that they emphasize the collaboration between the university and non-academic partners, in contrast to non-traveling counterparts, who stresses the importance of existing university infrastructures. Within the theoretical construct of the TH interrelationships, and despite the slow progress towards achieving the universities' third mission, the university-centered Ent_Eco requires more proactive leadership and more significant internal and external involvement stakeholders (Allahar & Sookram, 2019b).

Brem and Radziwon (2017) argue that collaboration between universities and their local stakeholders is a major success factor for regional Ent_Eco development. An efficient TH collaboration and cooperation could foster and support niche innovations and enhance innovation diffusion success. According to Carayannis et al. (2018) and based on its previous work (Carayannis & Campbell, 2009), the TH model should be extended to consider a 'fourth helix' that they identified civil society – involving (1)

media, (2) creative industries, (3) culture, (4) values, (5) life styles, (6) art (7) creative class notion. Furthermore, the authors also argue that innovation structures within society result from a knowledge-based economy where universities emerge with a new knowledge production and transfer model proposition that considers environmental dimension – pointing to the analysis of a “quintuple helix”.

Mudde et al. (2019) explore the Ent_Uni framework of the European Commission/OECD, considering staff, students, university top-management, faculty, and external stakeholders’ responses – and argue the existence of a tension between a decisive say of the government in university activity and the need to develop an autonomous, integrated entrepreneurial culture. As the author states, within the Ethiopian Universities context – where universities are operating in a top-down, central governmental-led development - leadership is the lever for an entrepreneurial turn at the universities. Budyldina (2018) also refers that the evolution of the Ent_Uni demands massive government funding during the initial stages and strategic policy coordination to leverage the university's innovative activities without compromising its traditional teaching and research functions.

Also, within the Ent_Eco concept, Carayannis et al. (2018) published an article to examine the concept of ‘Mode 3’ universities to clarify if they represent a new and advanced type of an Ent_Uni. The authors define a ‘Mode 3’ university as “a type of organization capable of higher-order learning and in this regard an open, highly complex, and non-linear knowledge production system that seeks and realizes creative ways of combining, recombining, and integrating different principles of knowledge production and knowledge application (e.g., ‘Mode 1’ and ‘Mode 2’)” (p. 146). According to the authors, when compared to an Ent_Uni, the concept of ‘Mode 3’ universities is better prepared to address the current and future challenges; however, it demands a strong linkage and contextualization with Ent_Eco. Even while adopting another perspective, it is possible to identify the impact of business and scientific experience of the head of university departments (Leitner et al., 2021), industry leadership experience (Rybnicek et al., 2019),

The article published by Wynn and Jones (2017) stresses the importance of knowledge transfer partnership programs, which, through customer-facing roles, leverage relationships, and linkages between initiatives and enable sustainable incomes from Ent_Act. Within the concept of university Ent_Eco, it is vital to observe the students' attitudes towards Ent_Uni activities (Sanadgol & Dadfar, 2020) explore the demand side regarding the entrepreneurial firm's role as the key user of university knowledge

(Link & Sarala, 2019). Link and Sarala (2019) results unveil the role of firm resources and capabilities as moderators, leveraging the ability to create value from university knowledge. Another contextual dimension is explored by Prencipe et al. (2020), approaching the regional entrepreneurial ecosystem and incorporating university spin-off through the knowledge spillover process. Amadi-Echendu et al. (2016) explore the potential of a particular university – the University of South Africa – to approach university entrepreneurship as a solution to end unemployment in South Africa. The authors argue the need for alternative approaches to complement traditional teaching methods - on-the-job training, assisting with incubating business ideas, and providing a platform for cross-pollination of knowledge between government, university, and industry.

Cluster 2: Universities Third Mission Performance and Impacts

Ten studies contribute to understanding Cluster 2. This cluster represents a literature path focusing on the Ent_Uni as a catalyst for regional economic and social development through the generation and exploitation of knowledge as entrepreneurial opportunities, emphasizing the need to enhance university technology transfer effectiveness and leverage the integration and collaboration between the multiple agents of an entrepreneurial ecosystem. One of the smallest clusters, it is responsible for 604 citations. The top five most cited articles of this cluster are briefly presented in Table 2.5.

An increasing pressure on universities to deliver on their third mission is undeniable, demanding a broader sense of knowledge exchange, involving research commercialization, Uni_Ind partnerships, and all related enterprise engagements (Abreu et al., 2016). There is now a recognition of the paramount importance of universities, particularly the Ent_Uni, in the development of innovation and Ent_Act, its influence on national innovation systems development and performance, and the emerging entrepreneurship ecosystems' literature (Guerrero et al., 2016). This scenario involves a broader range of Ent_Act. Referred as "problem-solving activities", they include consultancy, contract research, and joint research with external organizations; participation in research consortia, informal advice, prototyping and testing for external organizations, hosting personnel from external organizations, and secondments (Abreu et al., 2016).

Also focusing on the critical role of entrepreneurial universities ecosystems, Guerrero et al. (2020) affirm that they increase graduates' employability options and identify

how the university business incubator positively influences graduates' risk aversion and the work effort is positively influenced by entrepreneurship.

Table 2.5 Top 5 Most cited articles of cluster 2.

Author(s) Citations	Article	Objective	Methodology	Main Findings
Guerrero et al. (2015) 185	Economic impact of entrepreneurial universities' activities: An exploratory study of the United Kingdom.	Contribute to deepen the understanding of the economic impact of entrepreneurial universities' teaching, research, and Ent_Act .	Quantitative	The authors identify a positive and significant economic impact of teaching, research, and Ent_Act. Entrepreneurial spin-offs explain the higher economic implications of the United Kingdom's entrepreneurial universities (the Russell Group). In the control group, the highest economic impact is associated with knowledge transfer.
Guerrero et al. (2016) 110	Entrepreneurial universities: emerging models in the new social and economic landscape.	Development of the theoretical, empirical, managerial, and political implications of emerging models that approach Ent_Uni contextualized in the new socio-economic landscape.	Qualitative	The authors argued the relevance of entrepreneurial universities in developing innovation and entrepreneurship activities based on emerging models of entrepreneurial universities in the new socio-economic landscape. They highlight aspects related to individual-organizational interactions and the organizational-regional context interactions to outline a future research agenda based on entrepreneurial universities' role as drivers of innovation and entrepreneurship proposes.
Guerrero, Urbano, & Fayolle (2016) 81	Entrepreneurial activity and regional competitiveness: evidence from European entrepreneurial universities.	Analyse the impact of the university's Ent_Act on regional competitiveness to propose a conceptual framework.	Qualitative	The results show that informal factors (e.g., attitudes, role models) have a more significant influence on university Ent_Act than formal factors (e.g., support measures, education, and training). The results also evidenced a higher contribution of universities to regional competitiveness.
Guerrero & Urbano (2014) 70	Academics' start-up intentions and knowledge filters: An individual perspective of the knowledge spillover theory of entrepreneurship.	Explore the role of academics' start-up intentions and knowledge filters on entrepreneurial universities' knowledge transfer process.	Qualitative	The authors argue that Ent_Uni infrastructures and policies are correctly developed; however, they need to be appropriately implemented, reducing organizational barriers and reinforcing the perception that entrepreneurship is possible for academics.
Coduras et al. (2008) 63	The relationship between university support to entrepreneurship with entrepreneurial activity in Spain: A GEM data based analysis.	Analyse the statistical relationship between entrepreneurship university support and the level of Ent_Act.	Quantitative	The authors argue that there is no significant statistical relation between entrepreneurship universities' support and the Ent_Act level. However, it is possible to statistically relate entrepreneurial intention with university support, which denotes the improvement of high education in Spanish entrepreneurship.

According to Coduras et al. (2008), there is a relation between entrepreneurial intention and university support. From a holistic perspective, we cannot fail to mention the importance of incubators, and we need to understand these initiatives'

economic repercussions. Business Incubators have an impact on graduates' entrepreneurship (Guerrero et al., 2018).

Examining the associations between the intensity and performance of knowledge exchange activities undertaken between United Kingdom universities and non-academic actors, Zhang et al. (2016) clarify the nature of the existing interactions, based on the competitive level of the region where they occur and on the leverage of knowledge and partnership levels. As stated by the authors, there are differences between competitive and uncompetitive regions. In uncompetitive regions, it is common to verify a more intense engagement in academic Ent_Act; however, the study identifies the generation of less income compared to competitive regions. On the other hand, in competitive regions, it is possible to affirm that the university's geographical distance represents a minor obstacle compared to uncompetitive regions (Zhang et al., 2016).

The economic impact of entrepreneurial universities' teaching, research, and Ent_Act is the central theme of Guerrero et al. (2015). The theoretical criteria used to define entrepreneurship activities in Guerrero et al. (2015) were based on previous studies. Their study approach Ent_Act as activities performed at all university levels (university management, academicians, researchers, and potential entrepreneurs among students and alumni) that lead to the creation of new companies that could impact job creation and regional development, creating the conditions for partnerships between key regional clusters to generate the encounter of the current needs and their solution. Furthermore, these activities will produce several externalities – demography, economy, infrastructure, culture, mobility, education, and social challenges – with impacts on productivity, competitive advantages, regional capacities, regional networks, regional identity, and regional innovation. The authors argue that previous studies analyse universities' role in economic development without observing university outcomes' complexity and dynamic characteristics and their transformation into economic impacts. According to the conceptual model proposed by Guerrero et al. (2015), exists a positive and significant effect of these activities on economic development, revealing different results when we approach entrepreneurial universities, for which the performance of spin-offs is more relevant, and for the remaining universities, for whom the highest economic impact is associated with knowledge transfer.

Recognizing the relevance of the Ent_Uni, and despite the progress made in analyzing the economic impacts resulting from Ent_Act performed by them, evidence about this

phenomenon is still fragmented and disorganized (Urbano & Guerrero, 2013). To provide a better understanding of the socioeconomic impacts of the Ent_Uni, Urbano and Guerrero (2013) present some practices able to stimulate the Ent_Act of universities and thus foster their contribution to the development of the modern knowledge economy, particularly in times of crisis or in highly competitive environments. According to the authors, in these contexts, the most critical component will be the integration and collaboration of the multiple actors of the Ent_Eco, and the university authorities must identify their core role to enhance the entrepreneurship ecosystem leveraging the entrepreneurial potential, stimulating skills, competencies, and tools to create a mindset that drives innovation.

The relationship between Ent_Act and regional competitiveness is the central theme of Guerrero, Urbano, and Fayolle (2016) article, giving special attention to the role of institutions in the establishment of political, social, and economic rules and because in many regions, universities are seen as potential engines of economic growth. This article presents shreds of evidence that in a scenario where entrepreneurial universities are increasingly generating and transferring knowledge and simultaneously are providing the leadership that enables and leverages the entrepreneurial thinking, actions, and institutions. The authors argue that informal factors (e.g., attitudes towards entrepreneurship, role models) significantly influence university Ent_Act than formal factors (e.g., support measures to entrepreneurship, education, and training programs).

Guerrero and Urbano (2014) detailed it is possible to identify several filters that limit knowledge conversion into economically helpful knowledge. According to the knowledge spillover theory, the authors present insights valuable for policymakers to define policies that enhance social and educational benefits. Acknowledging that perceived behavioural control is a knowledge filter with implications on future knowledge diffusion (e.g., start-up intentions), betoken the challenges faced by experimented academics when they face the possibility of becoming entrepreneurs and come across the lack of specific experience, skills, and capabilities (Guerrero and Urbano, 2014). Within the same general approach, Abreu et al. (2016) argue the relevance of academics' prior university and business experience in providing cognitive guidance in Ent_Act. Previous experience will shape a person's engagement with various activities in different task domains with reflections on work performance, such as Ent_Act. A broad range of prior experience benefits academics' performance on problem-solving activities, whilst a narrower range of previous experience will help academic's involvement in licensing and spin-out activities (Abreu et al., 2016).

Cluster 3: Balance Ent_Uni Different Roles

Twenty-eight studies, responsible for 653 citations, contribute to understanding the Balance Ent_Uni Different Roles cluster. Cluster 3 emphasizes the university entrepreneurial transformation process clearly impacts balancing the different university roles. The university has to reconcile multiple aspects to achieve its third mission successful performance without compromising traditional teaching and research functions. There is a new university entrepreneurial logic, with repercussions in Ent_Act development and the knowledge exchange activities between universities and non-academic actors' implications in the performance of University-Business Cooperation. We briefly present the five most cited articles of Cluster 3 in Table 2.6.

Universities are progressively gaining prominence as economic actors, balancing knowledge creation, knowledge dissemination, and knowledge exploitation functions, generating intellectual value and benefiting both society and the economy (Kutinlahti, 2005). It is essential to understand the economic impact of the entrepreneurial ecosystems in support of university graduates' firm start-ups and the importance of the programs and historical culture of entrepreneurship. As an example of paramount importance, emerges Massachusetts Institute of Technology (MIT), which provides a benchmark to analyse the economic impact of their alumni entrepreneurs and identify some examples of programs and practices, widely accessible to students, that other universities might adopt towards entrepreneurial development (Roberts & Eesley, 2011).

As a result, the Ent_Uni will perform Ent_Act - spin-off firm formation, patenting, licensing, collaborative research, industry training courses, consulting, industry mobility, and networking – mechanisms for promoting social and economic development (Markuerkiaga et al., 2016).

The Ent_Act should cohesively encompass various entrepreneurship education dimensions due to an entrepreneurship strategy focusing on local needs and context (Markuerkiaga et al., 2017). This theme was the base of the project UNEK, developed to analyse the academic entrepreneurial situation to propose an entrepreneurial maturity model.

Table 2.6 Top 5 of Most cited authors of Cluster 3.

Author(s) Citations	Article	Objective	Methodology	Main Findings
Philpott et al. (2011) 214	The entrepreneurial university: Examining the underlying academic tensions.	Investigates the Ent_Uni concept, approached by Etzkowitz & Leydesdorff (2000) in the university context.	Qualitative	The Ent_Uni concept is a global phenomenon with an isomorphic development path due to several key barriers. Through this case study, it is possible to identify an attitudinal split that could cause disharmony amongst the academic community, which could compromise the achievement of the university's third mission. A top-down push towards the ideal of the Ent_Uni could reduce Ent_Act.
Phan & Siegel (2006) 160	The effectiveness of university technology transfer.	Present recommendations to enhance the effectiveness of university technology transfer.	Qualitative	The authors argue that the proposed recommendations will depend on universities' mechanisms to stress, based on their technology transfer strategy. Universities should also be aware of social ethics and responsibility issues, which will become increasingly important as they become more aggressively involved in commercializing the technology they develop.
Yokoyama (2006) 51	Entrepreneurialism in Japanese and UK universities: Governance, management, leadership, and funding.	Analyse university governance changes, management, leadership, and funding and their influences on Ent_Act development.	Qualitative	The authors propose a theoretical model according to five types of institutional entrepreneurial culture.
Roberts & Eesley (2011) 41	Entrepreneurial impact: The role of MIT.	Contribute to understanding the economic impact of the entrepreneurial ventures of university graduates.	Mixed	Acknowledging that some universities play an essential role in many economies through their core education, research and development, and other spillovers, the authors also sustain the need to develop a culture and programs that make entrepreneurship widely accessible to students to support economic growth through entrepreneurship.
Krücken, Meier, & Müller (2007) 25	Information, cooperation, and the blurring of boundaries - Technology transfer in German and American discourses.	Examine technology transfer mechanisms for speeding up innovation, based on the assumption of increased competitiveness associated and considering a more complex model that allows networking and Ent_Act of the universities themselves.	Qualitative	The authors argue three ideal-typical models in technology transfer - information and documentation model, cooperation model, and blurring of boundaries model.

Even while adopting another scope, the article published by Mathieu et al. (2008) also focuses on analyzing knowledge production and the changing relationships within the TH. The author argues that it is possible to identify multiple ways to approach the universities' third mission and offer a different perspective. Universities do not have to transform themselves into fully entrepreneurial organizations to contribute substantially to economic development.

Emphasizing the Ent_Uni' high expectations, Genç et al. (2020) argue that universities are expected to develop Ent_Act and promote University-Business Cooperation, education, and training, contributing to the entrepreneurial transformation. Furthermore, universities have to embed entrepreneurship in an academic culture that allows entrepreneurial capacity development, bringing together entrepreneurial capacity and opportunities, a scenario where new opportunities are perceived, capitalized, and converted into marketable products or services (Formica, 2002). Salamzadeh et al. (2016) stated that the Ent_Uni emerged as an efficient and effective university, conciliating its traditional mission and simultaneously pursuing a third mission.

Manage Ent_Uni multiple missions, including teaching, research, and entrepreneurship, reveal complexity in achieving the university third mission, denoting the existence of dilemmas in the creation of the Ent_Uni, encompassing challenges related to the academic resistance, internal factors, and social capital issues (Ahmad et al., 2016). The authors stress the need for a proper balancing between teaching, research, and entrepreneurship, structured based on effective TH links to promote the transition to the Ent_Uni concept. As stated by Ruiz et al. (2020), and in contrast with TH, based on university, government, and industry as protagonists, this study proposes that the entrepreneurial ecosystem includes multiple actors - university, industry, nonprofit organizations, financial institutions, civil society, among others. The actors can integrate the knowledge generated by the different areas, exploring potential partnerships to create economic, social, cultural, and environmental value.

Within the Ent_Uni concept, Ruiz et al. (2020) published an article to clarify the characteristics of the Ent_Uni, focusing on the commercial entrepreneurship aspects (e.g., social or different demands for solutions to problems in society) and integrating entrepreneurial practices with other university roles in the context of an entrepreneurial ecosystem. The authors present a theoretical-conceptual model of Ent_Uni reorganizing the Ent_Uni characteristics into dimensions – management, infrastructure, internationalization, finance capital, the academic community, and Ent_Eco and partnership. Education and training programs help students turn ideas into actual start-ups (Iscaro, Castaldi, and Sepe, 2017). The authors developed a virtual platform – ExperimentaLab – able to simulate its everyday dynamics through role-playing. The platform proved to effectively process an idea and make it potentially ready for the market and investors.

In the entrepreneurial transformation of universities into the Ent_Uni, Yordanova and Filipe (2019) investigate barriers, facilitators, and best practices in transforming Bulgarian and Portuguese universities. The authors identified both internal and external barriers and facilitators of the entrepreneurial change in both countries. Yordanova and Filipe (2019) argue that the significant barrier relates to the mindset/mentality of the academic and administrative staff mindset/mentality in the Portuguese case, and the most significant facilitator is leadership and strategic vision and motivated and dedicated staff. Within the same general approach, Reyes (2016) states that institutional members' emotions or sentiments could impede institutional changes within institutions, especially if they have diffused feelings or skepticism in handling. Philpott et al. (2011) identify key barriers to achieving the entrepreneurial ideal. According to the authors, these barriers – the lack of entrepreneurial role models within the university, the absence of a unified entrepreneurial culture across the institution, and the academic progression processes adversely affecting academic' entrepreneurial efforts - are responsible for the disharmony amongst the academic community and compromise the progress towards the achievement of the third mission.

The universities are in a transformation process via entrepreneurial actions (Romanovskyi, 2011a). The architecture of an innovative Ent_Uni should be built upon ideas of freedom and integration of education and science, independence and autonomy of the university, meeting the current requirements and challenges of the society, flexibility of university and its capability to change, and academic ethics and freedom (Romanovskyi, 2011b). These authors also defend that establishing an Ent_Uni should follow some vital prerequisites, namely the presence of academic entrepreneurs and the support of entrepreneurial ideas by the consensus of university staff and the government and community support of a university's Ent_Act.

That support could emerge from different entrepreneurial cultures, particularly how the university relates to the industrial sector, namely external funding, Ent_Act, and organizational reform (Yokoyama, 2006). As Sułkowski and Patora-Wysocka (2020) affirm, the Ent_Uni involves incremental organizational identity changes and culture and needs leadership intensely concentrated on sense-making and building the consensus around stakeholders' actions. Adopting the same general approach, Riviezzo and Napolitano (2010) present a study focused on the valorization and exploitation of university scientific knowledge analyzing the influence of the diffusion of Ent_Act, the evolution of the organizational models to facilitate Ent_Act, and the third mission commitment. The authors argue that despite the engagement of Italian universities

with the stakeholder community – through consultancy, education and training, research and technology transfer and setting up of Technology Transfer Offices and other specialized organizational units – and the increasing acceptance of third mission demands local development, entrepreneurship is not yet a central part of the core strategy of universities in Italy.

To analyse the conceptualization of technology transfer mechanisms for speeding up innovation, Krücken et al. (2007) approach three ideal-typical models - the information and documentation model, the cooperation model, and the blurring of boundaries model. According to these authors, the emphasis was on knowledge and technology information and documentation available to potential users. On the other hand, the cooperation model emphasized the need for a more active and dialogue-oriented role for academic and industrial researchers across the different organizations and institutional contexts. The blurring of boundaries model is characterized by a blurring of clear-cut institutional boundaries between academia and industry (Krücken et al., 2007).

The article published by Levie (2014) also focuses on technology commercialization and argues an interdependence of technology commercialization education and the Ent_Eco. According to the author, Ent_Eco enables technology commercialization, relying on cooperation and coordination between university departments to promote joint work and leverage goodwill and energy for students, staff, and alumni.

Even while adopting another scope, the article published by Kochetkov et al. (2017) also focuses on the evolution of university type. According to the authors, it is historically possible to “allocate four university types by analogy to four industrial revolutions” (p. 477). This paper scrutinizes a radical shift in the university model due to the fourth industrial revolution's conditions unveiling a transition from research, development, and technology transfer. The university is moving towards the creation of intellectual capital.

The challenges of University-Business Cooperation imposed by knowledge management could be analysed according to six dimensions – institutional context, stakeholders, motivations, facilitators/inhibitors, benefits, and drawbacks – to leverage dynamic local innovation and entrepreneurship ecosystems (Ranga et al., 2016).

Fuller and Pickernell (2018) approach university Ent_Act to identify activity groups' eventual statistical emergence by adopting another perspective. The authors identified

four groups of university Ent_Act, three of them related to the ownership of spin-offs or star-ups - “Staff Spin-off Activity”, “Non-HEI Owned Spin-Off Activity”, and “Graduate Start-up Activity” – and the fourth group encompassed a wide range of university knowledge creation, exchange and exploitation activities and was labeled as “University Knowledge Exploitation Activity”.

Four of the articles included in this cluster (Carayannis et al., 2015; Pazos et al., 2012; Phan and Siegel, 2006; Secundo et al., 2019) focus on several aspects of knowledge transfer and the need of enhancing the effectiveness of Technology Transfer Offices.

Phan and Siegel (2006) approach university technology transfer's effectiveness (e.g., licensing agreements between the university and private firms, science parks, incubators, and university-based start-ups). Drawing attention to the entrepreneurial dimension of technology transfer, the authors emphasize the need to address skill deficiencies in technology transfer offices and create a reward system adapted to Ent_Act, allowing better knowledge to start new ventures or interact with entrepreneurs. It is also essential to define a procedure to deal with ethics, and social responsibility, which will emerge as they intensify technology commercialization.

Increasing university entrepreneurialism will depend on a successful promotion of academic entrepreneurship – encapsulated in the performance of the Technology Transfer Offices - through strategic leverage of the intellectual capital (Secundo et al., 2019).

Opening a new perspective on the analysis of Technology Transfer Offices of entrepreneurial universities based on IC, Secundo et al. (2019), and considering that previous approaches were based on patents and other forms of tangible intellectual property, failing to approach a broad set of entrepreneurial universities activities, universities should seek to review their IP policies to consider IC. These authors argue a possible alignment of the determinants of academic entrepreneurship, characteristics of entrepreneurial universities, and IC indicators to place Technology Transfer Offices within the organizational structure that enables full access to an adjusted balance of IC subcomponents – Human Capital, Structural Capital, and Relational Capital – to leverage entrepreneurialism, the ideal spirit to entrepreneurial performance.

The success of university Ent_Act carried out by transferring technology to industry, particularly by creating spin-off firms, depends highly on the university Ent_Act expertise and the existence of a Technology Transfer Offices (Pazos et al., 2012). Also emphasizing the importance of universities' technology commercialization and

licensing, Carayannis et al. (2015) present a game-theoretical method to analyse, understand, and anticipate inventors, entrepreneurs, and innovators' behavioural profiles. The model considers the university or research center linkages with their entrepreneurship ecosystem to enable optimal licensing (Carayannis, Dubina, and Ilinova, 2015). According to the authors, Intellectual Property is emerging as the essential “currency” for global trade in strategic capabilities; thus, their results stress the enormous potential - for that university, it could enhance the quality of their technology commercialization and licensing negotiation the use of solid analytical models. The models could support the licensor and potential licensees to make substantiated decisions about optimal licensing and bargaining strategies (Carayannis et al., 2015).

Cluster 4: Entrepreneurial Education and Ent_Uni Support

Fourteen studies, responsible for 369 citations, contribute to the understanding of Cluster 4. The top five most authors of this cluster are briefly presented in Table 2.7. Cluster 4 focuses on entrepreneurial universities as entrepreneurship leading agents, creating an educational, support, and collaboration environment that promotes Ent_Act and innovation-driven entrepreneurship.

Achieving the Ent_Uni status involves well more than a simple setup of generic conditions, forcing academic environments to rethink their dynamic and performance (Alves et al., 2019). The collaborative and Ent_Act of university researchers point to the emergence of the Ent_Uni with an increasing overlay of activities of TH actors (Meyer, Siniläinen, and Utecht, 2003). At the same time, the Ent_Uni must integrate highly qualified managers and teachers with entrepreneurial vision, ready to embrace risk and change (Khassenova, 2018).

It is important to acknowledge understanding the systemic dynamics in which Ent_Act occurs to guide future policy-making processes to harbor student entrepreneurship (Alves et al., 2019). The transition to entrepreneurial universities also reinforces the need to conceive entrepreneurship education programs, establish effective university-led business incubators, and build a TH collaboration (Allahar & Sookram, 2019a). The authors also emphasize a strong collaboration among key stakeholders to achieve a successful Ent_Eco based on a quadruple helix system – university-enterprise-government-civil society collaboration – requiring Ent_Eco sustainability where all stakeholders need to collaborate and simultaneously need to contribute.

Table 2.7 Top 5 Most cited authors of Cluster 4.

Author(s) Citations	Article	Objective	Methodology	Main Findings
Rasmussen & Sørheim (2006) 238	Action-based entrepreneurship education	Explore the entrepreneurship education, which should evolve from a traditional approach, focused on teaching individuals, to a more action-oriented, emphasizing learning by doing.	Qualitative	Entrepreneurship education should focus on learning-by-doing activities in a group setting and a network context. The education should prepare entrepreneurs for the establishment of new ventures and university research commercialization.
Meyer, Siniläinen, & Utecht (2003) 58	Towards hybrid triple helix indicators: A study of university-related patents and a survey of academic inventors	Develop a simplified model of the innovation process indicators to benchmark their relevance to the TH environment.	Mixed	The majority of patented academic inventions, normally publicly funded, originated from scientific research used in large firms more than in start-up companies founded by academic entrepreneurs.
Meyer (2006) 36	Knowledge integrators or weak links? Inventor-authors: An exploratory comparison of patenting researchers with their non-inventing peers in nano-science and technology	Examine whether researchers productivity, exploring interdependencies between publication and patenting performance of authors and. Also approach the collaborative activity of inventor-authors and the relevance of their position networks of scientific communication.	Qualitative	In the science and technology area, it is possible to conciliate publication and patenting activity. Patenting scientists appear to outperform their solely publishing, non-inventing peers in terms of publication counts and citation frequency, playing a prominent role within networks of scientific communication.
Alves et al. (2019) 5	Determinants of student entrepreneurship. An assessment on higher education institutions in Brazil	Analyse the impact of individual traits and systemic conditions on Ent_Act, potential entrepreneurs, high-impact entrepreneurship, serial entrepreneurship, and innovation-driven entrepreneurship.	Quantitative	The results suggest that student entrepreneurship seems to be a random phenomenon in Brazil.
Guerrero et al. (2017) 4	Higher Education Entrepreneurial Ecosystems: Exploring the Role of Business Incubators in an Emerging Economy	Explore the role of an Ent_Uni business incubators within the entrepreneurial process.	Quantitative	The results show a positive impact of Ent_Uni business incubators on students' start-up.

Universities are the main pillars of Ent_Eco, generating an adequate environment to support the exploration and exploitation of Ent_Act and create their Ent_Eco, in which business incubators play a crucial role (Guerrero et al., 2017). Marques et al. (2019) argue that universities pursue an entrepreneurial mission expected from today's educational institutions within the same general approach. There is now a recognition that there is no adverse relationship between publication and patenting activity, and it is possible to be entrepreneurial without compromising teaching and research missions (Leydesdorff & Meyer, 2006).

It is essential to develop a holistic approach to the institutional factors of organizations (e.g., missions, incentives, and role models, technology transfer offices, norms, rules, structures, processes, university organizational characteristics, and cultural traits) to overcome the obstacles to university spin-off creation (Calderón-Hernández et al., 2020). In the particular case of universities in emerging countries, the challenges are related to developing structural mechanisms to facilitate the implementation of academic entrepreneurship. In this case, change the academic community's idea of spin-offs based on their perceived high-value for emerging contexts, the lack of specific incentives for spin-off creation, and cultural characteristic (e.g. social perceptions of corruption) (Calderón-Hernández, Jiménez-Zapata, and Serna-Gomez, 2020).

Shankar and Clausen (2020) also stress the relevance of accelerators as a fast-growing form of entrepreneurship support. Despite being considered the next-generation incubator model, the accelerator concept literature remains descriptive and disjointed (Shankar & Clausen, 2020). The authors' findings - distinguish their offerings based on ventures with the product-market fit, offering time-compressed scaling services and testing the ventures' ability to scale rapidly – stressing the enormous potential of accelerators as a support component of their entrepreneurial ecosystems.

Emphasizing the importance that students are more active than academic researchers in creating start-ups, Matt and Schaeffer (2018) affirm that universities should explore incrementing the entrepreneurial ecosystem integrating students' entrepreneurship activities technology transfer policies.

Considering it has active contributors to regional economic and social development, universities are asked to promote entrepreneurship with a clear emphasis on entrepreneurs' education (Rasmussen & Sørheim, 2006). Also focusing on the Ent_Eco perspective, and based on a case study of Massachusetts Institute of Technology, Ribeiro et al. (2018) highlight the importance of educational practices that go beyond the classical model of classrooms - student-led activities, mentorship

programs, competitions, project-based courses, experience-based activities, and active-based activities - and the need to see entrepreneurship education through the lens of ecosystems.

The Ent_Eco concept is now focused on creating an environment for entrepreneurship within its system, setting the emphasis on Ent_Uni (Sambo, 2018). As detailed by Markuerkiaga et al. (2018), there are universities in different stages within the Ent_Uni path – (1) emerging entrepreneurial universities; (2) en route entrepreneurial universities; and (3) advanced entrepreneurial universities -, and they could improve and move from one stage to the upper one.

Cluster 5: University Entrepreneurial Mindset

Twenty-two studies contribute to understanding Cluster 5 and are responsible for 141 citations. Cluster 5 represents a literature path that emphasizes the multiple actors, factors, and mechanisms that the Ent_Uni has to reconcile to achieve an entrepreneurial mindset engagement involving all entrepreneurial stakeholders. The five most-cited articles of Cluster 5 are presented in Table 2.8.

There is a complexity in academic initiatives to promote higher Ent_Act levels, with a clear need to assess faculty engagement with Ent_Act (de Moraes et al., 2020).

Focusing on entrepreneurship education, particularly science and technology entrepreneurship education, Duval-Couetil et al. (2020) propose a model that stresses the need for a more active and informed role of academic researchers in the commercialization process of their discovery. The model has four significant priorities - (1) technology readiness and timing, (2) intellectual property pathway decisions, (3) engagement with the entrepreneurial ecosystem, and (4) personal career choices – and enable academics to pursue technology entrepreneurship and demonstrate the contributions of academic institutions to the community and the economy.

Adopting another perspective, Wibowo et al. (2020) approached the university environmental factors and universities' personal factors on academic entrepreneurial intention. They identified the role of orientation, culture, attitude, and self-efficacy as the determinants of academic entrepreneurial intention. Soetanto and van Geenhuizen (2019) refers to the relevance of spatial and social proximity to universities, where the access to research orientation, entrepreneurial orientation, and market hostility

encourage spin-offs to maintain closeness, maintaining the accessibility to resources and as a technology transfer facilitator.

Table 2.8 Top 5 Most cited authors of Cluster 5.

Author(s) Citations	Article	Objective	Methodology	Main Findings
Loi & Di Guardo (2015) 25	The third mission of universities: An investigation of the espoused values.	Explore which are the organizational orientations that emerge by classifying the espoused values in the statutes of universities.	Qualitative	Universities need coherence – focusing on balancing public functions and third-mission activities; exploitation - based on patent disclosure; openness – being able to participate in external change and satisfy external needs; and finally, old school - focused on Ent_Act as a source of funding.
Gianiodis et al. (2016) 23	Entrepreneurial universities and overt opportunism.	Address the relevance of information symmetry on researchers' opportunistic behaviour.	Quantitative	Despite the significant contributions of the Ent_Uni to local economies, it is possible to identify hidden costs. There are substantial revenue losses when scientists privately sell or license their inventions to the market.
Miller et al. (2018) 22	Entrepreneurial academics and academic entrepreneurs: A systematic literature review.	Explore the changing roles of academics to identify key distinct traits between entrepreneurial academics and academic entrepreneurs.	Qualitative	The authors identify two types of academics - entrepreneurial academic and academic entrepreneur – arguing that the university needs both kinds of academics to contribute to the Ent_Uni's success.
Huang-Saad et al. (2017) 20	Closing the divide: accelerating technology commercialization by catalyzing the university entrepreneurial ecosystem with I-Corps™.	Describe the growth of NSF I-Corps™ Nodes, funded in 2012 and used for leveraged the program to catalyze the entrepreneurial ecosystem at the University of Michigan.	Qualitative	The authors concluded a set of eight valuable lessons to administrators and policymakers emphasizing the need for more active promotion of academic entrepreneurship and commercialization in universities.
Fogelberg & Lundqvist (2013) 14	Integration of academic and entrepreneurial roles: The case of nanotechnology research at Chalmers University of Technology.	Analyses how researchers in leading roles at a Swedish research university relate to integrating academic and entrepreneurial roles.	Qualitative	The authors argue that researchers can develop a positive approach towards entrepreneurship, leading to an innovation network and promoting commercialization.

As important drivers of technology, innovation, and economic development, Ent_Uni leaders have to balance competing for logic to perform towards Ent_Uni goals and achieve the desired outcomes of their Ent_Act (Tavella & Bogers, 2020). The entrepreneurial culture concept is expected to integrate academic and entrepreneurial roles that enable a positive approach in research entrepreneurship towards creating an

innovation network to promote technology commercialization (Fogelberg & Lundqvist, 2013).

Beyond the scope of factors that impact entrepreneurial performance, the article published by Gianiodis et al. (2019) approaches United States universities and government data to analyse the influence of consensus and stability on entrepreneurial and commercial performance. The authors argue an association of political harmony and serenity with higher licensing revenues. On the other hand, political stability is negatively associated with new venture creation. According to this study results, it is possible to link entrepreneurship policies and regional political processes with repercussions on university commercial outcomes.

It is possible to identify the impact of aspects related to academics' human, physical and organizational capital resources and ownership and management structure – public or non-public university - in the engagement in Ent_Act (e.g., commercialization of research results through patents, consulting, sponsored research, licensing/assignment of intellectual property and spin-off creation with industry, government, and civil society) (Meusburger & Antonites, 2016).

According to Davey and Galan-Muros (2020), academic entrepreneurship is seen as a pathway for universities to create value from their knowledge. However, their results stress the existence of a narrow view of academic entrepreneurship, which usually focuses only on spin-offs creation and research and development (R&D) commercialization – despite the findings, less than 1% of academics undertake spin-offs creation or R&D commercialization exclusively. Considering that the majority also engage in other Ent_Act, a broader view of academic entrepreneurship is recommended, creating the mechanisms to enable academics to capitalize on their Ent_Act results (Davey & Galan-Muros, 2020). Sharing the perspective of using Ent_Act as a funding source, Loi and Di Guardo (2015) questioned if all universities conceive the third mission within the same basis. The authors undertake a content analysis of the espoused values embedded within the statutes of 75 Italian universities to unveil four orientation patterns in third mission conceiving. The authors highlight the (1) need for coherence, focused on balancing public functions and third-mission activities; (2) exploitation, focused on patent disclosure; (3) openness, readiness to participate in external change and to satisfy external needs and (4) old school, focused on Ent_Act as a source of funding. As the work of Gianiodis et al. (2016) refers, the gains of Ent_Uni activities may leverage an opportunistic behaviour in faculty

scientists, which generally persist due to substantial information symmetry and where principals appear to be conniving despite the authority to apply sanctions.

Adopting another perspective, Ishizaka et al. (2020) characterizes universities based on the diversity and intensity of their knowledge transfer activities, identifying four distinct groups - ambidextrous, broad, focused, and indifferent. The authors also apply the Preference Ranking Organization Method for the Enrichment of Evaluations – PROMETHEE - to rank 162 United Kingdom universities based on their knowledge transfer activities portfolio. Intending to identify a broad set of Ent_Act and new university entrepreneurial models, Ricci et al. (2019) were able to characterize five Ent_Act - (1) research commercialization, (2) entrepreneurship education for students, (3) support for technology development, new venture creation, and growth, (4) academic engagement, and (5) creation of an entrepreneurial climate). The authors identify three main Ent_Uni models – (1) engage model focused on local economic development, (2) formal model focused on the systemic exploitation of research results, and (3) comprehensive model focused on local economic development and a university's financial advantage.

The article published by Crow et al. (2020) emphasizes the necessary contextualization of individual behaviour where university context has implications on actors' values and activities within that university and has repercussions on the performed EA Ent_Act. The authors present an emergent concept – academic enterprise – inherently entrepreneurial, relying on faculty and student entrepreneurship to conduct social and economic transformations. Sá et al. (2018) affirm that Portuguese academics have embraced Ent_Act and present a positive attitude towards applying research to real problems within the same general approach. However, the authors argue several significant differences in their attitudes, perceptions, and behaviours towards research activities, influenced by being involved or not involved in technology transfer processes in the previous academic year.

The University-Business Cooperation faces several challenges imposed by knowledge management (Ahmad et al., 2018). The academic environment shapes Ent_Uni performance (Fischer et al., 2019) by the existence of innovation centers (Wolf, 2017), the use of informal versus formal networks to develop their ventures (Padilla-Meléndez et al., 2020) by the ability of an academic to transfer knowledge to the industry effectively is key to universities achieving their entrepreneurial mission and ambition. Miller et al. (2018) categorize two types of academics - entrepreneurial academic and academic entrepreneur – arguing that we need both to achieve Ent_Uni success. It is

essential to involve faculty researchers to be their business development experts, empowering academic innovators with a better understanding of opportunity identification and the commercialization process; however, not all faculty want to be entrepreneurs due to the difficulty to balance their roles within the university (Huang-Saad et al., 2017).

Emphasizing academic entrepreneurship as a complex, multifaceted and fragmented concept, Skute (2019) presents a bibliometric analysis indicating four interconnected literature clusters that can enhance entrepreneurial processes and contribute to policies stimulating academic entrepreneurship.

Cluster 6: Entrepreneurial Orientation and Knowledge Capitalization

Ten studies contribute to understanding Cluster 6, a literature path that emphasizes the multiple aspects that an Ent_Uni has to embrace to promote a dynamic between knowledge and finance, shaped by TH, creating the capacity to recognize opportunities and enable a successful knowledge capitalization. Table 2.9 presents the five articles encompassed in Cluster 6, which are responsible for 797 citations.

In this cluster, we have to emphasize the article published by Etzkowitz (2003), representing the most cited article in our research results – 740 citations. This article approaches the transition from a research university to the Ent_Uni, where it is possible to identify a strategic orientation based on formulating academic goals and consolidating their knowledge production into economic and social utility. Etzkowitz (2003) approaches academic entrepreneurship based on the endogeneity and exogeneity - developed within an institutional sphere versus what is imported into it - of university-industry-government interactions. As stated by the author, these TH dynamics influence the relation between finance and knowledge, promoting an internal organization of research as “quasi-firms” – implying resource collection system and legitimations – and enabling the knowledge capitalization. In keeping with Etzkowitz (2003), Abereijo (2015) argue that entrepreneurial opportunities' exploitation originated in a previous collaboration with industry, cognitive integration, and prior entrepreneurial experience. Furthermore, the Ent_Uni should embrace conscious efforts to facilitate the commercialization of their knowledge, encourage the development of marketable products, and, at the same time, assume a leadership role to ensure successful commercialization (Abereijo, 2015).

Table 2.9 Top 5 Most cited authors of Cluster 6.

Author(s) Citations	Article	Objective	Methodology	Main Findings
Etzkowitz (2003) 740	Research groups as 'quasi-firms': The invention of the entrepreneurial university.	Analyse the transition from the research university to the Ent_Uni considering the TH implications for the relationship between finance and knowledge.	Qualitative	Academic entrepreneurship is both endogenous and exogenous, and we need to access what is developed within an institution versus what is imported into it. In a first approach, the scientific research organizations are seen as “quasi-firms”, considering their resources and legitimations. In a second approach, it is evaluated the way they capitalize knowledge. The academic development relies upon the development of cluster firms supported in public and private venture capital.
Lamine et al. (2018) 24	Technology business incubation mechanisms and sustainable regional development.	Explores several aspects of technology business incubators (TBI), the role they play in the spatial context, and their use as platforms and drivers of regional entrepreneurial ecosystems.	Qualitative	Presents the key themes of the emerging role of TBI in sustainable regional development, namely TBI biodiversity of ecosystems; accelerating startups in the Ent_Uni; TBI mechanisms challenged by green technology to sustain regional growth; and TBIs’ connecting role between entrepreneurship education, experiential knowledge, and regional development.
Abereijo (2015) 9	Transversing the “valley of death”: Understanding the determinants to commercialization of research outputs in Nigeria.	Approach the economic impact of scientific research and its potential contribution to economic growth to develop a model that integrates individual, organizational and institutional determinants of academic entrepreneurship, facilitating the ability to cross the “valley of death”.	Qualitative	The exploitation of entrepreneurial opportunities is driven by previous collaboration with industry, cognitive integration, and prior entrepreneurial experience. Moreover, the university institutional environment must encourage and facilitate the creation of university spin-offs.
Ferrandiz et al. (2018) 7	Promoting entrepreneurial intention through higher education in entrepreneurship and the participation of students in an entrepreneurship ecosystem	Explore the effects on the students' entrepreneurial intention caused by a higher education program for entrepreneurs integrated into an entrepreneurial ecosystem.	Qualitative	The higher education program positively influences students' entrepreneurial intention, especially in the medium term, considering that personal skills contribute to their entrepreneurial project's development.
Rialti et al. (2017) 7	Factors fostering students' spin-off firm formation: an empirical comparative study of universities from North and South Europe	Explore the role of entrepreneurial education on the internationalization process in transition economies.	Qualitative	In a transition economy context, such as those countries belonging to the former Yugoslavian republic, it is possible to consider internationalization as an advantage. In this scenario, entrepreneurs and their firms are able to overcome a limited internal market and local hostile conditions. Formal entrepreneurial education works as a facilitator of the internationalization process and affects the networking strategy, which seems as fundamental in internationalisation processes in transition economies.

According to Abdelkafi et al. (2018), universities have become increasingly entrepreneurial during the last several years and embrace Ent_Act, focusing on vocational education to generate funds independently. As detailed by Abdelkafi et al. (2018), it is possible to identify three evolutionary stages on Ent_Uni models - consulting services, combination consultancy-teaching and modularization, and self-reinforcement - where the modularity of the business model seems to play a vital role in Ent_Uni capability to change and scale up the business model over time. The authors also state that Ent_Act shapes the business models. Therefore Ent_Act should be developed according to an evolutionary Ent_Uni business model, and the university has to develop capabilities that enable the business model adaptability to generate additional revenue sources (Abdelkafi, Hilbig & Laudien, 2018).

Ent_Act promotion assumes a particular relevance, and universities have to assess the efficacy of innovation and entrepreneurship initiatives to be better prepared to build the perceptions of venture feasibility and desirability and consequently increase students' perceptions of opportunity (Bazan et al., 2019). Also focusing on the analysis of students' entrepreneurial intention, Ferrandiz et al. (2018) argue that educational programs for entrepreneurs positively influence medium-term students' entrepreneurial intention, and the working of personal skills in the program affects the development of the entrepreneurial project. The authors also emphasize the need for a methodical accompaniment performed by mentors with greater specialization. Educational programs expose students to entrepreneurial education, developing a workforce with an entrepreneurial mindset, and allow the opportunity to observe how students' different entrepreneurship-related skills and characteristics differ in a particular institution or Ent_Eco in which students are situated (Shekhar & Bodnar, 2020).

Beyond the scope of entrepreneurial education, Huezo-Ponce *et al.* (2021) analyse the implications of university students' emotional competencies to improve entrepreneurship programs that promote entrepreneurship and self-employment. The authors defend that university students' emotional competency is not associated with creating their own business; however, the emotional competencies will influence entrepreneurship as a career option. Also focusing on creating entrepreneurial capacity grounded on innovation and entrepreneurship education, Sánchez-López & Pedraza (2020) refer that universities deal with financial distress. The authors state that it is possible to stimulate innovation and entrepreneurship when the resources are scarce by developing an innovation and entrepreneurship mindset - increasing innovation

and entrepreneurship awareness, creating spaces for interdisciplinary interaction, fostering collaboration between faculty and students across disciplines.

The article published by Rialti et al. (2017) presents a particular use of networks and entrepreneurial education as facilitators, being instrumental in internationalization processes – allowing a better approach of the process and enhancing the ability for networking - offering to entrepreneurs and their firms a valuable advantage to overcome the limitations of their local environment.

From a holistic support perspective, we cannot fail to mention the importance of incubators, and we need to understand these initiatives' economic repercussions. Technology Business Incubators (TBIs) are increasingly being used as platforms and drivers of regional entrepreneurial ecosystems (Lamine et al., 2018). Their results stress the enormous potential of TBIs as bridging mechanisms and drivers of entrepreneurship, connecting entrepreneurship education, experiential knowledge, and regional development.

2.5 Discussion

The analysed articles enabled the characterization of the existing literature that approaches Ent_Uni and Ent_Eco simultaneously. The Bibliographic Coupling of document references allowed us to identify six clusters resulting - (1) University Entrepreneurial Anatomy and Ent_Eco, (2) Universities Third Mission Performance and Impacts, (3) Balance Ent_Uni Different Roles, (4) Entrepreneurial Education and Ent_Uni Support, (5) University Entrepreneurial Mindset, and (6) Entrepreneurial Orientation and Knowledge Capitalization.

The cluster identification and the analysis of the themes they approach unveils six distinct but complementary literature paths on Ent_Uni and Ent_Eco topics. The path identified as Cluster 1 - University Entrepreneurial Anatomy and Ent_Eco explore the building of entrepreneurial anatomy and the articulation of Ent_Uni and Ent_Eco concepts that create the ability to respond to the multiple challenges inherent to Ent_Act. The concept of 'Mode 3' universities could represent a new and advanced type of Ent_Uni, better prepared to address the current and future challenges; however, their development relies on a solid linkage and contextualization with Ent_Eco. The story of a successful Ent_Eco should be based on the collaboration between universities and their local stakeholders and an efficient TH collaboration and cooperation (Brem & Radziwon, 2017). The TH model should be extended to consider

a 'fourth helix' - civil society – and a “quintuple helix” that considers the environmental dimension – sustainability (Carayannis et al., 2018).

In Cluster 2 - Universities Third Mission Performance and Impacts – it is undeniable the pressure on universities to deliver on their third mission (Abreu et al., 2016), an engagement dependent on the competitive level of the region where they occur and on the knowledge and partnership levels (Zhang et al., 2016). To perform their third mission, universities have to master the ability to respond to the Ent_Act challenges approached in Cluster 1. It is essential to detain a broader sense of knowledge exchange involving research commercialization, Uni_Ind partnerships, and all related enterprise engagements (Abreu et al., 2016). Universities, particularly the Ent_Uni innovation and Ent_Act, influence national innovation systems development and performance (Guerrero et al., 2016). It requires a broader range of Ent_Act oriented to "problem-solving (Abreu et al., 2016) with impact on graduates' employability options, on graduates' risk aversion (Guerrero et al., 2016), and graduates' entrepreneurship (Guerrero et al., 2018). Ent_Act should be performed at all university levels, creating an entrepreneurial potential and a mindset that drives innovation, leading to regional socioeconomic development, bridging regional needs and their solution (Urbano & Guerrero, 2013). The third mission should be performed in the integration and collaboration of the multiple actors of the Ent_Eco (Urbano & Guerrero, 2013) where Ent_Uni are engines of economic, leading the dynamic of formal and informal factors to potentiate knowledge generation and transferring (Guerrero, Urbano, and Fayolle, 2016). The diffusion of economically helpful knowledge involves challenges that academics face when embracing an entrepreneurial path due to the lack of experience (Guerrero & Urbano, 2014).

Cluster 3 - Balance Ent_Uni Different Roles – approaches Ent_Uni as economic actors able to correctly balance the roles of knowledge creation, knowledge dissemination, and knowledge exploitation (Kutinlahti, 2005). Throughout the performance of Ent_Act, universities are leveraging socioeconomic development (Markuerkiaga et al., 2016). The Ent_Act should be integrated with entrepreneurship education and pursue an entrepreneurship strategy based on local needs and context (Markuerkiaga et al., 2017). Ent_Uni could contribute substantially to economic development into fully entrepreneurial organizations (Mathieu et al., 2008). The complexity of managing multiple roles denotes several role conflicts (Ahmad, Halim & Ramayah, 2016; Salamzadeh, Kesim & Salamzadeh, 2016), unveiling the need for a proper balancing built upon effective TH links (Genç et al., 2020). Ent_Uni should integrate Ent_Act and the other university roles in an Ent_Eco context (Ruiz et al., 2020). The

entrepreneurial transformation is related to constructing an entrepreneurial mindset, leadership, and strategic vision (Yordanova & Filipe, 2019). The Balance of Ent_Uni different roles affect University-Business Cooperation (Ranga, Perälampi & Kansikas, 2016) and the effectiveness of Technology Transfer Offices (Carayannis et al., 2015; Pazos et al., 2012; Phan & Siegel, 2006; Secundo et al., 2019).

Cluster 4 – Entrepreneurial Education and Ent_Uni Support – approaches the transition towards the Ent_Uni, reinforcing the need for a systemic dynamic of entrepreneurship education programs, the establishment of university-led incubators, and an effective TH collaboration (Allahar & Sookram, 2019a). The Ent_Eco collaboration should evolve to a quadruple helix system attaining sustainability based on the need of collaborating e contribute (Allahar & Sookram, 2019a). As the main pillar of Ent_Eco, the Ent_Uni should develop an environment to support the exploration and exploitation of Ent_Act in which incubators no such citation, start-ups (Matt & Schaeffer, 2018), university spin-offs (Calderón-Hernández, Jiménez-Zapata & Serna-Gomez, 2020), and accelerators play a crucial role (Shankar & Clausen, 2020). The engagement in these entrepreneurial paths needs an entrepreneurial vision of highly qualified managers and teachers (Khassenova, 2018). In this scenario, it is possible to generate the will to embrace risk and change (Khassenova, 2018), supported by entrepreneurs' education (Rasmussen & Sørheim, 2006) with renewed educational practices oriented to an ecosystem performance (Ribeiro et al., 2018).

In Cluster 5 – University Entrepreneurial Mindset – the focus is on evaluating faculty engagement with Ent_Act (de Moraes et al., 2020). The Ent_Uni should integrate active and informed academic researchers to participate in the research commercialization process (Duval-Couetil et al., 2020). The Ent_Uni is expected to develop an entrepreneurial culture that creates a synergic integration of academic and entrepreneurial facets (Fogelberg & Lundqvist, 2013) without the idea of competitive logic (Tavella & Bogers, 2020). Entrepreneurial performance is impacted by political stability (Gianiodis et al., 2019), academics' human, physical and organizational capital resources and ownership and management structure (Meusburger & Antonites, 2016), and actors' values and activities within the university (Crow et al., 2020). Universities perform Ent_Act in diverse forms and intensity levels (Ishizaka et al., 2020), but always to capitalize on their Ent_Act results (Davey & Galan-Muros, 2020) source of funding (Loi & Di Guardo, 2015). The attitudes, perceptions, and behaviours towards research activities are positively influenced when is applied to real problems (Sá, Dias, and Sá, 2018). In this sense, the entrepreneurial mindset will affect knowledge management and impose challenges to University-Business Cooperation (Ahmad et al.,

2018). The ability of academics to transfer knowledge affects university entrepreneurial performance (Miller et al., 2018). It is crucial to empower academic innovators allowing a balanced role performance within the university (Huang-Saad et al., 2017). Cluster 6 – Entrepreneurial Orientation and Knowledge Capitalization – approaches Ent_Uni as “quasi-firms” that perform to capitalize their knowledge production based on their economic and social utility (Etzkowitz, 2003). The achievement of an Ent_Uni status is an evolutionary process that involves acknowledging the need to integrate marketable products with the leadership of the commercialization process (Abereijo, 2015). In an interrelation with Cluster 4, and according to Abdelkafi et al. (2018), universities focus on vocational education, embracing Ent_Act to create financial independence. The entrepreneurial orientation is built upon the efficacy of innovation and entrepreneurship initiatives, affecting university and students’ perceptions of opportunity (Bazan et al., 2019).

2.6 Conclusions, Contributions, Limitations, and Future Research Agenda

Performing a generation and exploiting knowledge as entrepreneurial opportunities, the Ent_Uni is now seen as catalysts of regional socio-economic development. The relevance of the Ent_Uni and Ent_Eco topics motivates multiple literature approaches. Despite being widely explored concepts, the Ent_Uni and Ent_Eco are still fragmented and disorganized. In the sense of contributing to their theorization, this study aimed to narrow these gaps pointed out in the literature towards the systematization of the most relevant literature, trends, and dynamics of Ent_Uni on Ent_Eco.

This study conducted an SLR that approaches Ent_Uni and Ent_Eco simultaneously, and it attempts to answer two research questions - Which are the most relevant trends in the literature on Ent_Uni and Ent_Eco? And how Ent_Uni’ dynamics are performed within an Ent_Eco perspective? – The bibliographic analysis unveils six clusters denoting the existence of different thematic areas, and in this sense, it is possible to identify relationships between the thematic areas.

With impacts on the performance and results of the other identified clusters, Cluster 1 is an emerging theme, with an eventual transition to a basic or transversal theme. Entrepreneurial anatomy is necessary to allow the Ent_Uni to perform Ent_Act – an

interconnection with the thematic approach in Cluster 2. Cluster 2 is a motor theme of the literature on Ent_Uni and Ent_Eco topics. Approaches universities' third mission performance and the socio-economic impacts, motivated by the increasing pressure on universities to deliver on their third mission, in response to the emerging challenges inherent to Ent_Act. Universities have to master Ent_Act creating an entrepreneurial potential, building an entrepreneurial mindset – explored in Cluster 5 – leading to innovation and socioeconomic development, bridging regional needs and their solution. In Cluster 1, it is also approached the need for a contextualized linkage with Ent_Eco. This collaboration network established between universities and their local stakeholders should also integrate a TH collaboration and cooperation with an extension to a 'fourth helix' that involves the civil society and a "quintuple helix" that considers a sustainability dimension. To perform Ent_Act, universities have to balance their different roles – teaching, research, and entrepreneurship – approached in Cluster 3. The legitimation of the performed roles will make possible the advantage of knowledge creation, knowledge dissemination, and knowledge exploitation. The Ent_Uni should manage the complexity and conflict of multiple roles strengthened by the presence of effective TH links, strategically structured thinking in a Ent_Eco context. As approached in Cluster 4, this scenario is likely if the Ent_Uni creates a dynamic fusion between entrepreneurship education, university support, and an effective TH collaboration. The entrepreneurial education, based on Ent_Eco contextualization, will leverage the exploration and exploitation of Ent_Act, where incubators, start-ups, spin-offs, and accelerators play an essential role. In Cluster 6, and as a guarantee of independence, universities must consider their entrepreneurial anatomy within the Ent_Eco and perform Ent_Act to capitalize on their knowledge and finance their activity.

To contribute to a better understanding of the Ent_Uni and Ent_Eco topics, our study also proposes possible paths for future research. Based on the established relations between clusters, we argue that each cluster raises its challenges. However, to contribute to less fragmented and disorganized literature, we consider important to explore the articulation of research paths and highlight the confluence of interests between the agendas. Considering the six research paths identified in our SLR, we believe it would be interesting to develop more studies to assess a scale that allows the identification of the Ent_Uni entrepreneurial anatomy that confers the ability to perform Ent_Act, maximizing its impacts better. This will make it possible to measure entrepreneurship and create a ranking of the Ent_Uni.

The ongoing COVID-19 pandemic has had an overwhelming impact on labour markets worldwide (Fernandes, Veiga, et al., 2022). In this scenario, and according to Guerrero, Heaton and Urbano (2021), it is essential to promote the discussion of the relevance of universities' entrepreneurial strategies in the digital era. The pandemic has also intensified collaboration among many agents (N-Helix) powered by digital social entrepreneurship that can generate global social impacts (Ibáñez et al., 2022). Moreover, considering the Covid-19 pandemic and its impacts on educational delivery, it would also be important to approach how universities adapt to deliver teaching, research, and Ent_Act – considering the perspective of different stakeholders. Such an attempt will shed light on the essential dimensions of Ent_Act where universities should concentrate their efforts. The pandemic is affecting the scientific workforce, with notorious impacts on the commercialization process (Siegel & Guerrero, 2021). It is crucial to explore ways to better manage the process of research commercialization in a period of such turbulence as we are currently experiencing. It would also be interesting to assess how the Ent_Uni could bridge its university and economic demands without compromising its core functions as a learning institution. It would also be interesting to explore entrepreneurial education and its impact and how they engage with knowledge transfer processes (e.g. technology transfer and commercialization). The Ent_Uni should be structured from an Ent_Eco perspective; it would also be interesting to analyse entrepreneurship education (e.g. development of entrepreneurship education curricula according to the area of knowledge). It would also be interesting to assess the relevance of entrepreneurial education to an entrepreneurial mindset – exploring their relevance on skills, expertise, capacity, and competencies development – and the impact on third mission development and Ent_Eco growth. Moreover, it would also be interesting to assess the impact of support activities on the Ent_Uni entrepreneurial activity.

This study also presents contributions to the literature, providing a better understanding of the Ent_Uni and Ent_Eco concepts dynamic throughout the systematization of existing literature, narrowing the fragmentation. The systematization and interrelation of the research areas represent a relevant practical contribution, allowing that Ent_Uni and Ent_Eco stakeholders to improve the future decision process, very important when immersed in a knowledge economy with extremely complex and competitive environments. Our findings presented the relations between Ent_Uni and Ent_Eco as a mutualistic dynamic process with bidirectional flows of resources and capabilities (Schaeffer et al., 2021). This process is shaped by the academic environment, reinforcing the importance and influence of the

development of the entrepreneurial process and context on entrepreneurial performance (Guerrero, Liñán, et al., 2021).

Despite the contributions to the academic discussion on Ent_Uni and Ent_Eco topics, this study also presents limitations. We acknowledge that an SLR could be reductionist. As defined in our research protocol, we only consider peer-reviewed articles to ensure quality, excluding from our research book chapters, conference papers, book reviews, proceeding papers, editorial material, reviews, and books. We tried to expand the search scope by selecting keywords that we consider adequate for the simultaneous analysis of the Ent_Uni and Ent_Eco topics. Research that seeks a combined analysis of both themes may exclude relevant publications that address Ent_Uni and Ent_Eco issues in isolation.

Chapter 3. Unlocking the Connection between Education, Entrepreneurial Mindset, and Social Values in Entrepreneurial Activity Development

Abstract

The Entrepreneurial University (Ent_Uni) constitutes a phenomenon that highlights the prominent roles played by academic organizations as aggregators of capabilities, enabling the establishing of bridges between innovation and Entrepreneurial Ecosystems (Ent_Eco). This research therefore sets out to analyse the relationship between the Total Early Stage Entrepreneurial Activities of graduate individuals (TEAed4) and their entrepreneurial attitudes and social values towards entrepreneurship. This applies data sourced from the Global Entrepreneurship Monitor (GEM) report on innovation-driven countries. The main research findings stem from the regression models (Study 1) and fsQCA analysis (Study 2) returning evidence that the likelihood of adult graduates setting up firms or owning young companies rises whenever such individuals deem they hold the knowledge/skills required to start a business. The results also stress the importance of devoting high levels of media attention to entrepreneurship and fostering entrepreneurial cultures capable of fostering economic growth and prosperity. This research makes substantial theoretical contributions to the literature. Firstly, the findings reinforce the applicability and suitability of fsQCA analysis of GEM data. Secondly, this study strengthens the credibility of the Institutional Theory and Theory of Planned Behaviour (TPB) theoretical frameworks, correspondingly lending support to the importance of institutional or organizational factors as determinants of entrepreneurship and the need to focus on the linkage between entrepreneurial attitudes, entrepreneurial intentions, and entrepreneurial behaviours.

Keywords

Entrepreneurship, Entrepreneurial University, Educational level, Entrepreneurial Attitudes, Social Values, Total Early Stage Entrepreneurial Activity, Graduate, GEM, fsQCA.

3.1 Introduction

When placing the university as a key factor of economic change, it becomes possible to establish a parallel between the profound shift in the university model and the four industrial revolutions (Kochetkov et al., 2017). In this context, the university emerges as one of the main pillars of an ecosystem (Guerrero et al., 2017), responding to emerging socio-economic challenges (Kirby, 2006), contributing to economic development, innovation, and the competitiveness of companies, regions, and countries (Fernandes and Ferreira 2013; Huggins, Johnston, and Stride 2012). In this sense, universities act as innovation intermediaries in knowledge transfer processes of increasing complexity in keeping with the diversity of participating partners (e.g., companies, government, and societal actors (Feser, 2022)).

Furthermore, integrating into entrepreneurial ecosystems (Ent_Eco) may influence legitimization processes in which assessing the factors ensuring the optimization of entrepreneurial inputs is an stage (Bouncken & Kraus, 2022). This positioning is based on the combination of the university's traditional missions, based on teaching (first mission), research (second mission), and the emergence of an entrepreneurial academic spirit (Etzkowitz, 2003a) that emphasises entrepreneurship (third mission) and the corresponding emergence of the entrepreneurial university (Rubens et al., 2017). The entrepreneurial university therefore emerges as a catalyst for regional economic and social development (Urbano & Guerrero, 2013). In entrepreneurial economies that extend beyond the role of small businesses and their owners, we also have to consider an all-embracing socio-economic mindset that equates to the opportunities existing and does not only focus on the availability of resources (Guerrero, Cunningham, & Urbano 2015).

The Triple Helix concept usually serves to aggregate the Government-University-Industry cooperation perceived as crucial to economic progress with universities representing the enablers of qualified and specialized labour (Chen, Wu, & Yang 2016) through an appropriate alignment of university research and education and training priorities with the goals of the organizations active in the region (Hewitt-Dundas, 2012). An entrepreneurial university thus nurtures a range of employability alternatives in their students, such as being self-employed, academic entrepreneurs or intrapreneurs (Guerrero, Urbano & Gajón 2020).

It is important to bear in mind that new business creation is essential to generating employment, with education and training classing as core factors for fostering entrepreneurship, endowing graduate entrepreneurs with the rational capacity to develop initiatives with greater capacity for survival and growth (Coduras et al., 2008). The dynamics of entrepreneurial universities reflect the preponderant role that academic organizations play in shaping the aggregate capabilities (Audretsch et al., 2019) prevailing and building bridges between sources of innovation and Ent_Eco (Autio et al., 2014a).

Recognizing the paramount importance of universities as facilitators of contemporary knowledge and as the educators of potential entrepreneurs for society, exploring the interactions between university and entrepreneurship holds particular relevance (Coduras et al., 2008). Thus, considering how the interactions between university experiences and entrepreneurial activities open up vast and exciting research possibilities, there is clear interest in contributing by exploring the complexity of entrepreneurship based on Global Entrepreneurship Monitor (GEM) data (Coduras et al., 2016).

Through integrating the concepts described above, our research addresses the relevance of entrepreneurial universities in empowering potential entrepreneurs and reflects the need to further explore the complexity of entrepreneurship. The academic relevance of our research arises from the lack of studies establishing models that interrelate university support, attitudes, values and entrepreneurial activities – and, from the economic policy point of view - examining the relevance of promoting entrepreneurship within and from university contexts constitutes an essential facet.

In keeping with the literature and inspired by the gaps therein identified, our research analyses the relationship between the Total Early Stage Entrepreneurial Activity (TEA) of graduates and the entrepreneurial attitudes and social values towards entrepreneurial activities. As previous GEM research has shown, taking into account the different types of economy is essential – factor-driven, efficiency-driven, and innovation-driven - based on the World Economic Forum's classification (Coduras et al., 2016). In accordance with how relationships between entrepreneurship and economic development differ over the different phases of economic development, and also considering that innovation-driven countries rank highest for competitiveness according to the Global Competitiveness Report (Bosma et al., 2008), our study focused on innovation-driven countries in order to integrate the importance of the interactions of individuals with the environment within the scope of developing

entrepreneurial activities. Our research deploys a combination of the quantitative approach - regression methodology (Study 1) with qualitative analysis – the fsQCA method (Study 2), thus enabling more detailed answers that explain the levels of entrepreneurial activities undertaken by individuals holding university qualifications with a more extensive explanation thereby feasible than those returned by the results of the regression models. The application of fsQCA serves to explore and exploit a new research framework and enrich our knowledge about the complexity of entrepreneurship by establishing different combinations of conditions that reflect the entrepreneurial attitudes and values prevailing in the countries studied (Coduras et al., 2016).

This study makes three fundamental contributions. Firstly, this contributes to recent work on the relationship between university support for entrepreneurship and the subsequent development of entrepreneurial activities, exploring the role of entrepreneurial education on successful entrepreneurial behaviours. The articulation of quantitative and qualitative methodologies also opens a range of promising possibilities. Should we be able to quantitatively assess the factors determining entrepreneurial activities, we will be able to qualitatively ascertain the eventual combinations between the factors under analysis and characterize their respective contexts. Secondly, this study strengthens the credibility of the Institutional Theory and Theory of Planned Behaviour theoretical frameworks in lending support to the importance of institutional and organizational factors as determinants of entrepreneurship (Abreu et al., 2016) coupled with the linkage between entrepreneurial attitudes, entrepreneurial intentions and entrepreneurial behaviours (Ajzen, 1991). In this sense, these theories are applicable to analysing the specific contributions of universities to the development of entrepreneurial activities by their graduates alongside ascertain the relevance of universities and account for the entrepreneurial performance prevailing in particular contexts. Thirdly, this reinforces the applicability and suitability of fsQCA analysis to GEM data. In contrast with previous approaches that focus on linear regression models, this study deploys fsQCA models to establish different combinations of the multiple and interrelated entrepreneurial conditions to generate the scope for defining the most effective and sustainable public policies in accordance with the characteristics of each country.

Following this introduction, this study has the following structure: the next section set out our review of the literature on the theme under analysis. We subsequently present the research data and methodology followed by the presentation of the results of Study 1 and Study 2. Finally, we discuss the findings and the conclusions.

3.2 Theoretical Background

The theoretical framework applied in this research derives both from institutional theory - grounded on institutional or organizational cultural, social, political and economic factors as the determinants of entrepreneurship (Abreu et al., 2016) – and from the theory of planned behaviour – which draws attention to the interlinkage between entrepreneurial attitudes, entrepreneurial intentions and entrepreneurial behaviours on the grounds that becoming an entrepreneur represents consciously planned behaviour (Ajzen, 1991).

Drawing attention to the institutional or contextual factors - cultural, social, political, and economic - as the determinants of entrepreneurship, institutional theory stands out as one of the most appropriate theories for analysing the influence of environmental factors on entrepreneurship (Coduras et al., 2008). Organizations represent social and cultural systems that expect their members to engage in that deemed appropriate behaviour with institutional theory returning an understanding of innovation that always considers the influence of this institutional context (Hinings et al., 2018). In addition, we may conceive of change as an outcome of social, organizational and individual structures, activities and actions (Scott, 2014). The conceptual framework of institutional theory serves to approach the transition of universities from conservative institutions to leading entrepreneurial universities (Yoshioka-Kobayashi, 2019), in compliance with the third mission (Kitagawa et al., 2016) and the relationship between university support for entrepreneurship and the actual development of entrepreneurial activities (Coduras et al., 2008).

Initially presented by Ajzen (1991), the theory of planned behaviour posits that reasoning, control and planning underpin human social behaviour. Hence, this foresees certain consequences arising from given behaviours (Ajzen & Fishbein, 2000). Applied to predict many types of human behaviours (e.g., electoral choices, intentions to stop smoking, etcetera), the theory provides a meaningful framework for analysing the emergence of entrepreneurial behaviours (Fayolle et al., 2006). Accounting for actions in specific contexts (Ajzen, 1991), and taking into account how the effects of entrepreneurial education take many years to bear fruit, isolating the role of entrepreneurial education within the scope of its capacity to nurture successful entrepreneurial behaviours is essential to ensuring the theoretical support of planned behaviour theory (Fayolle et al., 2006). Furthermore, this educational exposure to entrepreneurship may or may not lead to later entrepreneurial activities. Despite the lack of general acceptance that entrepreneurial education generates some degree of

preparedness for entrepreneurs – as is the case in the education of future practitioners such as doctors, lawyers, and engineers – it is difficult not to notice the benefits of entrepreneurial practices (Hindle, 2007).

3.2.1 Entrepreneurial Ecosystems

The substantial transformations induced by digital technologies, the constantly changing demands of consumer as well as environmental uncertainties combine to create multiple challenges for companies that correspondingly need to display innovation to overcome the obstacles associated with disruptive business models (Stoiber et al., 2022). Establishing a social and economic environment for innovative and entrepreneurial endeavors requires the effective work of multiple and interconnected actors, including government entities, the private sector, society, universities and entrepreneurs themselves (Bouncken & Kraus, 2022). Within the networks establishing between the multiple stakeholders shaping their configuration, evolution and outcomes, the Ent_Eco emerges as a central topic on the agenda of researchers and political leaders (Fernandes & Ferreira, 2022).

Drawing on different perspectives and theories, the Ent_Eco has become a theme of great interest in the academic community with the literature containing multiple studies defining the concept (Isenberg, 2010, 2011; Stam, 2015) alongside studies bringing together a set of definitions enabling the joint analysis of multiple perspectives on the concept (De Brito & Leitão, 2021). Resulting from a biomimetic analogy, the Ent_Eco is best described as a "*set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory*" (Stam 2015, p.5). The Ent_Eco sets the systemic conditions for interactions that influence the identification and commercialization of entrepreneurial opportunities (Audretsch et al., 2017).

Centred on networks of entrepreneurs, leadership, finance, talent, knowledge, and support services (Stam, 2015), Ent_Eco should foster favourable environments for innovation-based undertakings (Spigel, 2017). In this scenario, innovation emerges out of the spatial concentration of principal and supporting companies that intentionally combine internal and external knowledge flows (De Brito & Leitão, 2021). Adopting another perspective, Muldoon et al. (2022) explore the extended and blurred boundaries of Ent_Eco, spanning the physical and cyber levels where technology has

dissolved locational barriers and connected the different actors to enable the existence of social relationships that guarantee access to greater resources.

The GEM 2021 / 2022 Global Report (GEM, 2022) describes and assesses Ent_Eco according to nine factor framework - entrepreneurial finance, government policy, government entrepreneurial programs, entrepreneurial education, research and development transfers, commercial and professional infrastructures, ease of entry, physical infrastructures, and social and cultural norms towards entrepreneurship. The GEM theoretical framework (figure 3.1), resulting from the successive findings of the GEM scientific community, constitutes a suitable approach to examining the intermediate relationships between social values and attitudes and entrepreneurial activities.

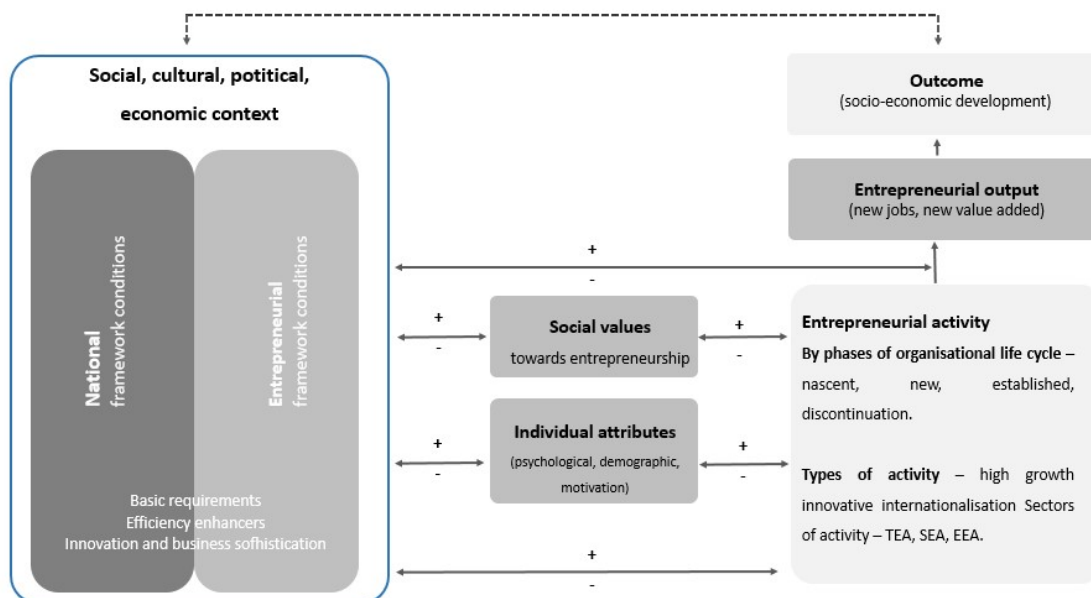


Figure 3.1 GEM Conceptual Framework (GEM, 2017).

The GEM evolution and transformation also take into consideration the different types of economy in keeping with the World Economic Forum's classification – factor-driven, efficiency-driven, and innovation-driven (Coduras et al., 2016) to reflect the importance of the interactions of individuals within this environment to developing entrepreneurial activities (Bosma et al., 2008).

3.2.2 Entrepreneurial Universities and Entrepreneurial Culture

As sources of knowledge, universities have to be based on an organizational culture that incorporates flexibility and is open to change, enabling the encouragement of

entrepreneurship through providing more proactive and engaged responses to solving problems and generally improving society (Ferreira et al., 2018). Perceived as catalysts of regional and national economic and social development (Abreu et al., 2016; Etzkowitz et al., 2000), entrepreneurial universities fuel their surrounding Ent_Eco (Audretsch & Belitski, 2022) and with entrepreneurial education representing one of foundational conditions (GEM, 2022).

It is important to bear in mind that the decisions leading to entrepreneurial activities are always based on individual motivations and deeper cognitive characteristics (Ferreira, Fernandes, & Kraus, 2019). Nevertheless, previous studies report a positive link between university-based entrepreneurship education and some entrepreneurial activities (Nabi et al., 2017). Their results stress the potential for exploring the impacts of other factors, specifically emotion-based and mindset related indicators with approaches to intention-to-behaviour transitions exploring the contradictory findings returned by analysis of the contextual effects (considering person, context, and educational—models as moderators). In seeking to combat the multiple barriers, it is essential to overcome the conditions preventing recognition and/or the pursuit of opportunities (Khanin et al., 2022). Furthermore, it is equally crucial to conceive of entrepreneurship as a predictive-adaptive process with the balance relying on intuition and planning judgment (Rapp, 2022).

As the work of Mukhtar *et al.* (2021) sets out, developing entrepreneurial mindsets might successfully accelerate the entrepreneurial intentions of university students. Additionally, entrepreneurship education and entrepreneurial culture display a robust correlation with the entrepreneurial mindsets of students (Mukhtar et al., 2021). An entrepreneurial society deploys institutions designed and implemented to facilitate entrepreneurial activities as a driving force bringing about economic growth and prosperity (Audretsch, 2014).

3.3 Data and Methods

This research applies the GEM 2017 Adult Population Survey (APS) Global National Data for Innovation-driven countries. The APS explores the role of individuals in entrepreneurial processes by focusing on business characteristics, the motivations of participants and entrepreneurial-related actions and attitudes. The 2017/18 GEM Global Report states that 54 economies around the world implemented the questionnaire. This generated information on entrepreneurial behaviour in five regions

- Europe, North America, Latin America, Caribbean, Africa, and Oceania - according to three economic development levels – Innovation-driven, Factor-driven, Efficiency-driven, merging 174,128 observations, randomly collected from the adult population aged between 18 and 64 years old. GEM APS makes available the TEA rate for measuring the prevailing entrepreneurial activities. The educational level allows for identifying the individuals with higher education degrees and enables analysis of the TEA of university graduates. We aim to investigate the relationship between the TEA of graduates (TEAed4) and variables exploring the entrepreneurial attitudes of these adults and the entrepreneurial social values prevailing towards entrepreneurial activities.

According to the GEM research community, there is general recognition that entrepreneurial attitudes and values return a positive effect on the TEA rate (Coduras et al., 2016). Thus, our study analyses the capability to identify opportunities, obtain the skills and knowledge to start up a business, know someone who started a business in the last two years, the absence of fear of failure and perceptions of entrepreneurship as a good career choice, and associating entrepreneurship high social status, attention, and recognition.

Our methodological approach is quantitative – the regression method – and qualitative – the fsQCA method. To this end, we now present the two studies undertaken within a complementary perspective.

In the quantitative approach (Study 1), we attempt to recognize whether the attitudes and values towards entrepreneurship relate to TEAed4 with these statistical analyses carried out by IBM SPSS Statistics - Version 26. We performed multilinear regression analysis where the dependent variable is TEAed4. Two distinct models define the independent variables, attitudes – Model 1 – and values – Model 2.

In the qualitative approach (Study 2), we explore whether the attitudes and values towards entrepreneurship relate to TEAed4 through Fuzzy Set Qualitative Comparative Analysis (fsQCA), applying the attitudes – Model 1 – and values – Model 2 as causal conditions to achieve the outcome: TEAed4. We adopted fsQCA software – version 3.0 – to apply the Fuzzy Set QCA method.

The complementary dimension of the approaches chosen interrelates with the need to complement the multilinear regression model results and explore the question of attitudes and social values, considering them as causal conditions to achieve the

outcome of the levels of entrepreneurial activity performed by individuals holding graduate degrees.

Both studies incorporate the following models:

$$\text{Model 1: } TEAed_4 = f(\text{Knoent}, \text{Opport}, \text{Suskil}, \text{Frfail})$$

$$\text{Model 2: } TEAed_4 = f(\text{Equali}, \text{NBgood}, \text{NBstat}, \text{NBmedi})$$

Table 3.1 describes the independent and dependent variables applied in Study 1 and Study 2.

Table 3.1 Variable Description

		Variable	Description
Independent Variables (Study 1 + Study 2)	Model 1	Knowing Entrepreneurs (<i>Knoent</i>)	Applies the percentage of GEM 2017 APS survey respondents who responded positively to " <i>Knows someone who started a business in the past two years</i> ".
		Opportunities' perception (<i>Opport</i>)	Applies the percentage of APS respondents who responded positively to " <i>Good conditions to start a business in the next six months in the area I live</i> ".
		Skills to start up (<i>Suskil</i>)	Applies the percentage of APS respondents who responded positively to " <i>Has required knowledge/skills to start a business</i> ".
		Fear of failure (<i>Frfail</i>)	Applies the percentage of APS respondents who responded positively to " <i>Fear of failure would prevent starting a business</i> ".
	Model 2	People prefer equal standards of living (<i>Equali</i>)	Applies the percentage of APS respondents who responded positively to " <i>People prefer equal standards of living for all</i> ".
		Entrepreneurship as a good career (<i>NBgood</i>)	Applies the percentage of APS respondents who responded positively to " <i>People consider starting a business as a good career choice</i> ".
		Entrepreneurship high social status (<i>NBstat</i>)	Applies the percentage of APS respondents who responded positively to " <i>People attach high status to successful entrepreneurs</i> ".
		Media spread entrepreneurship (<i>NBmedi</i>)	Applies the percentage of APS respondents who responded positively to " <i>In my country, there is lots of media attention for entrepreneurship</i> ".
Study 1 <i>Linear Regression</i> Dependent Variable	Innovation-driven TEA Graduate rate (TEAed ₄)	Applies the percentage of APS of adults with graduate experience who responded positively to " <i>Setting up firm or owner of a young firm</i> " – considering that they started or have been running a business for up to 3.5 years.	
Study 2 <i>fsQCA Model</i> Outcome			

3.4 Overview of Studies

3.4.1 Study 1

Study 1 analyses the statistical relationship between *TEAed4* and a set of variables reflecting the entrepreneurial attitudes of adults and the entrepreneurial social values prevailing. We carried out two multiple linear regressions using Model 1 and Model 2 variables based on the stepwise procedure.

This study deploys a conceptual model (see Figure 3.2) in which knowing recent entrepreneurs (*knoent*), perception of opportunities (*Opport*), skills to start up (*Suskil*), fear of failure (*Frfail*) – Model 1 – and the preference for equal standards of living (*Equali*), the perception that successful entrepreneurs get high social status (*NBstat*), consider entrepreneurship as a good career choice (*NBgood*) and the media properly covering national entrepreneurship (*NBmedi*) – Model 2 – positively influence forays into entrepreneurial activities undertaken by individuals with graduate degrees (*TEAed4*).

Model 1: $TEAed4 = \beta_0 + \beta_1Knoent + \beta_2Opport + \beta_3Suskil + \beta_4Frfail + \epsilon$

Model 2: $TEAed4 = \beta_0 + \beta_1Equali + \beta_2NBstat + \beta_3NBgood + \beta_4NBmedi + \epsilon$

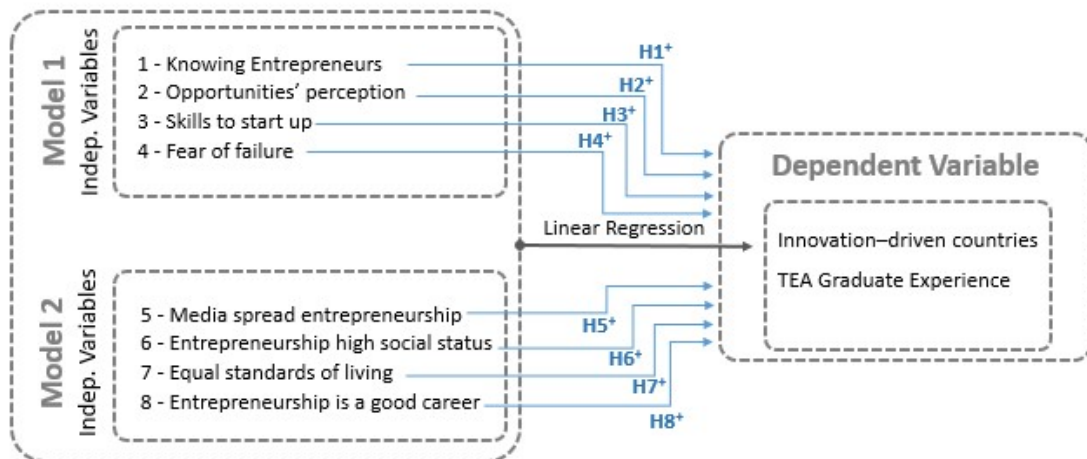


Figure 3.2 Conceptual Model

Table 3.2 presents a summary of the multiple linear regression analysis results.

Table 3.2 Stepwise multilinear regression models on the 2017 TEAed4 rate of innovation-driven countries

Dependent variable		TEAed4 rate for innovation-driven countries participating in GEM				
Model 1	R square	32.4%	95% confidence	R square	21.5%	95% confidence
	Independent variables	B	Significance	Independent variables	B	Significance
	Constant	-0.171	0.972	Constant	-0.890	0.895
	Skills to start up	0.313	0.009	Media spread entrep.	0.235	0.040
	Opportunities perception	0.153	0.476	Entrep. high social status	-0.112	0.615
	Knowing entrepreneurs	-0.319	0.199	Equal standards of living	-0.088	0.729
Fear of failure	-0.259	0.190	Entrep. good career	-0.107	0.621	

The assumptions of the multilinear regression – normal distribution and homogeneity - were analysed. The first two assumptions were validated graphically. VIF was used to diagnose multicollinearity. The model’s efficiency was based on the analysis of R^2 and VIF. Model 1 is significant and explains a relevant proportion of TEAed4 ($R^2=0.324$). Model 2 is significant and explains a relevant proportion of TEAed4 ($R^2=0.215$).

The regression models explain the outcome at 32.4% (Model 1) and 21.5% (Model 2). The analysis of entrepreneurial attitudes identifies the positive presence of the required skills to start a business as the most significant attitude to achieving higher TEA rates. In the study of entrepreneurial social values, the positive media attention to entrepreneurship is the most significant social value to achieving high TEA rates. These results corroborate with the results obtained by Coduras et al. (2016).

The results support the hypotheses H3 (Skills to start up positively influences TEAed4) - Model 1 and H5 (Media covers correctly national entrepreneurship positively influences TEAed4) - Model 2 as a positive influence TEAed4. Adults with graduate experience and entrepreneurial skills and who attach importance to the attention given by the media to entrepreneurship are more likely to engage in entrepreneurial activities. These results confirm the results obtained by Coduras et al. (2016). The results reinforce the importance entrepreneurship education to develop skills to pursue entrepreneurial behaviours (Ruiz et al., 2020), where the university could supply technical skills and provide infrastructures for (Bedó et al., 2020). The results also highlight the importance of a wider media coverage, which allows a high visibility of entrepreneurial impact on the economy where it is possible to identify entrepreneurship as a highly desirable path (Muralidharan & Pathak, 2017).

The hypotheses H1 (knowing recent entrepreneurs positively influences TEAed4), H2 (Opportunities’ perception positively influences TEAed4), and H4 (Fear of failure positively influence TEAed4) – Model 1 were not supported. As well as the hypotheses H6 (Perception that successful entrepreneurs get high social status positively influences TEAed4), H7 (Consider entrepreneurship as a good career choice positively influences

TEAed4), and H8 (Preference for equal standards of living positively influences TEAed4) – Model 2 were not statistically significant. In this sense, in Model 1, it is possible to affirm that knowing recent entrepreneurs, the opportunities perception, and the fear of failure are not significantly related to the engagement in entrepreneurial activities.

Furthermore, in Model 2, it is possible to affirm that the fact that successful entrepreneurs get high social status, the perception of entrepreneurship as a good career choice, and the preference for equal standards of living are not significantly related to the engagement in entrepreneurial activities. It is possible to conclude that the TEA rate of graduate experience in innovation-driven countries can benefit if the countries develop entrepreneurial skills. The media devote a high level of attention to the positive information regarding entrepreneurship.

3.4.2 Study 2

Study 2 aims to generate more detailed insights into explaining the relationship between *TEAed4* and the influences of entrepreneurial attitudes and social values over entrepreneurial activities, thus complementing the results of the regression models. This study applies fsQCA for which we performed a calibration in accordance with the direct method (Ragin, 2007). The proposed model (Figure 3.3) is based on Model 1 – conditions 1, 2, 3, and 4 and Model 2 – conditions 5, 6, 7, and 8. The variables included in each model depict the scores for the calibrated condition rates.

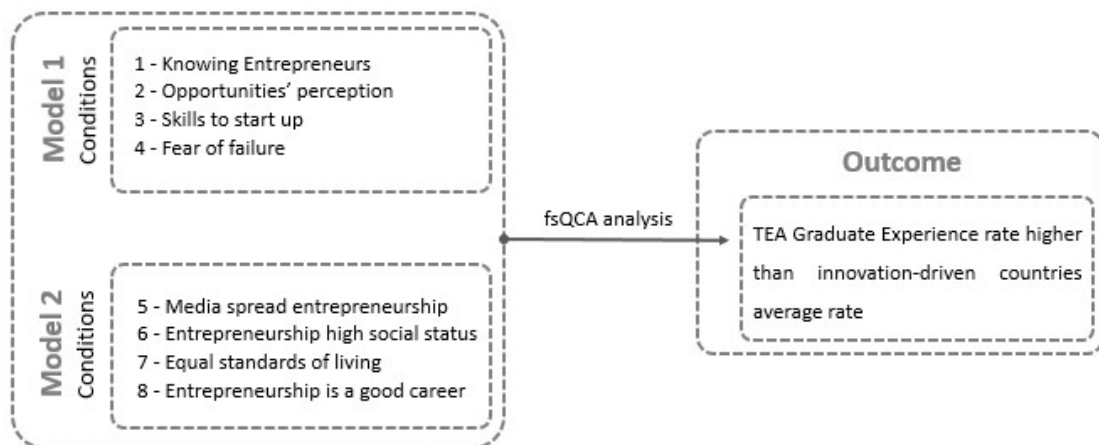


Figure 3.3 Proposed Model

The direct method is based on three qualitative calibration anchors – the threshold for full non-membership, full membership, and the cross-over point (Ragin, 2007).

The GEM innovation-driven countries reflect a country sample that varies each year according to the World Economic Forum classification. This classification represents different cultural backgrounds, transitions between efficiency-driven to innovation-driven and other specific factors that may condition the existence of extreme positive or negative values. Hence, this requires a foundation based on the recent trends in *TEAed4* (2008-2017) to justify the selection of the threshold (Coduras et al., 2016). Despite the availability of 2018 Global National APS Data, we undertaken analysis only until 2017. This decision derives from the change in the World Economic Forum classification, which now considers low income, middle income, and high income as a criterion in a classification that, following its application for the first time, would prevent the collection of the necessary past data to enable calibration. Table 3 presents the *TEAed4* historical information.

Table 3.3 GEM TEAed4 historical information

TEAed4	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Minimum values	0.11	5.64	0.33	5.16	2.55	3.11	4.70	4.59	3.23	3.64
Means	7.72	8.09	7.14	8.65	9.10	10.63	14.03	9.76	7.86	13.57
Maximum values	14.11	14.65	21.41	11.95	16.59	24.54	31.66	27.13	17.30	30.06

The cross-over point conveys the value of the interval-scale variable that a particular case most belongs to – whether more in or out of the targeted outcome. According to the results, 10% establishes the cross-over point based upon the approximate *TEAed4* 10 year average.

Table 4 presents the original sample and the *TEAed4* calibration – column "membership degree". After completing this calibration, deploying a similar procedure to calibrate the Model 1 and Model 2 conditions, this study advanced with fsQCA analysis.

Table 3.4 Sample data and outcome direct method calibration*Knoent*: Knowing Entrepreneurs, *Opport*: Perception of opportunities, *Suskil*: Skills to start up, *Frfail*: Fear of failure,

Country	Knoent	Opport	Suskil	Frfail	Equali	NBgood	NBstat	NBmedi	TEAed4	COP	TEAed4-COP	Membership Degree
JP	18.88	7.41	10.77	43.96	43.01	24.27	51.96	56.17	3.64	10	-6.36	0.06
IT	20.47	28.78	30.39	51.11	68.92	64.17	73.21	54.94	6.43	10	-3.57	0.18
FR	33.19	34.13	36.31	38.3	53	59.06	74.21	47.04	7.61	10	-2.39	0.26
SE	36.11	79.49	34.5	43.07	64.31	53.6	70.52	64.69	7.82	10	-2.18	0.28
AE	65.96	35.45	64.79	53.57	82.33	82.73	87.77	84.46	8.24	10	-1.76	0.32
CY	37.96	51.01	46.35	54.85	51.93	66.2	61.53	50.51	9.19	10	-0.81	0.41
GR	22.8	13.74	43.4	70.19	61.26	63.36	66.49	43.35	10.05	10	0.05	0.50
QA	28.23	45.59	41.07	43.34	57.02	65.93	77.32	54.04	12.22	10	2.22	0.65
SW	33.86	47.16	42.09	35.23	60.23	53.02	73.2	58.96	12.43	10	2.43	0.66
NL	36.75	64.09	44.61	32.9	63	81	67.5	63.18	12.91	10	2.91	0.69
ES	32.96	31.86	44.8	43.55	71.39	53.83	47.88	50.91	14.17	10	4.17	0.76
IL	60.17	58.29	44.14	54.71	41.01	65.16	86.07	55.32	15.32	10	5.32	0.81
SI	38.98	34.6	53.31	34.77	80.45	55.12	73.42	72.65	15.54	10	5.54	0.82
LU	35.42	54.77	40.86	50.58	44.8	42.98	69.95	48.67	15.65	10	5.65	0.82
AU	34.84	51.39	49.3	41.79	79.03	53.87	68.91	74	15.69	10	5.69	0.83
KR	42.94	35.3	45.68	32.56	67.11	47.24	68.57	60.48	16.71	10	6.71	0.86
US	32.78	63.59	54.31	34.45	52.42	63.05	75.49	74.48	16.79	10	6.79	0.86
EE	46.49	60.95	49.72	36.84	57.01	54.22	64.74	60.99	18.27	10	8.27	0.91
PR	20.08	27.97	46.65	33.35	55.57	22.56	52.3	81.15	22.65	10	12.65	0.97
CA	39.21	60.23	55.59	47.17	74.85	65.61	73.96	76.5	30.06	10	20.06	1

Equali: People prefer equal standards of living, *NBgood*: Entrepreneurship as a good career, *NBstat*: Entrepreneurship high social status, *NBmedi*: Media spread entrepreneurship, *TEAed4*: Innovation-driven TEA Graduate rate, *COP*: Cross over point.

Table 3.5 conveys how this condition is verifiable in all the solutions presented with levels of consistency attaining values between 0.750597 and 0.984542. Hence, and in keeping with the results, we may state that coverage of the conditions corresponds to at least 78% of the outcome.

Table 3.5 fsQCA Solutions for TEAedu4 according to Model 1 conditions.

Model 1: TEAedu4 = f(Knoent, Opport, Suskil, Frfail)		
Algorithm: Quine-McCluskey		
Frequency cutoff: 1	Solution coverage:	Solution consistency:
Consistency cutoff: 0.789934	0.811858	0.782774
	Raw coverage	Consistency
~Knoent*~Suskil	0.497233	0.750597
Knoent*Suskil	0.566798	0.892902
~Knoent*~Frfail	0.56917	0.862275
Suskil*~Frfail	0.654546	0.984542
Cases with greater than 0.5 membership in term ~Knoent*~Suskil: Japan (0.95,0.06), Italy (0.78,0.18), France (0.62,0.26), Qatar (0.57,0.65), Switzerland (0.54,0.66), Luxembourg (0.53,0.82), Greece (0.51,0.5)		
Cases with greater than 0.5 membership in term Knoent*Suskil: United Arab Emirates (0.95,0.32), Estonia (0.69,0.91), Canada (0.58,1), Slovenia (0.57,0.82), Korea (0.56,0.86), Cyprus (0.55,0.41), Netherlands (0.52,0.69)		
Cases with greater than 0.5 membership in term ~Knoent*~Frfail: Puerto Rico (0.94,0.97), USA (0.64,0.86), France (0.62,0.26), Switzerland (0.59,0.66), Australia (0.55,0.83), Qatar (0.54,0.65), Spain (0.53,0.76)		
Cases with greater than 0.5 membership in term Suskil*~Frfail: USA (0.81,0.86), Slovenia (0.79,0.82), Estonia (0.69,0.91), Australia (0.65,0.83), Puerto Rico (0.59,0.97), Korea (0.56,0.86), Spain (0.53,0.76), Netherlands (0.52,0.69)		

Table 3.6 sets out the results demonstrating how this condition is verifiable in all the presented solutions with levels of consistency of between 0.780368 and 0.843949. Hence, and based on these results, we may state that condition coverage attains at least 75% of the outcome.

Table 3.6 fsQCA Solutions for TEAedu4 using Model 2 conditions.

Model 2: TEAedu4=f(Equali, NBgood, NBstat, NBmedi)		
Algorithm: Quine-McCluskey		
Frequency cutoff: 1	Solution coverage:	Solution consistency:
Consistency cutoff: 0.821721	0.823715	0.746953
	Raw coverage	Consistency
~NBstat*~NBmedi	0.456126	0.792582
~Equali*~NBmedi	0.502767	0.780368
Equali*NBgood	0.490119	0.825566
NBgood*NBstat	0.56996	0.81377
~Equali*~NBgood*~NBstat	0.377075	0.816781
Equali*NBstat*NBmedi	0.418972	0.843949
Cases with greater than 0.5 membership in term ~NBstat*~NBmedi: Spain (0.85,0.76), Cyprus (0.74,0.41), Japan (0.72,0.06), Greece (0.59,0.5), Estonia (0.54,0.91), Korea (0.52,0.86)		
Cases with greater than 0.5 membership in term ~Equali*~NBmedi: Luxembourg (0.89,0.82), Cyprus (0.8,0.41), France (0.77,0.26), Israel (0.74,0.81), Japan (0.72,0.06), Qatar (0.64,0.65), Estonia (0.54,0.91), Switzerland (0.53,0.66)		
Cases with greater than 0.5 membership in term Equali*NBgood: United Arab Emirates (0.95,0.32), Canada (0.73,1), Italy (0.7,0.18), Netherlands (0.57,0.69), Greece (0.51,0.5)		
Cases with greater than 0.5 membership in term NBgood*NBstat: United Arab Emirates (0.95,0.32), Qatar (0.74,0.65), Israel (0.72,0.81), Canada (0.69,1), USA (0.67,0.86), Italy (0.66,0.18), France (0.56,0.26)		
Cases with greater than 0.5 membership in term ~Equali*~NBgood*~NBstat: Japan (0.92,0.06), Puerto Rico (0.69,0.97), Estonia (0.56,0.91)		
Cases with greater than 0.5 membership in term Equali*NBstat*NBmedi: United Arab Emirates (0.95,0.32), Canada (0.69,1), Slovenia (0.67,0.82), Sweden (0.56,0.28)		

Table 3.7 portrays the results of the necessary and sufficient conditions analysis of the TEAed4 outcome taking into account the Model 1 and Model 2 variables as conditions.

Table 3.7 Results for Necessary Conditions for Outcome – TEAed4

Model 1: $TEAed4 = f(Knoent, Opport, Suskil, Frfail)$		
	Consistency	Coverage
<i>Knoent</i>	0.607115	0.862921
<i>~Knoent</i>	0.653755	0.745045
<i>Opport</i>	0.718577	0.885102
<i>~Opport</i>	0.557312	0.724563
<i>Suskil</i>	0.776285	0.913488
<i>~Suskil</i>	0.546245	0.747027
<i>Frfail</i>	0.452174	0.707921
<i>~Frfail</i>	0.766798	0.813758

Model 2: $TEAed4 = f(Equali, NBgood, NBstat, NBmedi)$		
	Consistency	Coverage
<i>Equali</i>	0.646640	0.816367
<i>~Equali</i>	0.616601	0.781563
<i>NBgood</i>	0.648221	0.769953
<i>~NBgood</i>	0.622134	0.841711
<i>NBstat</i>	0.667194	0.800000
<i>~NBstat</i>	0.601581	0.805291
<i>NBmedi</i>	0.630830	0.864572
<i>~NBmedi</i>	0.598419	0.702878

In Model 1, *~Frfail* constitutes a sufficient condition for a TEAed4 outcome with *Suskil* (0.913488), *Opport* (0.885102), and *Knoent* (0.862921) standing out as the most prominent necessary conditions. In Model 2, the most prominent necessary conditions are *NBmedi* (0.864572) and *~NBgood* (0.841711).

Based on the complex solutions, fsQCA also allows for the presentation of possible paths for TEAed4 in accordance with the Model 1 and Model 2 conditions. Table 8 details the most relevant recipes returned by fsQCA and complementing the multilinear regression analysis presented in Study 1.

The first recipe - *Suskil*~Frfail* – incorporates the presence of the knowledge/skills required to start businesses and the absence of fear of failure. The second recipe - *Knoent*Suskil* – also refers to the knowledge/skills required to start businesses alongside the importance of knowing someone who started a business in the past two years.

Considering the Model 2 conditions, the first recipe - *Equali*NBgood* – relays the importance of equal standards of living existing for all and the belief that starting a business constitutes a good career choice. The second - *Equali*NBstat*NBmedi* – incorporates the importance of equal standards of living for all alongside society

attaching high status to successful entrepreneurs and the country devoting high levels of media attention to entrepreneurship.

Table 3.8 Most relevant fsQCA recipes for TEAed4

Model 1: TEAed4 = f(Knoent, Opport, Suskil, Frfail)	
<i>Suskil*~Frfail</i>	The possibility of adults with graduate degrees setting up a firm or owning a young firm is potentiated when individuals consider they hold the required knowledge/skills to start a business and report an absence of fear of failure that would prevent them from starting businesses. The countries with high membership scores for this outcome are USA, Slovenia, Estonia, Australia, Puerto Rico, Korea, Spain, and Netherlands.
<i>Knoent*Suskil</i>	The possibility of adults with graduate degrees setting up a firm or owning a young firm is potentiated when individuals consider they hold the required knowledge/skills to start businesses and know someone who started a business in the past two years. The countries with high membership scores for this recipe outcome are the United Arab Emirates, Estonia, Canada, Slovenia, Korea, Cyprus, and Netherlands.
Model 2: TEAed4=f(Equali, NBgood, NBstat, NBmedi)	
<i>Equali*NBgood</i>	The possibility of adults with graduate degrees setting up a firm or owning a young firm is potentiated when individuals prefer the existence of equal standards of living for all and consider that starting a business is a good career choice. The countries with high membership scores for this outcome are the United Arab Emirates, Canada, Italy, Netherlands, and Greece.
<i>Equali*NBstat*NBmedi</i>	The possibility of adults with graduate degrees setting up a firm or owning a young firm is potentiated when individuals prefer the existence of equal standards of living for all, society attaches high status to successful entrepreneurs and the country devotes high media attention to entrepreneurship. The countries with high membership scores for this recipe outcome are the United Arab Emirates, Canada, Slovenia, and Sweden.

The first recipe - *Suskil*~Frfail* – incorporates the presence of the knowledge/skills required to start businesses and the absence of fear of failure. The second recipe - *Knoent*Suskil* – also refers to the knowledge/skills required to start businesses alongside the importance of knowing someone who started a business in the past two years.

Considering the Model 2 conditions, the first recipe - *Equali*NBgood* – relays the importance of equal standards of living existing for all and the belief that starting a business constitutes a good career choice. The second - *Equali*NBstat*NBmedi* – incorporates the importance of equal standards of living for all alongside society attaching high status to successful entrepreneurs and the country devoting high levels of media attention to entrepreneurship.

3.5 Discussion

The literature exploring the TEA rate of university graduates and variables depicting adult entrepreneurial attitudes and entrepreneurial social values have not yielded consistently strong results. Simultaneously, the level of university commitment to entrepreneurial training seems to return a discretely positive relationship considering the results obtained from the performed regression models. As a catalyst for regional economic and social development, entrepreneurial universities, within a Triple Helix context, enables a range of employability alternatives for their students while emphasizing the importance of launching new businesses for employment generation. Given this scenario, aligning university research and training priorities with the priorities of organizations represents an essential need.

According to the results, and despite not being generally accepted that entrepreneurial education provides a meaningful degree of preparedness for entrepreneurship, the regression models and fsQCA analysis convey how the likelihood of an adult with university experience setting up a firm or owning a young firm rises when such individuals consider they hold the knowledge/skills required for launching companies. Education and training configure the main factors for fostering entrepreneurship and reinforcing the need to endow graduate entrepreneurs with the capacity for developing sustainable entrepreneurial initiatives.

Therefore, whenever universities influence entrepreneurial activities in a particular country, they need to direct education processes towards entrepreneurship in order to foster entrepreneurial skills and capacities, thereby establishing entrepreneurial education and vocational training integrated into other fields of education. In this way, we may conclude that entrepreneurship can be taught and that universities represent the right environment for this. Furthermore, both the regression models and the fsQCA analysis also stress the importance of media outlets paying prominent attention to entrepreneurship, contributing to constructing an emotion-based and entrepreneurial mindset and successfully nurturing the acceleration of university student entrepreneurial intentions and building an entrepreneurial culture that supports economic growth and prosperity.

The articulation of quantitative and qualitative methodologies opens a range of promising possibilities through providing methodological synergies that expand the results from quantitative analysis - which are the most significant relevant factors for later entrepreneurial activities – by combining them with the qualitative results that

return insights into the combinations of the factors analysed and also characterizing the context where they occurs. Hence, the combination of Study 1 and Study 2 generates more extensive answers than those returned by the results of the regression models, deepening the information explaining entrepreneurial activity levels of graduates.

The results of Study 1 lend support to the hypotheses H3 (Start up skills positively influence TEAed4) - Model 1 and H5 (Appropriate media coverage of national entrepreneurship positively influences TEAed4) - Model 2 as a positive influence on TEAed4. Adults with graduate degrees and entrepreneurial skills and who attach importance to the attention paid by the media to entrepreneurship are therefore more likely to engage in entrepreneurial activities. These results confirm those obtained by Coduras et al. (2016) and correspondingly reinforce the importance of entrepreneurship education in developing the skills necessary to pursue entrepreneurial behaviours (Ruiz et al., 2020), within the scope of which universities may supply not only technical skills but also provide infrastructures (Bedó et al., 2020). These results also highlight the importance of wider media coverage, which enhances visibility of entrepreneurial impacts on the economy and that enable the identification of entrepreneurship as a highly desirable path (Muralidharan & Pathak, 2017). Within this framework, Model 1 underpins the affirmation that knowing recent entrepreneurs, the perception of opportunities and the absence of fear of failure do not significantly relate to undertaking entrepreneurial activities.

Furthermore, Model 2 identifies how successful entrepreneurs receiving high social status, perceptions of entrepreneurship as a good career choice and the preference for equal standards of living do not significantly relate to engaging in entrepreneurial activities. We may thus conclude that the graduate TEA rate in innovation-driven countries can benefit from actively developing entrepreneurial skills and the media devoting a high level of attention to positive entrepreneurship related information.

Identification of the various types of entrepreneurship present in GEM data allows for the fsQCA approach to return a conceptual framework that enriches our understanding of the contributions each of the different conditions makes to TEAed4 outcomes.

Based on Study 2 fsQCA analysis, the results of the most prominent necessary conditions are *Suskil* (0.913488), *Opport* (0.885102), and *Knoent* (0.862921) – in Model 1 – and *NBmedi* (0.864572) and *~NBgood* (0.841711) – in Model 2 - confirming and enabling the extension of the results made possible by the regression models. Analysis of the most relevant fsQCA recipes for TEAed4 in accordance with the Model 1

conditions allows for reflection on pertinent points potentially justifying these solutions in accordance with the groups of countries they occur in. The first recipe - *Suskil*~Frfail* – refers to the presence of the knowledge/skills required to start a business and the absence of fear of failure. This recipe becomes viable in the USA, Slovenia, Estonia, Australia, Puerto Rico, Korea, Spain and the Netherlands, countries with significant entrepreneurial cultures, high levels of development, increased commitments to entrepreneurial education and access to modern financial channels. This reinforces a positive link between university-based entrepreneurship skills and some entrepreneurial activities (Nabi et al., 2017) and the paramount importance of exploring the mindsets prevailing among entrepreneurial university students as regards their entrepreneurial intentions (Mukhtar et al., 2021).

The second recipe - *Knoent*Suskil* – also refers to the knowledge/skills required to start a business and the importance of knowing someone who started a business in the past two years. This recipe is viable for United Arab Emirates, Estonia, Canada, Slovenia, Korea, Cyprus and the Netherlands. The literature suggests that when individuals knowing someone personally who started a business in the past two years (Davidsson & Honig, 2003) generates a second-hand experience of entrepreneurship that emerges as a relevant driver of entrepreneurial intentions through learning from the experiences, feelings or actions of another (Davidsson, 1991).

Considering the Model 2 conditions, the first recipe - *Equali*NBgood* – relays the importance of equal standards of living existing for all and the belief that starting a business is a good career choice. This recipe is viable in the United Arab Emirates, Canada, Italy, the Netherlands and Greece. The second recipe - *Equali*NBstat*NBmedi* – encapsulates the importance of equal standards of living for all, people attaching high status to successful entrepreneurs and the country devoting significant media attention to entrepreneurship. The importance of entrepreneurship is also equality based as entrepreneurs often focus on solving problems, finding solutions to many issues that would otherwise be hard or nearly impossible to solve and, while benefiting themselves, also benefiting the rest of society (Hernández-Sánchez et al., 2019).

Theoretical implications

This research provides substantial theoretical contributions to the literature. Considering the relevance of the entrepreneurial process outputs - new job and value creation, and their respective outcomes - socio-economic development, exploring all

research strands is essential to generate a basis for actions in support of developing entrepreneurship. Firstly, the findings demonstrate that articulating quantitative and qualitative methodologies enables an expansion of the results returned by the quantitative analysis, unveiling combinations among the factors analysed and exploring the context in which they occur. Secondly, this study strengthens the appropriateness of the Institutional and Planned Behaviour theoretical frameworks and not only emphasising the importance of institutional or organizational factors as determinants of entrepreneurship (Abreu et al., 2016) but also the need to focus on the linkage between entrepreneurial attitudes, entrepreneurial intentions, and entrepreneurial behaviour (Ajzen, 1991). There is thus now recognition of the relationship between university support for entrepreneurship and the development of entrepreneurial activities (Coduras et al., 2008) based on the role of entrepreneurial education and approaching this as the driver of successful entrepreneurial behaviour (Fayolle et al., 2006). In this scenario, entrepreneurial universities play a preponderant role as aggregators of capabilities (Audretsch et al., 2019) and the subsequent linkage between innovation and the Ent_Eco (Autio et al., 2014a) in a relational system that should function from a mutualist perspective (Schaeffer et al., 2021).

The study also very much highlights the importance of positive media attention to entrepreneurship and the most significant social value as regards achieving high TEA rates. We were furthermore able to conclude that adults with graduate degrees and entrepreneurial skills attach importance to this attention paid by the media to entrepreneurship and correspondingly display a greater likelihood to engage in entrepreneurial activities. In this context, exploring the media's approaches to entrepreneurship represents an essential research objective. This crucially involves conveying the success and failure stories associated with entrepreneurial activities and raising general awareness of the scope for actions and reactions to each different situation.

In addition, establishing specific recipes with different combinations of conditions and their association with specific countries where those recipes hold validity enables the definition of more targeted and effective policies in keeping with the economic, social, and historical particularities framing each country's particular situation at any given moment, scenarios that require theoretical exploration for later, duly contextualized, application.

Practical Implications

There is now general recognition that universities constitute one of the core pillars of any Ent_Eco (Guerrero, Urbano, and Gajón, 2017). The emergence of entrepreneurial universities, as catalysts for regional economic and social development (Abreu et al., 2016; Etzkowitz et al., 2000), comprises the development of mindsets that equates to the existence of market opportunities.

The Triple Helix concept describes the essential need to align university research and training priorities with the goals of organizations in the region, enabling a range of employment alternatives for their students – whether self-employed, academic entrepreneurs, or intrapreneurs. Additionally, taking into account the impacts of launching new businesses and companies on the creation of employment, with education and training standing out as the main factors for fostering entrepreneurship, reinforces the need to endow graduate entrepreneurs with the capacity to develop sustainable entrepreneurial initiatives (Coduras et al., 2008).

Although attention mostly focuses on the skills needed for further entrepreneurial activities, we also need to explore the media attention to entrepreneurship. Given that positive media attention to entrepreneurship accounts for the most significant social value for achieving high TEA rates, we need to work on how we communicate entrepreneurial cases outputs and achievements.

Despite the setbacks in determining which factors broadly influence entrepreneurial performance and recognition of universities as the means of impacting on entrepreneurial attitudes and values, we need to gather out efforts around all the opportunities to bring about this development. Based on that detailed above, advancing with development of the fsQCA models is crucial to establishing the different combinations in the multiple and interrelated entrepreneurial conditions able to underpin effective and sustainable public policies most appropriate to the characteristics of each country.

Limitations and Future Research

Our study holds limitations that further investigations may overcome. First, our analysis only applies to GEM TEAed4 data on innovation-driven countries. Possible lines of future research might deploy this methodology to analyse other educational levels, accessible through TEAed1, TEAed2, and TEAed3 variables, which captures the

percentage of APS of adults with lower secondary, secondary or post-secondary education qualifications respectively. Another possibility derives from the need to weight this analysis as entrepreneurial activities may arise out of need or opportunity. Secondly, the need to work on the way to measure the performance of entrepreneurial universities remains outstanding. Despite the existence of instruments that allow for institutional self-analysis, such as HEInnovate, developed in a joint effort by the Organization for Economic Cooperation and Development and the European Community, there remains the need to ascertain the tools to evaluate universities and their performance in accordance with entrepreneurship. This type of evaluation might return a means of directing students with more entrepreneurial aptitudes towards those universities more qualified for teaching and providing future support for entrepreneurial activities. Thirdly, and according to the 2021/2022 GEM Global Report (GEM, 2022), recognizing the paramount importance of entrepreneurship as a critical driver of economic development and recovery, there is also the need to understand the impacts on entrepreneurship driven by the COVID-19 pandemic. These questions arise because entrepreneurship can solve countless economic, environmental and social challenges. While positive media attention may significantly impact on entrepreneurial activities, exploring utilisation of all digital infrastructures reflects another core research goal. The pandemic has highlighted the importance of digital ecosystems as 'invisible infrastructures' that encourages emerging entrepreneurs (Fernandes, Ferreira, et al., 2022). In the digital context, where metaverse technology appears as a future center of gravity for online social interactions (Kraus et al., 2022), it is crucial to approach just how entrepreneurs can prepare to deal with this new reality and leverage all of its opportunities.

Chapter 4. University Entrepreneurial Performance: A Fuzzy Set Qualitative Comparative Analysis (fsQCA)

Abstract

As key players in innovation and entrepreneurial ecosystems (Ent_Eco), Higher Education Institutions (HEI) assume a position as catalysts in creating and disseminating knowledge with repercussions in the societal, economic, political, and innovation environments. In this scenario, HEI are facing the need to balance the performance of their traditional missions - teaching and research - with the pursuit of entrepreneurial performance. This brings awareness of the need to pay particular attention to HEI entrepreneurial performance (HEIEP) and how to measure it. Based on HEInnovate, a self-assessment tool resulting from a joint effort of the European Community and the OECD, this study aims to explore the benefits of university entrepreneurial metrics, analyzing HEIEP as a discriminant function of the HEInnovate dimensions complemented with a qualitative approach using Fuzzy Set Qualitative Comparative Analysis (fsQCA). The analysis provides valuable details, presenting recipes based on the HEInnovate dimensions or combinations of dimensions to achieve a Mission legitimization. This research brings awareness to the use of the HEInnovate scale, where it is possible to highlight the importance of the digital transformation and capability dimension to entrepreneurial performance (EP) and university mission legitimization.

Keywords

Entrepreneurial University, Entrepreneurial HEI, HEInnovate, fsQCA, Discriminant Analysis

4.1 Introduction

“The problem, of course, is that good instruments are hard to find”
(OECD, 2007)

There is a recognition that Higher Education Institutions (HEI) assume paramount importance as catalysts for regional economic and societal development (Bedó et al., 2020). With a significant role in entrepreneurial ecosystems (Ent_Eco), many countries reform their higher education systems, affecting HEI missions, autonomy, public financing, and governance (Stolze & Sailer, 2021). The involvement of HEI in technology transfer, company formation, and regional development emerges as a new academic ideal in a clear transition from a traditional to an entrepreneurial HEI (Etzkowitz, 2013).

In a highly unpredictable environment for higher education, entrepreneurial HEI, commonly approached as Entrepreneurial University (Ent_Uni), emerges as an organizational response to environmental challenges and pressures (Voolaid et al., 2019).

Pursuing entrepreneurial pathways unveil opportunities and risks to HEI and Ent_Eco stakeholders (Stolze & Sailer, 2021). It also represents the emergence of institutional tensions, creating a necessity for a legitimation in which the new objective was tied to the old task (Etzkowitz, 2013). In response to the growing expectations of entrepreneurialism, HEI needs to create a synergic balance between research, education, and entrepreneurship missions (Lahikainen et al., 2019). In a mission legitimation where two activities were more productively done together than carried out separately (Etzkowitz, 2013).

As described by Taucean et al. (2018), HEI needs to develop an entrepreneurial mindset that allows business creation and the exploitation of new ideas, fostering the discussion and debate on their entrepreneurial and innovative nature. Given the diversity and to facilitate access to the state of entrepreneurship and innovation, it is vital to trust that some key characteristics allow us to evaluate an entrepreneurial and innovative HEI (OECD/EC, 2018).

Multiple studies explore the concept of entrepreneurial HEI (Cerver Romero et al., 2020; Ferreira et al., 2018; Gianiodis & Meek, 2020; Guerrero, Urbano, Fayolle, et al., 2016; Rubens et al., 2017; Ruiz et al., 2020). Nevertheless, considering the different approaches to HEI entrepreneurship, it is essential to develop tools to guide HEI and

policymakers in establishing an entrepreneurial agenda, illustrating how to become an entrepreneurial institution (Taucean et al., 2018).

Despite the interest in the topic and considering the relevance of the Ent_Uni in response to the economic and social challenges, it is necessary to assess and explore the capabilities of HEI to meet those challenges and expectations (Voolaid et al., 2019).

Discussing the Ent_Uni as a trend in the development and transformation of HEI, it is essential to focus on its reason, relevance, and importance and deepen our knowledge of the entrepreneurship components, mission, objectives, and strategies (Taucean et al., 2018). There is now a recognition that being an Ent_Uni does not have a singular approach but a variety of entrepreneurial and innovative behaviours (Gibb et al., 2018). Considering the importance of the Ent_Uni in economic and social development and its prominent role in the triple helix (TH), we must invest in responsible metrics as an essential element of responsible innovation (Etzkowitz, 2016). The facilitation of Ent_Uni development would primarily benefit from developing existing metrics (Etzkowitz, 2016; Henry, 2015). The HEInnovate self-assessment tool, an initiative of the European Commission in partnership with the Organization for Economic Cooperation and Development (OECD) (www.heinnovate.eu), enables HEI to evaluate different components of entrepreneurial capacity for further entrepreneurial developments, working as a guiding framework for the Ent_Uni (Voolaid et al., 2019). The exploration and exploitation of the HEInnovate tool configure a significant gap in the literature to develop metrics that facilitate the evolution of the Ent_Uni and emphasize its role in economic and social development (Etzkowitz, 2016). It is essential to focus on the challenges involved in the application and considered particular ways in which its accuracy and value might be strengthened (Henry, 2015). This paper hereby acknowledges this gap. In this sense, this study explores the benefits of university entrepreneurial metrics, analyzing HEI Entrepreneurial Performance (HEIEP) as a discriminant function of the HEInnovate dimensions complemented with a qualitative approach using Fuzzy Set Qualitative Comparative Analysis (fsQCA).

The study intends to analyse the influence of the HEInnovate dimensions on entrepreneurial self-perception and Mission Legitimation (ML) of HEI, to present recipes based on the HEInnovate dimensions or combinations of dimensions to achieve ML and bring awareness to using the HEInnovate scale. The purpose of this study is twofold. Based on the perception of the deans/presidents of Portuguese HEIEP and ML, the questionnaire also focuses on 42 criteria grouped into eight key dimensions known as the HEInnovate scale. In the study, we explore the relevance of each critical

dimension in the construction of the entrepreneurial HEI, intending to acknowledge the dimensions of HEInnovate, where HEIEP works as a discriminant function. Throughout an fsQCA analysis, we also explore the recipes based on the HEInnovate dimensions or combinations of dimensions to attain the ML outcome.

This study provides substantial theoretical contributions to the literature. First, it confirms the applicability and suitability of HEInnovate dimensions to HEI. Secondly, this study reinforces the Resource-Based Theory, reiterating the need to deepen the existing knowledge about the entrepreneurial parameters to consider in developing entrepreneurial anatomy to develop entrepreneurial performance (EP) metrics. According to Resource-Based Theory, the resources and capabilities determine the ability to explore and exploit innovation throughout internal/external knowledge flows (Guerrero, Urbano, & Herrera, 2019). In this sense, the EU will develop knowledge transfer activities in areas where their skills are more developed (Kitagawa et al., 2016), and the availability of resources will determine the capacity to pursue knowledge transfer activities as a path for emancipating from governmental funding (Ferreira et al., 2018). The dynamic capabilities approach the need for organizations to combine internal and external resources and capacities (Teece, 1998), building a resilient and agile way to deal with complex and uncertain socio-economic contexts (Urbano et al., 2018).

Our results confirm the applicability and suitability of HEInnovate dimensions to Portuguese HEI and present recipes based on the HEInnovate dimensions or combinations of dimensions to achieve an ML. Our approach allows the identification of what is central and peripheral to HEIEP, presenting possibilities of more targeted and appropriate actions according to the institutional context in a strategic alignment with the socio-economic needs of the region. This perspective helps us to understand the relevance of self-knowledge as part of the process of detaining an added value in entrepreneurial performance (OECD/EC, www.heinnovate.eu).

After this introduction, this study is structured as follows: the next section focuses on the literature review that we consider pertinent for framing the theme under analysis. Afterward, we present the method and the research design structure. This is followed by the presentation of the results. Finally, we offer a discussion of the results and the conclusions. We also indicate the lines of future research that we consider relevant for pursuing further research toward an entrepreneurial HEI reality.

4.2 Theoretical Background and Research Framework

Considering the subject under study is essential to approach the Resource-Based Theory and the Dynamic Capabilities Theory. According to Resource-Based Theory, and as described by Grant (1991), resources and capabilities determine the enterprise's ability to achieve competitive advantage. Organizations implement innovative practices that explore/exploit innovation throughout internal/external knowledge flows (Guerrero et al., 2019). In this sense, as a knowledge-intensive environment, the EU plays a significant role in collaboration, allowing the exploration and exploitation of innovative and entrepreneurial ideas (Guerrero et al., 2019).

As Ishizaka, Pickernell, Huang, & Senyard (2020) described, the Ent_Uni differs in its resources and capabilities, developing knowledge transfer activities in areas where their skills are more developed (Kitagawa et al., 2016). At the same time, the availability of resources will determine the capacity to pursue knowledge transfer activities, resulting in HEI looking for alternative ways to obtain revenue, emancipating itself from governmental funding (Ferreira et al., 2018).

The dynamic capabilities approach highlights the need for organizations to integrate, build, and reconfigure internal and external resources and capacities, particularly in highly demanding environments (Teece, 1998). In this sense, dynamic organizational capabilities should be reinforced and intensified to build resilience and agility in competition during complex and uncertain socio-economic contexts (Urbano et al., 2018) in a mutualist process of value co-creation resulting from the interaction of the Ent_Eco agents (Schaeffer et al., 2021). The organizational resources and capabilities value in innovation creation could be conditioned by the environmental conditions (Barasa et al., 2017). In this regard, the influence of environmental conditions on the value of organizational resources and capabilities could be enhanced in a supportive environment and reduced under weak environmental conditions (Autio et al., 2014b). At the same time, considering the relevance of the EU in response to the economic and social challenges, it is necessary to assess and explore the capabilities of HEI to meet those challenges and expectations (Voolaid et al., 2019).

4.2.1 Entrepreneurial University and Entrepreneurial Anatomy

Universities have become complex organizations (Ahmad et al., 2016). Consequently, the Ent_Uni emerges as an organizational entity that articulates multiple missions - teaching, research, and entrepreneurship - generating profits and creating a local, regional and national economic impact (Budyldina, 2018). Given the complexity of the

Ent_Uni concept, it is necessary to define the specific characteristics, beyond the commercialization of generated knowledge, that allows them to respond to the challenges posed by society in an integration of the different missions performed, enabling innovation in a context of an Ent_Eco (Ruiz et al., 2020). Furthermore, transforming a traditional university into an Ent_Uni takes several years, implying cultural and infrastructural changes (Jacob et al., 2003). Simultaneously we will have to verify cultural changes in government, industries, and other ecosystems agents (Ruiz et al., 2020).

In a still-evolving concept, it is possible to identify several definitions of the Ent_Uni and its characteristics in the literature. An idea initially focused on universities looking for new sources of funding (Etzkowitz, 1983) rapidly found the need to encompass the strategic integration of this entrepreneurial thinking with a focus on technology transfer (Etzkowitz, 1998). The concept also approaches the Ent_Uni as an HEI with the ability to innovate, recognize and create opportunities, work as a team, take risks and respond to challenges (Kirby, 2002). The Ent_Uni concept also explores the HEI as an entity that embraces and encourages entrepreneurship, creating favourable conditions such as opportunities, practices, cultures, and environments (Barnes et al., 2002). Guerrero & Urbano (2012) described the Ent_Uni as knowledge producers and disseminators, generating ideas and qualified human resources for future industrial use. Also focusing on the Ent_uni concept, Sam & van der Sijde (2014) points to the Ent_Uni as an HEI that actively identifies and exploits opportunities to improve its missions. An improvement originated in a legitimation game where it can manage the dependence and mutual impact of the three university missions (Etzkowitz, 2003b). In the development of the Ent_uni, it is possible to identify three phases that do not occur in exact order (Etzkowitz, 2013): University Entrepreneur One, University Entrepreneur Two, and University Entrepreneur Three. The *University Entrepreneur One* is characterized as an academic institution that detains a strategic vision, allowing the definition of the direction to follow, revealing some skills in setting priorities, and obtaining forms of financing. The *University Entrepreneur Two* is an academic institution with an active role in commercializing intellectual property resulting from the activities developed by its collaborators, researchers, and students (Etzkowitz, 2013). The *University Entrepreneur Three* refers to a proactive academic institution influencing regional innovation's effectiveness with an active role in collaboration with industry and the government (Etzkowitz, 2013). According to Carayannis, Grigoroudis, Campbell, Meissner, & Stamati (2018), the Ent_Uni "MODE 3" transcend the conventional concept of an Ent_Uni with a potential need to be accompanied by contextual changes. To Sam & van der Sijde (2014), a consolidated EU should assume

various roles in the Ent_Eco and establish complex networks - private industries, financiers, and government agencies – to pursue common technological goals and obtain mutual gains. Ruiz et al. (2020) also proposed a conceptual integration of the definition of an Ent_Uni as *"an institution integrated into an entrepreneurial and innovative ecosystem, capable of changing, innovating, recognizing and creating opportunities. Its academic community is proactive, willing to take risks and respond to challenges, aiming at internal and external development and creating different values through knowledge generated by the university"*.

Intrinsically related to the Ent_Uni, the TH concept is based on the idea of a synergic harmonization of the three pillars of the virtuous circle of innovation - university, industry, and government – where the Ent_Uni is expected to perform a more prominent role that leverage knowledge society innovation and economic development (Ranga & Etzkowitz, 2013). According to Etzkowitz & Dzisah (2007), the TH also relies on improving the collaborative relationships in which innovation policy is increasingly an outcome rather than a government imposition or an industry outcome. While the Schumpeterian entrepreneur was based in an industrial society, the driving force could be the Ent_Uni, where each actor plays a specific role but in a synergic collaboration with the other fostering the development of innovative businesses (Etzkowitz & Dzisah, 2007).

4.2.2 Measuring Entrepreneurship

Contrary to the underlying logic of the economic and governmental spheres, which are more focused on the primary institutional nature, the multiplicity of the logic underlying the Ent_Uni creates a problem in the development and dissemination of university metrics (Etzkowitz, 2016). According to Etzkowitz (2014), the development and widespread acceptance of university metrics tend to metamorphosis valued criteria creating a counterproductive force. One of the metrics that has been gaining popularity due to its perceived ease of application and broad applicability is the HEInnovate tool (Henry, 2015). The HEInnovate tool stimulates HEI reflection on its entrepreneurial activities, allowing the identification, prioritization, and action planning in eight key areas (Appendix A). Self-knowledge will enable the Ent_Uni to maintain an independent perspective as a creative player in economic and social development and, at the same time, be responsive to government and industry priorities, combining university autonomy and greater involvement of external stakeholders (Etzkowitz, 2016).

Based on the relevance assumed by HEI in economic development (Bedó et al., 2020), this research aims to analyse the influence of the HEInnovate dimensions on entrepreneurial self-perception and ML of HEI. Figure 4.1 includes the eight HEInnovate dimensions and represents our research framework.

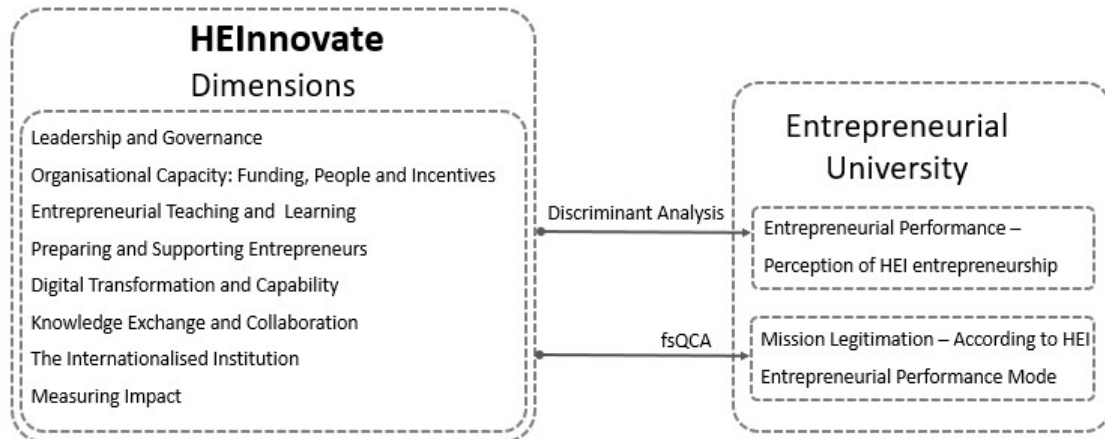


Figure 4.1 Research framework

4.3 Data and Methods

4.3.1 Data Source, Collection, and Sample

This study is based on data gathered from an online survey applied to the dean/president of Portuguese HEI (Appendix B). The Portuguese higher education system is regulated by the Basic Law of the Educational System (<https://www.dges.gov.pt/en/pagina/portuguese-higher-education-system>). In Portugal, higher education is structured in a binary system that integrates universities and polytechnics, financed by resources from public or private capitals. HEI enjoys scientific, pedagogical, cultural, and disciplinary autonomy.

HEI education "is guided by a perspective of research promotion and creation of knowledge and aims to ensure solid scientific and cultural preparation and provide technical training to enable for the exercise of professional and cultural activities and promote the development of design capabilities, innovation, and critical analysis". Polytechnic education comprises polytechnic institutes and other polytechnic teaching institutions – "is guided by a perspective of applied research and development aimed at understanding and solving concrete problems and aims at providing a solid cultural and technical training at the higher level, developing the capacity for

innovation and critical analysis and providing scientific knowledge of theoretical and practical nature and their applications for the exercise of professional activities".

In the academic year 2021/2022, the training offer was provided by 92 institutions involving 296 faculties/schools. Among them, they allowed the existence of 3563 courses in universities and 2644 courses in Polytechnics - 1st Cycle - Short-cycle, Graduation, Integrated Cycle Leading to Master Degree, 2nd Cycle - Master, and 3rd Cycle - Ph.D.

Our questionnaire was performed on the LIME platform - Version 2.73.1. It made it possible to send a personalized e-mail to the 92 institutions involved in the study. The platform also allows for the centralization of responses for further data processing. The first e-mails were sent through the LIME platform on 22nd September 2021. The platform collected responses over an approximate period of 4 months, having closed on 15th January. During this period, telephone calls were made to the institutions involved in the study to recall the invitation that had been made, appealing to the relevance of participation. Our questionnaire enabled the collection of the self-assessment of Portuguese HEI, and 44.6% of the institutions surveyed responded to the questionnaire running through the eight dimensions of the HEInnovate scale.

Considering that the HEInnovate scale is not intended to be a ranking or a benchmarking tool - it intends to help diagnose areas of strengths and weaknesses, fostering debate and discussion on the institution's innovative and EP, enabling an analysis of its evolution over time - we chose to keep the answers anonymous.

The questionnaire was applied to the dean/president to standardize the typology of respondents. This decision is linked to the need to homogenize the institutional position occupied by respondents, considering that entrepreneurial perception differs depending on the hierarchical situation of the respondent, which is a criticism pointed out on the HEInnovate scale (Henry, 2015).

4.3.2 Methods and Measures

The analysis is complemented with the HEIEP analysis, based on the answer where it is intended to assess whether HEI considers itself an entrepreneurial institution or not.

Table 4.1 presents the description of the variables under analysis.

Table 4.1 Variable Description

Independent Variables		
HEInnovation Dimension	Metric	Description
Leadership and Governance (LeadGov)	Score ranging from 1 to 5	Captures the HEI entrepreneurial perception related to the specific factors that must be considered to strengthen its entrepreneurial agenda.
Organizational Capacity: Funding, People and Incentives (OrgCap)	Score ranging from 1 to 5	Captures the HEI perception of its organizational capacity, allowing to know to what extent organizational capacity conditions the ability to execute the strategy and performed entrepreneurial activities, which must be aligned with strategic objectives and simultaneously sustain and grow its capacity for entrepreneurship.
Entrepreneurial Teaching and Learning (EnTeaLearn)	Score ranging from 1 to 5	Captures the conditions that an HEI has to explore innovative teaching methods and stimulate entrepreneurial mindsets.
Preparing and Supporting Entrepreneurs (PrepSuppEn)	Score ranging from 1 to 5	Captures how HEI could support, providing targeted assistance in generating, evaluating, and acting upon student, graduate, and staff entrepreneurial ideas.
Digital Transformation and Capability (DigTranCap)	Score ranging from 1 to 5	Captures the HEI digital capability as an ability to integrate, optimize and transform digital technologies to support innovation and entrepreneurship.
Knowledge Exchange and Collaboration (KnExColl)	Score ranging from 1 to 5	Captures the HEI third mission performance and its impacts on the benefit of social, cultural, and economic development of society.
The Internationalized Institution (TIntInst)	Score ranging from 1 to 5	Captures the HEI approach to the design and delivery of education, research, and knowledge exchange, integrating an international or global dimension.
Measuring Impact (MeasImp)	Score ranging from 1 to 5	Captures the HEI importance of acknowledging the impact of the changes performed in their institution.
Dependent Variable – Discriminant Analysis		
Variable Name	Metric	Description
Entrepreneurial Performance (EP)	Score ranging 0 to 1	Captures dean/president perception of HEI entrepreneurship. 0 = HEI with EP 1 = HEI without EP
Outcome - fsQCA		
Variable Name	Metric	Description
Mission Legitimation (ML)	Score ranging 1 to 5	Captures dean/president perception of the HEIMLin result of an EP. Five point Likert scale from 1 = strongly disagree To 5 = strongly agree
Entrepreneurial Mode (Mode)	Score ranging 0 to 3	Captures dean/president perception of entrepreneurial mode. 0 = Non entrepreneur 1 = <i>University Entrepreneur One</i> 2 = <i>University Entrepreneur Two</i> 3 = <i>University Entrepreneur Three</i>

We aim to explore the versatility of the HEInnovate scale, presenting two approaches to the same reality and exploring the HEInnovate eight dimensions.

A quantitative approach intends to acknowledge the dimensions of HEInnovate, where HEIEP works as a discriminant function. We employed discriminant analysis to identify which of the eight HEInnovate dimensions differentiate the Entrepreneurial/Non-Entrepreneurial HEI. The statistical analyses were performed using IBM SPSS Statistics - Version 26. We performed a Confirmatory Factorial

Analysis (CFA) to test if the HEInnovate dimensions were consistent with the observed data and to analyse the factorial structure of each one of the eight dimensions. CFA allows the use of theory, empirical research, or both, hypothesizing the relationship pattern.

This research also explores, through a Fuzzy Set Qualitative Comparative Analysis (fsQCA), the causal contributions of HEInnovate dimensions as conditions to achieve the outcome: the legitimation of university missions – teaching, research, and entrepreneurship – showing solutions cases in the output according to the dean/president perception of entrepreneurial mode. In this approach, we use fsQCA software – version 3.0 – to apply the Fuzzy Set QCA method. The diffusion of the comparative method, a process initiated by Charles Ragin (Ragin, 1987), represents an opportunity to explore the question of "what should we identify as entrepreneurial?" considering the causal contributions of entrepreneurial conditions to achieve an entrepreneurial outcome (Coduras et al., 2016). Nowadays Fuzzy Set QCA method is used in multiple areas of knowledge, namely in international relations, business and economics, management and organization, legal studies and criminology, education, and health policy research (Thiem & Duşa, 2013). Commonly valuable for the analysis of asymmetric information (De Crescenzo et al., 2022), it has also been used to explore the combination of dimensions, motivations, and opportunity perceptions that lead to an increase in performance (Kusa et al., 2021). The Fuzzy Set QCA method presents clear benefits in the financial area analysis (Lassala et al., 2021; Ribeiro-Navarrete et al., 2021) and knowledge innovation management (Yue, 2022). This represents an opportunity to explore using the Fuzzy Set QCA method to identify the HEI different evaluations of HEInnovate dimensions to achieve an ML.

4.4 Results

We performed descriptive analyses to characterize our sample. It was possible to obtain a geographic dispersion, bringing at least one answer in 65% of the Portuguese districts. 37.5% of respondents were from universities, while 62.5% were from Polytechnic Institutes. 50% of respondents are from private institutions, and 50% are public.

A CFA was conducted to investigate the adequacy of each HEInnovate scale dimension on this data set (Appendix C). Bartlett's test of sphericity was performed to test the

significance of all the correlations within the correlation matrix. The Kaiser-Meyer-Olkin (KMO), which measures the sampling adequacy and shows the strength of the relationships among variables, was also analysed.

Appendix D presents the descriptive statistics of the variables under study. In Table 4.2, the dimensions are presented ordered according to their explanatory power for the discriminant analysis. Thus, the dimensions are ranked by considering their ability to differentiate the group that considers having an EP from the one that claims not to have an EP. According to the higher-value (considering it has a cutoff point: load value ≥ 0.3), the discriminant analysis revealed that 6 of the eight dimensions displayed a higher value to differentiate the groups. In this sense (Table 4.2), it is possible to observe that the variables associated with the dimensions of Digital Transformation and Capability (0,572), Entrepreneurial Teaching and Learning (0,537), Organizational Capacity: Funding, People, and Incentives (0,515), Leadership and Governance (0,514), Preparing and Supporting Entrepreneurs (0,452) and Knowledge Exchange and Collaboration (0,341) and differentiated better the group that presents an EP.

Table 4.2 Structure Matrix

Dimension	Function 1
DigTranCap	0,572
EnTeaLearn	0,537
OrgCap	0,515
LeadGov	0,514
PrepSuppEn	0,452
KnExColl	0,341

Furthermore, we explore the relationship between university ML and HEInnovate dimensions or dimension combinations responsible and appropriated to an ML outcome. The HEInnovate scale uses a five-point Likert scale ranging from 1 to 5. The statements have been designed to be rated on a scale of 1 to 5, where 1 represents the lowest and 5 is the highest score. To perform fsQCA analysis, it is necessary to rescale the answers in a process called calibration (Ragin, 2017). The fsQCA software package (version 3.0) used in the second approach allows the automatic recoding of the variables according to the degree of membership ranging from 0 to 1. Based on the direct assignment method, the transformation of five-point scale was transformed into a Fuzzy Set membership of 0.1, 0.2, 0.4, 0.7, and 1. With the use of a truth table, it is possible to present the k conditions is possible to obtain 2^k combinations that allow the achievement of the required results (Ragin, 2017). Considering eight causal conditions,

we are faced with a truth table with 256 lines where the totality of possible combinations is presented. The '~' represents a sign of negation (Ragin, 2017).

This analysis tests the ML that represents the existence of a legitimation game of university missions, a concept developed by Etzkowitz (2003) as a function of the HEInnovate dimensions - LeadGov, OrgCap, EnTeaLearn, PrepSuppEn, DigTranCap, KnExColl, TIntInst, MeasImp – as conditions to its achievement. Table 4.3 summarizes the relevant solutions to an ML outcome presenting the conditions, levels of consistency, and coverage. According to Schneider & Wagemann (2012), the consistency level to a necessary condition should be above 0.9.

In Table 4.3, it is possible to observe that this condition is verifiable in all the presented solutions with levels of consistency with values between 0.986431 and 1. In this way, and based on the aforementioned values, we can say that the coverage of the conditions corresponds to at least 98% of the outcome.

Table 4.3 fsQCA Solutions for Mission Legitimation using HEInnovate dimensions as conditions.

Model: ML=f(LeadGov, OrgCap, EnTeaLearn, PrepSuppEn, DigTranCap, KnExColl, TIntInst, MeasImp)		
Algorithm: Quine-McCluskey		
Frequency cutoff: 1	Solution coverage:	Solution consistency
	0.693184	: 0.980862
Consistency cutoff: 0.982166	Raw coverage	Consistency
~LeadGov*~OrgCap*~EnTeaLearn*~PrepSuppEn*~DigTranCap*~KnExColl*~TIntInst	0.229286	1
~ LeadGov *~ OrgCap *~ EnTeaLearn *~ PrepSuppEn * DigTranCap * TIntInst *~MeasImp	0.321938	0.976737
~ LeadGov *~ OrgCap *~ PrepSuppEn *~ DigTranCap * KnExColl * TIntInst *~ MeasImp	0.297657	0.989381
LeadGov * EnTeaLearn * PrepSuppEn * DigTranCap * KnExColl * TIntInst *~ MeasImp	0.404473	1
LeadGov * OrgCap * EnTeaLearn * PrepSuppEn * DigTranCap * TIntInst * MeasImp	0.452609	1
LeadGov * OrgCap * EnTeaLearn * DigTranCap * KnExColl *InstInter* MeasImp	0.511182	0.996885
LeadGov *~ OrgCap * EnTeaLearn * PrepSuppEn * DigTranCap *~ KnExColl *~ TIntInst *~ MeasImp	0.186794	1
LeadGov *~ OrgCap *~ EnTeaLearn * PrepSuppEn * DigTranCap *~ KnExColl * TIntInst *~ MeasImp	0.253248	1
LeadGov * OrgCap *~ EnTeaLearn *~ PrepSuppEn *~ DigTranCap * KnExColl *~ TIntInst * MeasImp	0.201278	1
LeadGov *~ OrgCap *~ EnTeaLearn *~ PrepSuppEn *~ DigTranCap * KnExColl * TIntInst * MeasImp	0.255059	0.997501
LeadGov * OrgCap *~ EnTeaLearn *~ PrepSuppEn * DigTranCap * KnExColl * TIntInst *~ MeasImp	0.309691	0.986431
Cases with greater than 0.5 membership in term ~LeadGov*~OrgCap*~EnTeaLearn*~PrepSuppEn*~DigTranCap*~KnExColl*~TIntInst: Non Entrepreneur(0.616667,0.7), Non Entrepreneur (0.6,0.7), Non Entrepreneur (0.54,0.7)		
Cases with greater than 0.5 membership in term ~ LeadGov *~ OrgCap *~ EnTeaLearn *~ PrepSuppEn * DigTranCap * TIntInst *~MeasImp: Mode 1 (0.56,0.7), Non Entrepreneur (0.54,0.4), Non Entrepreneur (0.52,1)		
Cases with greater than 0.5 membership in term ~ LeadGov *~ OrgCap *~ PrepSuppEn *~ DigTranCap * KnExColl * TIntInst *~ MeasImp: Non Entrepreneur (0.54,0.7), Non Entrepreneur (0.52,1), Non Entrepreneur (0.52,0.7), Non Entrepreneur (0.52,0.7), Non Entrepreneur (0.52,0.7)		
Cases with greater than 0.5 membership in term LeadGov * EnTeaLearn * PrepSuppEn * DigTranCap * KnExColl * TIntInst *~ MeasImp: Mode 1 (0.55,0.7), Mode 3 (0.55,1), Mode 1 Non Entrepreneur (0.55,0.7), 1 (0.52,0.7)		
Cases with greater than 0.5 membership in term LeadGov * OrgCap * EnTeaLearn * PrepSuppEn * DigTranCap * TIntInst * MeasImp: Mode 3 (0.64,1), Mode 2 (0.633333,0.7), Mode 1 (0.6,1), Mode 3 (0.58,1), Mode 3 (0.55,1), Mode 3 (0.55,1), Mode 3 (0.55,1), Mode 1 (0.55,0.7), Mode 3 (0.55,1), Mode 3 (0.55,1), Mode 3 (0.516667,0.7), Mode 2 (0.516667,0.7)		
Cases with greater than 0.5 membership in term LeadGov * OrgCap * EnTeaLearn * DigTranCap * KnExColl *InstInter* MeasImp: Mode 2 (0.75,0.7), Mode 2 (0.7,1), 3 (0.7,0.7), Mode 1 (0.64,1), Mode 3 (0.64,1), Mode 1 (0.6,1), Mode 3 (0.55,1), Mode 3 (0.55,1), Mode 1 (0.55,0.7), Mode 3 (0.55,1), Mode 3 (0.55,1), Mode 1 (0.54,0.7), Mode 3 (0.52,1), Mode 3 (0.516667,0.7), Mode 2 (0.516667,0.7)		
Cases with greater than 0.5 membership in term LeadGov *~ OrgCap * EnTeaLearn * PrepSuppEn * DigTranCap *~ KnExColl *~ TIntInst *~ MeasImp: Mode 1 (0.52,0.7)		
Cases with greater than 0.5 membership in term LeadGov *~ OrgCap *~ EnTeaLearn * PrepSuppEn * DigTranCap *~ KnExColl * TIntInst *~ MeasImp: Mode 2 (0.52,0.7)		
Cases with greater than 0.5 membership in term LeadGov * OrgCap *~ EnTeaLearn *~ PrepSuppEn *~ DigTranCap * KnExColl *~ TIntInst * MeasImp: Mode 1 (0.54,0.7)		
Cases with greater than 0.5 membership in term LeadGov *~ OrgCap *~ EnTeaLearn *~ PrepSuppEn *~ DigTranCap * KnExColl * TIntInst * MeasImp: Mode (0.52,0.7)		
Cases with greater than 0.5 membership in term LeadGov * OrgCap *~ EnTeaLearn *~ PrepSuppEn * DigTranCap * KnExColl * TIntInst *~ MeasImp: Mode 2 (0.533333,0.4), Mode 1 (0.516667,0.7)		

Table 4.4 shows the necessary and sufficient conditions analysis of the outcome ML for Portuguese HEI considering HEInnovate dimensions as conditions. The LeadGov, OrgCap, EnTeaLearn, PrepSuppEn, DigTranCap, KnExColl, TIntInst, and MeasImp are

sufficient conditions for an HEIML. The conditions DigTranCap (0.807667) and TIntInst (0.880511) assume greater prominence in the analysis of necessary conditions.

Table 4.4 Results for Necessary Conditions for Outcome – ML

Model: ML= f(LeadGov, OrgCap, EnTeaLearn, PrepSuppEn, DigTranCap, KnExColl, TIntInst, MeasImp)

	Consistency	Coverage
LeadGov	0.769968	0.940671
~ LeadGov	0.433866	0.944367
OrgCap	0.657508	0.973510
~ OrgCap	0.563578	0.935313
EnTeaLearn	0.658147	0.969868
~ EnTeaLearn	0.552715	0.922175
PrepSuppEn	0.605431	0.981865
~ PrepSuppEn	0.599041	0.905797
DigTranCap	0.807667	0.948237
~ DigTranCap	0.415335	0.974513
KnExColl	0.754632	0.902905
~ KnExColl	0.428115	0.968208
TIntInst	0.880511	0.911979
~ TIntInst	0.311821	0.997955
MeasImp	0.610756	0.972858
~ MeasImp	0.612353	0.941851

Furthermore, fsQCA also presents paths for HEIML using HEInnovate dimensions as conditions based on the complex solutions. Table 4.5 synthesizes the most relevant recipes that fsQCA offers and that complements the discriminant analysis conclusions.

Table 4.5 fsQCA recipes for HEI Missions Legitimation

Model: ML=f(LeadGov, OrgCap, EnTeaLearn, PrepSuppEn, DigTranCap, KnExColl, TIntInst, MeasImp)	
LeadGov * EnTeaLearn * PrepSuppEn * DigTranCap * KnExColl * TIntInst *~ MeasImp	A high perception of HEIML exists when an HEI considers it relevant the observance of the dimensions of Leadership and Governance, Entrepreneurial Teaching and Learning, Preparing and Supporting Entrepreneurs, Digital Transformation and Capability, Knowledge Exchange and Collaboration, The Internationalized Institution, without considering the observance of the dimension referring to Measuring Impact. The HEI with high membership scores for the outcome with this recipe is <i>University Entrepreneur Three</i> .
LeadGov * OrgCap * EnTeaLearn * PrepSuppEn * DigTranCap * TIntInst * MeasImp	A high perception of HEIML exists when an HEI considers it relevant to comply with the dimensions of Leadership and Governance, Organizational Capacity: Funding, People and Incentives, Entrepreneurial Teaching and Learning, Preparing and Supporting Entrepreneurs, Digital Transformation and Capability, The Internationalized Institution, and Measuring Impact. The HEI with high membership scores for the outcome of this recipe is <i>University Entrepreneur One</i> and <i>University Entrepreneur Three</i> .
LeadGov * OrgCap * EnTeaLearn * DigTranCap * KnExColl *InstInter* MeasImp	A high perception of HEIML exists when an HEI considers it relevant to comply with the dimensions of Leadership and Governance, Organizational Capacity: Funding, People and Incentives, Entrepreneurial Teaching and Learning, Digital Transformation and Capability, Knowledge Exchange and Collaboration, The Internationalized Institution, and Measuring Impact. The HEI with high membership scores for the outcome with this recipe are <i>University Entrepreneur One</i> , <i>University Entrepreneur Two</i> , and <i>University Entrepreneur Three</i> .

4.5 Discussion

The results reveal that the DigTransCap dimension has the greatest discriminant power in HEIEP. The fsQCA also highlights TIntInst (0.880511) and DigTransCap (0.807667) as necessary and sufficient conditions for an ML outcome. Consequently, the results show the positive presence and relevance of digital capability. According to OECD/EC (www.heinnovate.eu), the HEI digital capability dimension refers to integrating, optimizing, and transforming digital technologies to support innovation and

entrepreneurship. Considering that in the second decade of the 21st century, digital transformation has become a priority for HEI (Benavides et al., 2020). As a natural and necessary process for organizations, digital transformation has social, organizational, and technological implications, affecting teaching, infrastructure, curriculum, administration, research, business process, human resource, extension, digital transformation governance, information, and marketing. More than technological progress, digital transformation affects the university culture, administrative activities, teaching, research, and the people involved (Benavides et al., 2020).

Our results show that each condition (i.e. Leadership and Governance, Entrepreneurial Teaching and Learning, Preparing and Supporting Entrepreneurs, Digital Transformation and Capability, Knowledge Exchange and Collaboration, The Internationalized Institution, Measuring Impact, and Organizational Capacity: Funding, People and Incentives) is present in at least one combination (recipe) that allows the achievement of a ML outcome (see Table 5). However, it is also possible to verify that we can find the conditions in more than one of the solutions. These results are in line with Kusa et al. (2021), who observed that achieving the outcome through different articulations of existing conditions is possible. It is important to highlight that the three solutions that showed a higher consistency are those that integrate elements that they consider to be entrepreneurial and that are *University Entrepreneur Three* - influencing regional innovation's effectiveness with an active role in collaboration with industry and the government (Etzkowitz, 2013). In addition, the TIntInst dimension presents results for Necessary Conditions for Outcome ML, where we can identify a more significant discrepancy between consistency for the condition TIntInst (0.88051) and its negation represented by \sim TIntInst (0.311821). Therefore, we can consider that the absence of an internationalized approach to the HEI is inconsistent with the HEIML.

This research provides substantial theoretical contributions to the literature. First, it confirms the applicability and suitability of HEInnovate dimensions to Portuguese HEI. Secondly, this study reinforces the Resource and Capabilities approach, reiterating the need to deepen the knowledge about the entrepreneurial parameters to consider in entrepreneurial anatomy and develop EP metrics. There is a recognition that the successful development of the Ent_Uni metrics needs radical revision (Etzkowitz, 2016). Knowing the aspects to be observed allows for identifying what is central and peripheral to HEIEP on a process of reflection and self-knowledge of the dimensions that wish to be observed in the development of the entrepreneurial process (OECD/EC, www.heinnovate.eu). The knowledge of the aspects that should be central to HEIEP

allows the triggering of more targeted and appropriate actions in the entrepreneurial context in which the institution is inserted. Thus, it will be more fruitful to work on more specific aspects that lie in the strategic alignment of HEI needs with the socio-economic needs of the region. From a mutualist perspective, we will have to foster cultural changes in the industry, government, and other ecosystems agents, assuming a bidirectional flow of resources and capabilities generated by the interaction and which enables the value co-creation between the multiple agents of the Ent_Eco (Schaeffer et al., 2021).

This research also demonstrates the versatility of analysis of the HEInnovate scale is fundamental to understanding and developing a HEIML. The study presents recipes based on the HEInnovate dimensions or combinations of dimensions to achieve an ML in a perspective that proves to be complementary when associated with other statistical analyses, allowing details that contribute to explaining the combination of dimensions to achieve the outcome (Coduras et al., 2016). The HEI who consider themselves entrepreneurs and who consider themselves to be in a *University Entrepreneur Three* phase - denoting the ability to influence regional innovation's effectiveness and performing with an active role in collaboration with industry and the government - are present in the three solutions that showed higher consistency. The absence of an internationalized approach to the HEI is inconsistent with the HEIML. The analysis of the HEInnovate criteria indicated that *University Entrepreneur Three* activities are targeted at supporting entrepreneurship (Voolaid et al., 2019).

This study also presents managerial implications. HEI are in demand to respond to higher education policies, funding pressures, and the pressure to become more 'entrepreneurial' and perform an active role in economic and social development (Kitagawa et al., 2016). This perspective helps us to understand the relevance of self-knowledge as part of the process of detaining an added value in EP (OECD/EC, www.heinnovate.eu). From this perspective, it is possible to create a synergy between improving aspects that we have already developed and exploring others that, until now, we did not know as being necessary to EP.

EP depends on the approach taken to the multiple dimensions of the HEInnovate scale (Voolaid et al., 2019). Considering the importance attributed to each of them by the HEI surveyed, it is essential to highlight the dimensions that stand out the most as they prove to be the most important for institutions that consider having an ML - TIntInst and DigTransCap. The results stress the enormous versatility potential of the HEInnovate scale, where each HEI could self-assess and self-define the better path to

pursue a HEIML. The importance of defining paths that are increasingly individualized and defined according to particularities and typologies and that reflect the historical conditions experienced in a given country or region are in line with recent studies that highlight their relevance in promoting entrepreneurship resulting from public policies increasingly suited to these specificities (Coduras et al., 2016). Analyzing the dimensions that did not show discriminate power is no less critical. The approach can be analysed in two ways. The variables TIntInst and MeasImp are not considered. In this case, we can assume that EP does not influence how HEI approach internationalization and impact measurement issues. Thus, there is a need to deepen the knowledge about the approach taken to these dimensions. We may question whether entrepreneurial HEI and non-entrepreneurial HEI already correctly address the TIntInst and MeasImp dimensions or, on the contrary, neglect them in their entrepreneurial strategy.

4.6 Conclusions

Each HEI should create its entrepreneurial anatomy to perform its third mission by combining a different set of missions, capabilities, and resources and contradicting the idea of an isomorphic solution where "one-size-fits-all". The HEI entrepreneurial transition merges internal development with necessary changes to reconcile an economic activity and address the emergent societal challenges. It is essential to facilitate Ent_Uni development based on entrepreneurial metrics with a significant variety of HEI third mission strategies and the tensions between external policy pressures and internal dynamics.

Despite the number of scientific studies developed on the Ent_Uni theme, we still need to deepen our understanding of "what should be considered entrepreneurial". Policies, practices, and organizational innovations designed to translate knowledge into economic activity and address societal problems have spread globally. The objective is to enable universities to play a creative role in economic and social development from an independent perspective while still being responsive to government and industry priorities. In this way, HEI can contextualize themselves and see their strengths and weaknesses, finding a strategic balance to find entrepreneurial anatomy that leads them to the desired EP.

Despite the accessibility and ease of use of the HEInnovate tool, determining how the assessment will be made could raise several questions related to the potential biases

associated with self-assessment - Which individual takes responsibility in the institution for self-assessing?; Whether or not this can or should be done in isolation and without consulting others in the organization.; Does a single individual would detain relevant information across all seven dimensions?; The respondent(s) have a too positive/ negative perspective on the organization's capability?; How could the respondent provide a single score to be given to each question without some cross-organizational consultation to demonstrate transparency and justify the Likert scores (from 1 to 5) provided? (Henry, 2015).

Our study has limitations that further investigations may overcome. First, our analysis is limited to Portuguese HEI. Secondly, we must also consider the sample size involved in the study. Although the population under analysis is small, using a reduced sample may imply a reduction in the power to detect an effect when one is to be noticed and increase the margin of error. Future research might develop studies that use the HEInnovate scale on larger samples. Knowing the relevance of training and digital adaptation of HEI, it is also crucial to deepen the instruments that allow a self-reflection of the relevant conditions for effective training to enable self-knowledge that enables a continuous improvement process. It is also essential to analyse the changes in institutional entrepreneurial solutions over different periods would be a helpful step forward to empirically enrich our understanding of entrepreneurial anatomy composition and entrepreneurial evaluation. Future research might analyse ML processes on an ecosystem level to explore the factors that positively and negatively influence the ML process.

Chapter 5. Bridging University Entrepreneurship Education and Support with Entrepreneurial Activity: A Graduate-centered Approach

Abstract

Entrepreneurial universities are capable of bridging innovation and the entrepreneurial ecosystems (Ent_Eco) to emerge as knowledge providers and capability aggregators that catalyse regional and national economic and social development. Given their prominent role in society, this study seeks to understand how entrepreneurial teaching and learning, preparing and supporting entrepreneurs and digital transformation and capabilities (HEInnovate dimensions) influence the development of entrepreneurial activities. Based on several interviews with graduate entrepreneurs, this study reveals the multiple different aspects involved in the university entrepreneurial structures approached by the dimension of the HEInnovate scale. This study discusses how entrepreneurial universities may train their graduates to develop entrepreneurial activities through investment in entrepreneurial education and a strong link between theoretical and practical aspects, thereby incorporating greater cooperation with industry and the government. The findings convey how entrepreneurial graduates are aware of the need for university-industry collaboration and the dependence on government policy and funding. The findings generate implications. This study contributes for theory and practice as well as a framework illustrating the articulation among formulated research propositions and underlining their positioning within the mutual engagement of triple-helix dynamics.

Keywords:

Entrepreneurial University, Entrepreneurial Ecosystem, Entrepreneurial Activity, Entrepreneurial Education, University Support for Entrepreneurship, University Digital Capacity

5.1 Introduction

As agents, universities directly engage in entrepreneurial processes (Huezo-Ponce et al., 2021). It is possible to observe mixed results, even after changing organizational structures, incentive systems, and strategic priorities, it is time for universities to examine the role played by entrepreneurial education (Ent-Edu) in shaping the entrepreneurial university (Ent_Uni) models to explore and exploit its entrepreneurial benefits (Gianiodis & Meek, 2020). Ent_Uni stand out as catalysts of regional and national economic and social development (Abreu et al., 2016; Etzkowitz et al., 2000; Gianiodis & Meek, 2020). As knowledge providers, the Ent_Uni has to deploy an entrepreneurial organizational culture characterized by flexibility and openness to change, that encourages entrepreneurship and provides more proactive and engaged responses to solving problems or otherwise helping society (Audretsch & Belitski, 2022; Etzkowitz, 2016), and driving entrepreneurial ecosystems (Ent_Eco) forward (Audretsch & Belitski, 2022). Ent_Uni act as capability aggregators (Audretsch et al., 2019), bridging innovation and Ent_Eco (Autio et al., 2014a) and play a preeminent role in establishing the framework and conditions for Ent_Eco through entrepreneurial education (GEM, 2022).

Ent_Uni, integrated into entrepreneurial and innovation ecosystems, can change, innovate, recognize and create opportunities, and achieve widespread recognition for their proactivity and propensity to deal with risks and challenges to extract value from their knowledge bases (Ruiz et al., 2020). It is still vital to stress the relevance of evolving toward greater digitalization, a process where strategic partners in the innovation ecosystem are essential (Beliaeva et al., 2020). Linking the formal and informal aspects inherent to entrepreneurial processes (Kirby et al., 2011), Ent_Uni also embrace the challenges inherent to involvement in large-scale scientific projects, carrying out contracted research, consulting, patenting, licensing, producing spin-offs, external education and/or the development of new products (Bernasconi, 2005; Jacob et al., 2003; Klofsten & Jones-Evans, 2000; Zhao, 2004). Furthermore, we are currently witnessing growing appreciation of liaisons between academic research and industry to interconnect research and innovation and enable simultaneous gains for science and industry while also meeting societal challenges (Sá et al., 2018).

In keeping with the relevance of Ent_Uni in responding to economic and social challenges, there is a need to assess and explore the capabilities of HEI to meet those challenges and expectations (Voolaid et al., 2019). In a virtuous circle of independence from and involvement with government, industry, and sponsors, Ent_Uni seeks out the

practical and theoretical implications of research, technology transfer, launching firms and businesses and running training entrepreneurship programs (Etzkowitz, 2016).

The HEInnovate self-assessment tool (<https://www.heinnovate.eu/en>), developed by the OECD/EC, enables HEI to evaluate the different components of their entrepreneurial capacities to gain the opportunity to reflect on their perceived strengths and weaknesses and create awareness of institutional development needs (Voolaid et al., 2019). Nevertheless, the literature has not fully accounted for the link between Ent_Uni entrepreneurial capacity components, in particular, the relevance of three HEInnovate dimensions - (1) Entrepreneurial Teaching and Learning, (2) Preparing and Supporting Entrepreneurs, and (3) Digital Transformation and Capability - in further developing entrepreneurial activities (Ent_Act) of graduate students. This paper hereby acknowledges this gap, addressing Ent_Uni entrepreneurial capacities in the aforementioned HEInnovate dimensions to explore the conventional wisdom that entrepreneurial education boosts intentions to start one's own business and adopt a graduate-centered approach (Sánchez, 2013).

The literature reviewed and the need to deepen our understanding of the adequacy of the HEInnovate self-assessment tool, in accordance with graduates who undertook entrepreneurial projects, underpin the formulation of the following research questions: *How relevant are the HEInnovate dimensions - Entrepreneurial Teaching and Learning, Preparing and Supporting Entrepreneurs, and Digital Transformation and Capability - for further developing Ent_Act? And what aspects are missing from a graduate-centered perspective?*

To address the research questions, we conducted an inductive qualitative study based on 13 interviews with university graduates. Each interviewee presents a path featuring, following graduated from university, the launching of entrepreneurial projects. Thus, based on this graduate centered perspective, we are able to assess the relevance of the aspects addressed in the dimensions under analysis in further developing Ent_Act and identify which facets are still lacking and require inclusion.

In acknowledging education as an essential instrument for fostering entrepreneurship in society and exploring the conventional wisdom that entrepreneurial education raises the level of intention to start businesses, this study makes three fundamental contributions. Firstly, based on original primary data, this contributes to the existing literature on Ent_Uni, Ent_Edu, and Ent_Act, and the need to develop, improve and explore measurement scales that return knowledge on Ent_Uni levels and the Ent_Edu outputs and outcomes. Secondly, considering that the HEInnovate self-assessment tool

involves certain challenges, it is important to raise awareness of the need for its continued evaluation and explore ways to strengthen its accuracy and value (Henry, 2015). Thus, this study extends the HEInnovate self-assessment tool and presents some relevant particularities for future entrepreneurs. The proposed framework visualises the articulation in the various research propositions (RP) formulated. Thus, the findings provide practical guidelines for rendering HEI more robust in terms of Ent_Edu. Thirdly and finally, based on the empirical evidence and in response to the research questions established, this sets out a framework enabling the illustration of the articulation in these themes and their positioning in the mutualism of Triple Helix (TH) dynamics, confirming the results of Clark *et al.* (2020).

To explore this theme, and following this introduction, the structure of our study is as follows: the next section focuses on reviewing the most pertinent literature for framing the HEInnovate dimensions under analysis. Afterwards, we present the methodology and then the results. Finally, we put forward a discussion of our results and the conclusions.

5.2 Theoretical Background

This study applies the theoretical perspective of the Theory of Planned Behaviour (TPB) (Ajzen, 1991), approaching the essential cognitive linkage between the antecedents and actual entrepreneurial actions (Zhang *et al.*, 2014). TPB is one of the prominent theories in assessing individual behaviours (Al-Kurdi *et al.*, 2020) based on the individual intentions presumed to capture the motivational factors that influence behaviours in accordance with the attitudes, subjective norms and perceived behaviour control (Ajzen, 1991).

TPB represents a common option for studying entrepreneurial education outcomes and outputs (Fayolle *et al.*, 2006; Fernández-Esquinas *et al.*, 2016; Huezco-Ponce *et al.*, 2021; Maresch *et al.*, 2016). Furthermore, education in entrepreneurship needs to result in entrepreneurial behaviours (Huezco-Ponce *et al.*, 2021) in keeping with the increasing student interest in entrepreneurship as a career choice (Fayolle & Gailly, 2015). Thus, Ent_Uni must shape the entrepreneurial self-efficacy of their students and, based on perceived behavioural control and intentions, predict behavioural achievement (Ajzen, 1991).

Ent_Uni may apply HEInnovate to explore, evaluate and develop their entrepreneurial capacities (Voolaid et al., 2019). Hence, and according to the research question, exploring whether Ent_Uni are actually preparing entrepreneurs according to their graduates who promoted entrepreneurial projects represents an essential objective. Are these HEInnovate dimensions relevant to actual entrepreneurial processes? What might be lacking?

We, therefore, analyse entrepreneurial education according to the HEInnovate dimensions, specifically: (1) Entrepreneurial Teaching and Learning, (2) Preparing and Supporting Entrepreneurs, and (3) Digital Transformation and Capability.

There is now due recognition that entrepreneurial education represents an unavoidable component of training and education within the scope of fostering market competition and entrepreneurship to continuously serve society and deliver entrepreneurial talents, adding theoretical value and practical significance (Xu et al., 2021).

5.2.1 Entrepreneurial Teaching and Learning

Universities develop, implement, and cultivate entrepreneurship education in recognition of its paramount importance to obtaining high-quality skilled talents with entrepreneurial spirits and abilities (Xu et al., 2021). Providing entrepreneurial teaching and learning involves exploring innovative teaching methods. More than simply learning about entrepreneurship, exposure to entrepreneurial experiences is also essential to both acquiring skills and competencies and stimulating entrepreneurial mindsets (OECD/EC, 2022).

Educating entrepreneurs differ from other academic fields in establishing goals that generally divide into three sliding levels - pioneers and entrepreneurs, individual operators and founders of new enterprises - that are interchangeable and mutually assist each other (Xu et al., 2021). The same authors state that classifying the educational goals of university entrepreneurship will help these institutions to implement education for entrepreneurship. Furthermore, focusing on the importance of HEI positioning and self-knowledge, the HEInnovate self-assessment tool enables institutions to create awareness about the dimensions of entrepreneurial capacities already mastered and those that still need strengthening (Voolaid et al., 2019). We seek to gauge the extent to which Ent_Uni provide formal and informal learning opportunities and experiences to stimulate entrepreneurial mindsets and develop skills.

The last two decades contain great promise for the emerging field of entrepreneurship as a far broader subject, exploring the development of entrepreneurial aspirations, orientations, behavioural patterns, university-industry-government partnerships, TH dynamics and launching businesses and firms (Audretsch & Belitski, 2021). Furthermore, the objectives have to highlight entrepreneurship education that enables more proactive academic researchers that prioritize (1) technology readiness and timing, (2) intellectual property pathway decisions, (3) engagement with Ent_Eco, and (4) personal career choices (Duval-Couetil et al., 2021b). These priorities align with those recommended by HEInnovate, enabling HEI entrepreneurial learning outcomes, which drive the design and execution of the entrepreneurial curriculum, co-designing and delivering the curriculum with external stakeholders and integrating the results of entrepreneurship research (OECD/EC, 2018).

5.2.2 Preparing and Supporting Entrepreneurs

HEI can assist students, graduates and staff to start businesses and adopt entrepreneurship as a career option (OECD/EC, 2022). As a rule, the challenges involved in supporting student startups and mentoring relate to one of two reasons: a lack of demand for support or a lack of supply of support (Zobnina et al., 2019). Furthermore, the university's entrepreneurial performance should reflect its capabilities for patenting, licensing, research collaboration, consulting, networking, entrepreneurship education, and support for creating and growing new ventures (Ricci et al., 2019). Philpott et al. (2011) also stress the relevance of other support activities, including research collaboration, training, consulting, networking and face-to-face communication, startup assistance and funding support. Synergistic combinations of different types of support provide targeted assistance for getting from idea generation to business launch while enabling the necessary skills for successful entrepreneurship. HEI constitute part of broader business support ecosystems that facilitate, or otherwise, access to appropriate financing and effective networks (OECD/EC, 2022). To achieve high levels of entrepreneurial performance, HEI should commit to their "entrepreneurial climates" which reward, promote and support entrepreneurship with the participation of academic and non-academic, duly trained staff that assist researchers in the commercializing and funding processes of their projects (Ricci et al., 2019).

The literature also details how entrepreneurial processes are incompatible with the minor "supporting" role played by conventional teaching and, furthermore, verifies the

broad benefits returned by comprehensive university Ent_Eco playing significant roles (Levie, 2014). Formal channels need complementing with informal channels, enriched by the development of activities inherent to knowledge transfer processes ongoing between HEI and industry, including industry mentoring, internships, and industry talks and projects (Dang et al., 2019). Mentoring usually provides critical input into management development and assumes an even more important role in innovation development, playing a crucial role in university Ent_Eco (Ribeiro et al., 2018). Nevertheless, stealthy incursions into the ecosystem enhance the informal existence of industry mentoring, which further benefits from basing student assignments on their technology and enabling local role models in class (Levie, 2014). Incubation platforms also play crucial roles in stimulating the development of innovative business climates with their immersion in regional ecosystems bringing together a set of key stakeholders, for example, industrial clusters, academic institutions, research labs, banks, and investors (Lamine et al., 2018). Enabling access to incubators provides essential links in the entrepreneurial value chain (Phan & Siegel, 2006), fostering the conceptual connection between science, technology, education, knowledge, entrepreneurial talent and capital (Mian et al., 2016).

This therefore requires appropriately aligning knowledge creation, knowledge transformation, and knowledge commercialization, which in turn demonstrates the importance of exploring the extent to which the congruence between entrepreneurial capital and knowledge capital contribute to the performance of Ent_Uni (Audretsch & Belitski, 2021).

5.2.3 Digital Transformation and Capability

The digital economy is redefining the rules of the game for higher education. Therefore, this requires exploring just how Ent_Uni manages this transition and digital competencies while remaining competitive in the higher education market (Guerrero, Heaton, et al., 2021).

Digital technology appears as an input necessary to enhancing the efficiency of the value chain and productivity (Iansiti & Levien, 2004). In this scenario, we have to couple the digitization concept with the radical transformation that digital technologies leveraged at the economic and social levels (Acs et al., 2018).

The COVID-19 pandemic posed an unprecedented challenge that added to the continuous training in the digital competencies required in current workplaces.

Additionally, a new profile exists for students born in an online era with constant digital access and broader training paths (Guerrero, Heaton, et al., 2021).

While there is recognition that HEI already deploy digital technologies, there still remains significant asymmetries in their acceptance and institutional integration (OECD/EC, 2022). Thus, it is important to continue emphasizing that HEI should approach digital technologies as key enablers, with HEInnovate proposing a reflection on (1) promoting digital culture and implementing and monitoring digital strategies in support of innovation and entrepreneurship, (2) investing in management and the continuous improvement of fit-for-purpose digital infrastructures, (3) supporting the application of digital technologies to enhance quality and equity in teaching, learning and assessment, (4) making recourse to open educational resources, open science and open data practices to improve the performance of institutions and heighten their impacts on their respective ecosystems, and (5) fully leveraging their digital capabilities for nurturing sustainable and inclusive innovation and entrepreneurship (OECD/EC, 2022).

5.3 Methodology

5.3.1 Research Context

We explore three HEInnovate dimensions - (1) Entrepreneurial Teaching and Learning, (2) Preparing and Supporting Entrepreneurs, and (3) Digital Transformation and Capability – that, according to the OECD/EC (2022) require prioritising by Higher Education Institutions (HEI) in keeping with their relevance to graduate Ent_Act development. We relied on the HEInnovate dimensions to assess their relevance and identify those aspects for improvement or even launching so that HEI provide education for entrepreneurship metacognition. Based on the Preparing and Supporting Entrepreneurs HEInnovate dimension, we also enquire into understanding the relevance of the items considered, both those most relevant and potential, not yet considered, aspects that these graduates identify as susceptible for improvement or introduction to boost the HEI level of performance. Based on the Digital Transformation and Capability HEInnovate dimensions and, according to the current understanding that HEI already deploy digital technologies, we also study the uptake and integration of this digital transformation to understand whether digital technologies serve as key enablers for innovation and Ent_Act.

Several motives explain this exploration of the alignment between the teaching, preparing, and supporting of entrepreneurs by HEI and the skills entrepreneurs themselves perceive as necessary for undertaking Ent_Act where first, there is the need to understand whether what universities are focusing on – HEInnovate - effectively reflects that most relevant to entrepreneurial training processes. Assessing the correct development of system metrics will facilitate the future evolution of Ent_Uni and enhance their repercussions in economic and social development (Etzkowitz, 2016).

Second, understanding whether there are discrepancies between the entrepreneurial education actually provided by HEI and the skills necessary for entrepreneurial metacognition and subsequent development of entrepreneurial activities is essential to exploring the synergetic use of causal and effectual logic (Chen & Xu, 2022).

5.3.2 Sampling Logic and Data Collection

This study aims to enrich the issues studied by a primary data based qualitative methodology. Qualitative studies consider the respective research questions and defined objectives (Smith, 1983). Carrying out inductive qualitative studies represents a promising option whenever quantitative analysis does not allow for study of the essence of the phenomena under study, for example, more complex issues, returning a deeper understanding and with applications of this methodology accounting for a growing trend (Yin, 2018).

The study analyses the qualitative data obtained through interviews, deemed an appropriate option whenever seeking to grasp a particular fact or phenomenon, particularly with the lack of a robust theoretical framework to understand it (Guerrero & Urbano, 2012). From June to October 2022, we conducted 13 semi-structured interviews (see interview guidelines Appendix E), characterized by a script that helps the interviewer develop the interview through randomness in order to place the questions and adapt to individual interviewees.

Figure 5.1 illustrates the analysis model based on the HEInnovate self-assessment tool dimensions – Entrepreneurial Teaching and Learning, Preparing and Supporting Entrepreneurs and Digital Transformation and Capability. Based on interviewee perceptions, we are able to ascertain their relevance to further developing Ent_Act in addition to proposing suggestions for improving each dimension.

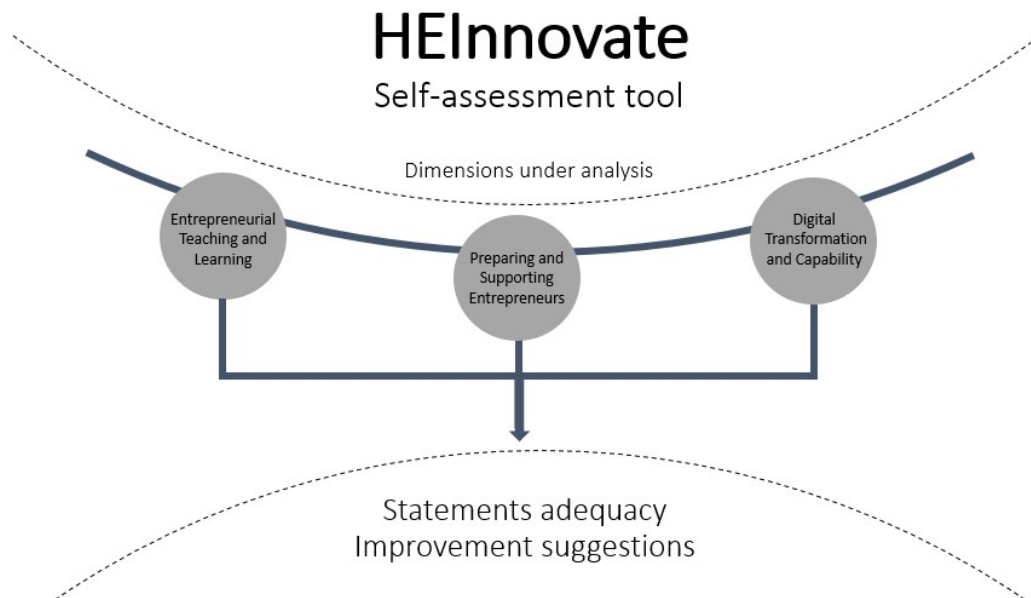


Figure 5.1 Model of analysis.

Table 5.1 briefly describes the study respondents, identifying their sectors of activity and entrepreneurial projects they developed, their hierarchical position, the locations of their projects and the year of foundation.

Table 5.1 Summary of respondents

Respondent	Sector (market)	Brief description of the entrepreneurial project	Location (Country)	Position of interviewee	Founded
E1	Technology (B2B)	Tech startup focused on building efficient machine learning-based products to solve and automate daily problems through computer vision and take a step forward towards smarter cities.	Covilhã (Portugal)	CEO and founder	2015
E6	Services (B2C)	Development of clean and renewable energy generation projects especially focused on solar technology, providing services and specialized know-how throughout the project value chain.	Viseu (Portugal)	CEO and founder	2018
E2	Technology (B2B)	An engineering company that provides outsourcing R&D services for 5G wireless communications and high-performance software solutions for various industries.	Castelo Branco (Portugal)	CEO and founder	2015
E3	Services (B2C)	Execution of irrigation systems, pumping, and filtering, as well as photovoltaic systems. The company carries out the study, design and implementation and provides technical assistance.	Mangualde (Portugal)	CEO and founder	2016
E4	Technology (B2B)	A biotechnology company dedicated to designing and manufacturing human protein-based products with applications in cell culture, tissue engineering and regeneration, and disease modelling.	Aveiro (Portugal)	CEO and founder	2018
E5	Technology (B2B and M2M)	A company specializing in computer security, data communications, cloud computing, software platforms, systems, and network management. This includes consulting, auditing, the design, development, and administration of ICT solutions for companies, public sector institutions, public services, and telecommunications operators.	Castelo Branco (Portugal)	CEO and founder	2015
E7	Services (B2C)	Developing clean and renewable energy generation projects, focusing on solar technology, providing services and specialized know-how throughout the project value chain.	Viseu (Portugal)	CEO and founder	2018
E8	Services (B2C)	Online sale of products designed to simplify the use of multiple cards, providing RFID protection.	Viseu (Portugal)	CEO and founder	2019
E9	Services (B2C)	Elaboration of agro-industrial projects involving planning, budgeting, monitoring and investment projects under the Rural Development Program European Union.	Mangualde (Portugal)	CEO and founder	2014

Table 5.1 Summary of respondentes (*Continued*)

Respondent	Sector (market)	Brief description of the entrepreneurial project	Location (Country)	Position of interviewee	Founded
E10	Services (B2B and B2C)	Development of projects, construction and engineering and diversified follow-ups in engineering.	Guarda (Portugal)	CEO and founder	2016
E11	Services (B2C)	Manufacture of orthodontic material and dental prostheses through innovative technological solutions associated with high investment in research and development activities to enable the introduction of new products and the increasing automation of production processes.	Oliveira do Hospital (Portugal)	CEO and founder	2017
E12	Technology (B2B)	Biotech company focused on the discovery and development of cutting-edge therapies targeted at slowing down neurological disorders, especially effective and safe therapeutic solutions to slow-down and treat Parkinson Disease patients.	Covilhã (Portugal)	CEO and founder	2020
E13	Services (B2C)	Park that promotes the organization of individual or group adventure activities, such as tree climbing, team building, bubble football, walking trails.	Penela (Portugal)	CEO and founder	2017

The flexibility in the interview structure also enables the interviewer to carry out good advance preparation. Correspondingly, the interviews provided the scope to approach themes not foreseen in the script, allowing for the emergence of some aspects we did not identify at the outset. Hence, it is the interviewer’s responsibility to conduct the interview and keep the discourse within the intended thematic line while ensuring the flexibility necessary to clarify certain aspects or address appropriate and relevant topics.

The respondent selection criteria increased the likelihood of study success in keeping with the knowledge and experience detained – graduates who later became advanced with entrepreneurial projects – on our study's central topic of University Entrepreneurial Education and Support for the Ent_Act of graduates (Eisenhardt & Graebner, 2007).

5.3.3 Data Analysis

We applied the principles of grounded theory to encode the information collected with constant interaction between the evidence collected and the concepts set out by the literature existing on the subject under study (Strauss & Corbin, 1998).

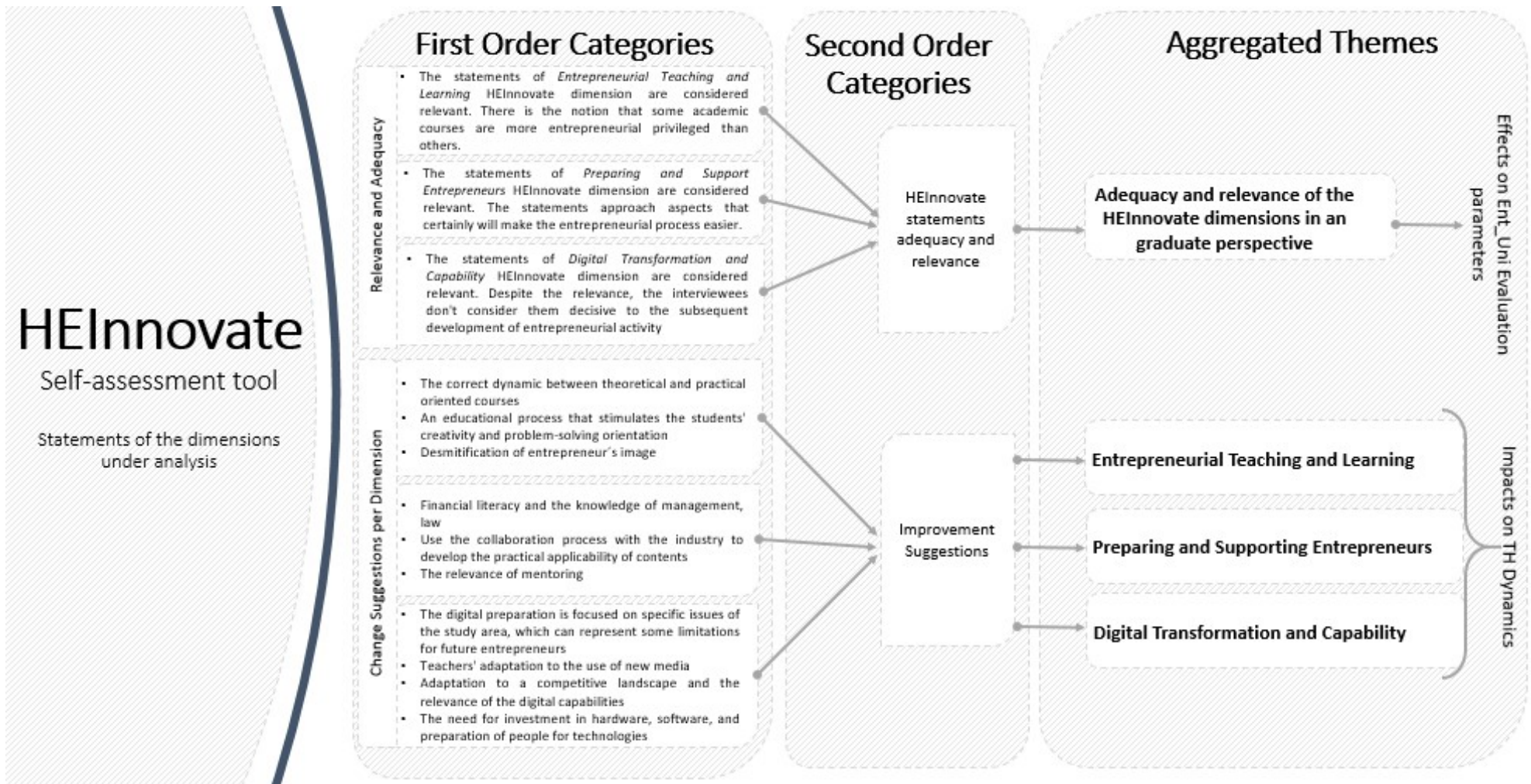


Figure 5.2 Data structure.

Figure 5.2 details the data structure resulting from successive combinations of the central themes of our study on University Entrepreneurship Education and Support in fostering subsequent graduate entrepreneurial activity.

We audio-recorded the interviews carried out with the prior authorization of the interviewee. To increase the reliability of interviews, we established feedback loops during the conversion to enrich the validity of the respective interpretations.

We deployed NVIVO software – version 12.6.1 – to support the coding process. This was interactive, involving successive rounds of literary interpretation and referencing as the themes emerged (Evans, 2013). In accordance with the interpretive research approach, we articulate three criteria that justify the contents presented in the study by Zayadin *et al.* (2022). To this end, and to construct communicative validity - coherence between the analysed information and the interpretations performed - an interview contextualization explains this purpose. Regarding transgressive validity, attentive to any contradictions or differences in the interpretations of researchers, we avoided preconceived ideas. Lastly, we ensured reliability through interpretive awareness focusing on the researchers' understanding of the perceptions and actions of each participant according to constant interaction with the existing literature (Zayadin *et al.*, 2022). Subsequent content analysis of the interview transcripts enabled identification of the predominant themes, the most representative quotations, the perceived relevance of HEInnovate statements on ulterior Ent_Act performance and the references to suggestions for change. Content analysis also served to develop a theoretical framework to illustrate how graduates perceive Ent_Edu, Ent_Uni support to entrepreneurs and Ent_Uni digital transformation and capability.

5.4 Findings

This analysis follows the recommendations of Yin (2018), structuring the research based on the existing literature, analyzing the emergence of eventual gaps and identifying exciting aspects of the topic under study. In keeping with the objective underlying this study - the need to deepen our understanding of the effectiveness of the HEInnovate self-assessment tool from the perspective of graduates who advanced with entrepreneurial projects - as well as the research questions formulated, we present the results obtained, structured according to each of the three HEInnovate dimensions under analysis.

5.4.1 Entrepreneurial Teaching and Learning

Recognizing the relevance of teaching and learning entrepreneurship, the OECD/EC deployed a specific dimension in its HEInnovate self-assessment tool designed to reflect HEI perceived strengths and weaknesses and foster awareness of institutional development needs, entitled Entrepreneurial Teaching and Learning (OECD/EC, 2022). This dimension explores the importance of entrepreneurial teaching and learning, innovative teaching methods, exposing students to entrepreneurial experiences and enabling the acquisition of skills and competencies that enhance the development of entrepreneurial mindsets. All the respondents consider the statements addressed in the Entrepreneurial Teaching and Learning dimension relevant. Nevertheless, despite the cross-disciplinary applicability of entrepreneurship (Maritz, 2017), E6 and E13 point out how some subject fields align better with Ent_Edu, such as management and economics degrees that inherently approach more entrepreneurship associated content. E7 and E13 further state that Ent_Edu is essential regardless of the study area. E7 also presents an example underlining the importance of entrepreneurial concepts in describing a civil engineer who only knows how to ask for prices and compare proposals.

Furthermore, E9 posits that Ent_Edu enables contacts with skills that not only apply to any job but also make entrepreneurs more independent, with freer thinking and more often outside of the box, of value and relevance to any entity, adding this should happen 'the sooner, the better'. This statement also addresses aspects referred to by Zhang (2020), underlining the importance of being entrepreneurial, with entrepreneurship education running from primary school to higher education, leveraging student capabilities for coping with uncertainty, ambiguity and risking to overcome new challenges, embracing constant personal and professional challenges: an idea widely shared by E8. Within the same general approach, E3 and E6 refer to the education system in the United States of America, which they state integrates Ent_Edu perfectly across the different levels of education.

According to E9, study programs remain overly theoretical and their contents lack practical applicability. E6 goes further and states that fostering experimentation and practice is crucial. E12 and E7 underline the importance of the ongoing proximity between companies and universities for promoting student contacts with the private sector with such interactions providing a practical meaning to classroom-covered contents.

E1 addresses these aspects by underlining the importance of the practical applicability of taught contents and a problem-solving orientation:

"I think that universities need to train entrepreneurs ... how to start, sell, and solve problems, which is very critical. Yet, everything in the curricular units related to entrepreneurship is usually very focused on the theoretical dimensions of management and writing business plans instead of taking a problem and finding a solution, understanding how this solution could be put on the market in a more practical style of learning".

This requires demystifying the image of entrepreneurs, demonstrating how entrepreneurship is a challenging but attainable path (E1). Ent_Edu can nurture belief in student ideas, encouraging the entrepreneurial process and clarifying the underlying bureaucratic requirements, aspects otherwise impossible for students without financial means. To enable these processes, someone needs to believe, encourage and help us take our first steps (E9). E12 reinforces the relevance of mentoring with E10 also mentioning the benefits of contacting mentors with entrepreneurial cultures more closely oriented towards extracting research-generated knowledge.

All respondents recognize such investment on behalf of HEI. Various statements particularize the importance of initiatives such as incubators, stating their path would have been different had this not been the case (E1, E4, E7, E8, E9, E10, and E11).

E10 and E2 posit that, based on their experiences, they consider the existence of a time gap between training and Ent_Act to be very relevant. E4 and E10 further affirm this time should serve to understand the transactional and contextual environments better so that it is later possible to proceed with the Ent_Act more effectively.

5.4.2 Preparing and Supporting Entrepreneurs

This HEInnovate dimensional approaches the process of Preparing and Supporting Entrepreneurs. The HEInnovate self-assessment tool posits that:

"HEI can help students, graduates, and staff consider starting a business as a career option. At the outset, it is important to help individuals reflect on the commercial, social, environmental or lifestyle objectives related to their entrepreneurial aspirations and intentions. For those who decide to proceed to start a business or another type of venture, targeted assistance

can then be offered in generating, evaluating, and acting upon the idea, building the skills necessary for successful entrepreneurship, and importantly finding relevant team members and getting access to appropriate finance and effective networks. In offering such support, an HEI should ideally act as part of a wider business support ecosystem rather than operating in isolation." (OECD/EC, 2022)

In terms of the relevance and suitability of the statements making up the *Preparing and Supporting Entrepreneurs* dimension, all respondents say they are suitable for the preparation and subsequent support of entrepreneurs.

E8 affirms that "everything you need is already mentioned," with E9 going further and stating that the conjunction of the aforementioned statements:

"will certainly make the (entrepreneurial) process easier".

In E2's opinion, what is effectively missing for the synergistic unification of the dimension under analysis is:

"above all, there is a lack of appropriate articulation with industry".

E4 and E7 underline the importance of this collaboration recognizing how Ent_Edu have benefited from mutualism in the established relationships between universities and ecosystem agents in line with the findings of Schaeffer *et al.* (2021).

Another example arises with financial literacy, which should relate to entrepreneurship teaching. The interviewees address the issue of financial literacy and emphasize the need to teach basic content that any entrepreneur needs to understand the rationale for the investment (E3) or the costs that salaries represent to the company (E7).

Respondents reference alumni even when adopting another scope and underline their potential role for supporting student Ent_Act. According to E1:

"The most important thing would be connecting alumni and new students to share knowledge and experiences. A platform - a social network - is an elementary thing that can change someone's future. Former students could provide knowledge (in a more informal way) about aspects that worked and what did not work for them so that this does not happen to us (especially concerning the mistakes they made)".

Ent_Edu should provide the knowledge that takes away feelings of need for experience of working as employees to gain the knowledge they need before feeling prepared to launch a business (E2, E3, and E4).

In an informal approach to knowledge transfer with industry partners, and according to E9, an example of a more useful practical applicability stems from running of internships with practical repercussions, and that lead to:

"measures that can be implemented, for example, when a student has to do a master's thesis or an internship, why not create a business model and a business idea?" and, whenever considered valid, the idea "could be integrated into an incubator or a workspace, and the business model could be transcribed into more practical things".

Mentoring represents another aspect widely valued by interviewees. E9 mentions its relevance to demystifying student ideas that:

"nobody believes in them because nobody encourages them and the process seems too bureaucratic. It is almost impossible and even more so for a student without financial means. You need someone who believes, encourages and helps you take your first steps".

According to E1, what:

"made all the difference was the existence of idea contests and showing that there was support to get started and that there were also people who would be available to give some help in whatever way they could".

E4, E9, E10 and E13 also highlight the importance of initiatives such as POLIEMPREENDE and university ideas competitions.

5.4.3 Digital Transformation and Capability

The HEInnovate dimension of Preparing and Supporting Entrepreneurs addresses this issue. According to the information available at www.heinnovate.eu/en (OECD/EC, 2022),

"HEI are already deploying digital technologies, however, the uptake and integration varies among and within institutions. HEI should make the

most out of the opportunities presented by digital transformation and consider digital technologies as a key enabler. This section of the self-assessment provides a number of statements to reflect on HEI digital capability, defined as the ability to integrate, optimize and transform digital technologies to support innovation and entrepreneurship”.

Regarding the relevance of the statements underlying the Digital Transformation and Capability dimension, interviewees consider they account for fundamental aspects of the entrepreneurial performance of HEI. E2 and E9 state that, despite their great relevance, these aspects are not decisive for the subsequent development of Ent-Act. E9 posits that the software used is very focused on specific issues in the study field and does not significantly relate to building digital skills, without which entrepreneurs may encounter certain limitations despite not representing a barrier. E6 explains how:

"if it weren't for digital skills, it would be impossible for me to be an entrepreneur in this area because they make it possible to do everything with fewer people at a structural and process level".

The ongoing COVID-19 pandemic has brought terrifying effects for labour markets worldwide (Fernandes, Veiga, et al., 2022). Nevertheless, COVID-19 also emerges as an opportunity to reinforce the social importance of Ent_Edu as a holistic process that requires the integration of response mechanisms, specific how to achieve recovery and change (Ratten & Jones, 2021). Since the first COVID-19 pandemic lockdown, HEI have abruptly switched to online learning and digital technologies (Nicklin et al., 2022). E1 refers to how:

"the digital transition, something whose need has been accentuated in recent decades, allows for fuller and more equitable education in which digital capacity is central".

E4 describes how:

"young people are all digital. To reach them, it has to be through digital media".

Within the same general approach, E12 and E8 posit

"it is essential to be well prepared digitally. Increasingly, those who do not have these capabilities are outdated".

E3 goes even further and declares:

"To perform our functions as we currently do, we can't learn much more and will undoubtedly become outdated. Our companies are not competitive. They don't generate money because they don't have enough innovation to have added value and to be able to work less (we have to work more to earn less), which doesn't allow us to evolve. When more digitally capable generations arrive in a few years, we will not be able to compete because, during that time, I was committed to not letting my company go bankrupt."

E1 states the problem lies in teachers adapting to and applying the new media with the probable tendency to stick with that they already know and already use. E9 explains:

"We talk about digital technologies and infrastructures but little is said about people. The human part of the question is missing – the lack of training, the lack of preparation of people for technologies. For example, the faculty, often so open to embracing these new technologies, is already somewhat resigned. There is a point missing in which the motto should be the person and preparing the person to welcome the other issues".

As referred to by E5, within this newly competitive landscape, it is essential HEI:

"Create working groups focused on digital capabilities with appropriate challenges to contribute significantly to development. Contributions could be transversal and involve several HEI (technological development, scientific articles). It makes people feel the need to learn to work in complementary areas, not in-depth, which allows me to make the decision-making process more accurate. Groups with tools and energy would enable kids to grow with the direct involvement of teachers".

E6 presents an example to illustrate the enrichment of Ent_Edu powered by DT with the case of *engineering in a global context*, a class taught in conjunction with a foreign university.

Another aspect raised addresses how HEI deal with increased complexity, which is necessary to enable students to manage large amounts of data (E6). E7 refers that we are not used to working on aspects related to collecting and processing the information, we are generating and should be able to manage.

5.5 Discussion

Based on our findings, this study also proposes a framework to illustrate the articulation in the formulated RP, underlining their positioning in the mutualism of TH dynamics as visualized in Figure 5.3. This section presents its discussion, which aims to deepen existing knowledge on the relevance of Ent_Edu as an essential instrument for fostering entrepreneurship in society and exploring the wisdom behind Ent_Edu increasing intentions to start business ventures. Seeking to answer the research questions - (1) How relevant are the HEInnovate dimensions under analysis for the future development of Ent_Act?; (2) What aspects are not included in the HEInnovate dimensions under analysis and which are essential for the future development of Ent_Act?

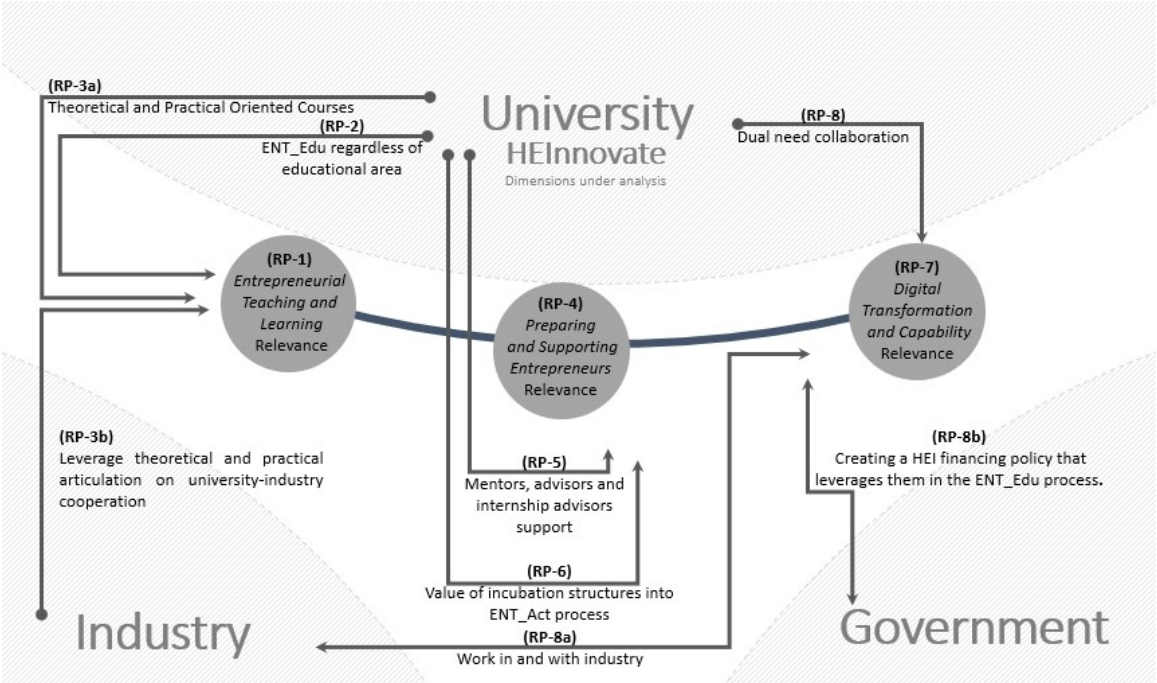


Figure.5.3 Graduate entrepreneur approaches to the HEInnovate dimensions.

This approach enables the recognition of the multiple aspects involved in the university entrepreneurial structure underlying the HEInnovate scale. Furthermore, this paper discusses how to portray the suggested changes by developing a framework that aligns them with TH dynamics, which bears implications for policymakers, universities, and the industry.

The advance of the 21st century presents educational institutions with challenges associated with implementing key concepts in contemporary Ent_Edu (Warhuus et al., 2017). In this scenario, Ent_Edu performs significant roles that, to a certain extent, serve as the driving motor for university Ent_Eco (Zobnina et al., 2019).

As new work environments develop and job markets change, the inevitability of university commitment to Ent_Edu stems from the capacity to enable high-quality skilled talents with entrepreneurial spirits and abilities, ensuring sense market competition and entrepreneurship (Xu et al., 2021).

The Ent_Uni and Ent_Edu (Audretsch, 2014) emerged as comprehensive concepts, cross-disciplinary and across universities (Maritz, 2017). The HEInnovate self-assessment tool seeks to promote reflection on the perceived strengths and weaknesses of HEI, creating awareness of institutional development needs, especially in how they perform Entrepreneurial Teaching and Learning (OECD/EC, 2022).

An Ent_Uni has configured its core activities - teaching, research, and entrepreneurship - around an Ent_Eco that generates a series of employment alternatives, fostering self-employment, academic entrepreneurship and leveraging intrapreneurship (Audretsch, 2014). HEI face various challenges - higher unemployment rates among university graduates, lowers levels of state funding and falls in demand for higher education studies - (Guerrero and Urbano, 2019a). There is now recognition that Ent_Uni combine their resources and capabilities to provide infrastructures, mechanisms, and educational programs to support the exploration and exploitation of entrepreneurial ideas (Guerrero & Urbano, 2012).

This study's empirical data revealed that the interviewees continue to associate Ent_Edu as prioritised only by certain fields of study, particularly management. Respondents affirm that regardless of the field of graduate study, knowing about management, law, and economics is essential. In keeping with the cross-disciplinary applicability of entrepreneurship (Maritz, 2017), these interviewees affirm the need to hold this knowledge to be able to process all the business information they have to deal with when developing Ent_Act and participating in decision-making processes in informed and conscious ways.

The aspects Zhang (2020) identifies underline the importance of being entrepreneurial, with Ent_Edu extending from primary schools into university, leveraging student capacities to cope with uncertainty, ambiguity and risk to overcome new challenges, embracing constant personal and professional challenges. Notably, this study observed that interviewees report the Ent_Edu system of the United States of America as a firm reference and an example to follow, both for the contents taught and the quality of the integration and articulation across multiple levels of education.

There is also questioning of the continuation of theoretically based entrepreneurial teaching systems, furthermore verifying that practical approaches still remain guided by a notorious lack of teacher experience and with a still incipient monitoring quality (Xu et al., 2021). The impact of practical teaching plays a central role in vocational education (Xu et al., 2021) with Ent_Edu eligible for delivery in various formats, with some heavily embedded in university infrastructures, providing students access to resources and expertise and enabling their business to develop (Zobnina et al., 2019). The dichotomy of theoretically or practically oriented Ent_Edu courses generates impacts according to the contents and contexts, the pedagogical strategies adopted as well as the educational consequences, broadly structured by actions, practices, experimentation/decision making, problem-solving/opportunity grasping and reflection (Piperopoulos & Dimov, 2015).

The findings demonstrate how entrepreneurs expect a type of teaching from universities that emerges out of the harmonious articulation of theory and practice. The interviewees also mentioned the opportunities for experimentation and verifying the practical applicability of the theoretical teachings as advantageous. At the same time, they feel there are benefits from instruction processes that nurture the development of critical thinking and problem-solving orientations.

This study also notes how several interviewees registered the need for more excellent university-industry articulation. They consider these cooperation relationships produce very enriching knowledge and that they somehow manage to bridge the classroom taught contents with industry experience able to guide this knowledge towards effectively resolving problems.

Taking into account how students generally hold stereotypical perceptions of entrepreneurs, what they do, how they get ideas, how they build their businesses and how they build networks. Usually myth based, the stories told by the media are primarily responsible for reinforcing these stereotypes (Warhuus et al., 2017). Hence, there is also a clear need to demystify the image of entrepreneurs, conveying how entrepreneurship constitutes a challenging but widely accessible path. Hence, Ent_Edu also proves preponderant in this aspect with interviewees pointing this out as the means of demystifying and encouraging entrepreneurial approaches. Another aspect concerns the integration of Ent_Edu initiatives into surrounding catalysts - science parks, incubators and accelerators - that received interest from Ent_Edu scholars (Maritz, 2017). The findings highlight the importance of these Ent_Uni initiatives considering that, otherwise, they would have been unable to gather the necessary

resources and mentoring support to develop their business ideas. Therefore, our study arrives at the following RP:

RP-1: Entrepreneurs consider the statements contained in the Entrepreneurial Teaching and Learning dimension relevant although they should be more detailed to enable more homogeneous institutional applicability.

RP-2: In keeping with the cross-disciplinary applicability of entrepreneurship, HEI are expected to consider Ent_Edu regardless of the field of education.

RP-3a: The dichotomy between theoretical or practical oriented Ent_Edu study programs requires careful management and, whenever possible, allowing for contact with reality.

RP-3b: The articulation between theoretical and practical-oriented courses would benefit from deepening university-industry collaboration, endowing a sense of practical applicability to classroom learned contents and enhancing student orientation towards problem-solving.

Collaboration between industry and academia must be based on entrepreneurial dynamics effectively contextualized within ecosystem contexts (Bouncken & Kraus, 2022). Furthermore, it is simply not possible to dissociate this theme from the importance of the respective ecosystem which necessarily requires valuing university interactions with the surrounding cultures, social networks and sources of investment capital. These right economic policies foster the development of innovation favourable environments (Spigel, 2017). Ent_Edu benefits from mutualism in the relationships established between universities and ecosystem agents in agreement with the findings of (Schaeffer et al., 2021).

With the labour market's requirements evolving rapidly, we currently witness an overlap of employability requirements and the competencies and skills generally associated with entrepreneurial performance (OECD/EC, 2018). Thus, and according to the same source, the market values business orientation - with strong customer awareness, problem-solving, teamwork, communication and literacy, information technology applications and an openness to new ideas coupled with the drive to extract value from these - goals that become achievable when we enable learning environments and teaching strategies to experience and exploit tacit knowledge and that encourage students to take ownership of their learning processes. Another example relates to teaching financial literacy, which requires interlinking with the teaching of

entrepreneurship (Isenberg, 2010). This study also notes that several respondents expressed the importance of integrating financial literacy, law, and economics, which they felt represented needs irrespective of the study field. Although they recognize that education must, above all, pass on the knowledge specific to the respective field, they maintain not broadly understanding these areas, broadly applicable to every areas of business, can be very limiting. Entrepreneurial education must be incorporated into all Ent_Uni qualifications, providing students with the exposure to on-the-job training, assisting with incubating business ideas and providing TH knowledge cross-pollination (Amadi-Echendu et al., 2016). The findings emphasise the appreciation these entrepreneurs have of opportunities to meet and interact with alumni and more informally discuss issues with someone who both followed the same academic path and later developed Ent_Act. In this way, speaking as equals in more informal contexts, they hope to demystify the journey, hear about mistakes, the means of overcoming eventual difficulties and how they achieved their goals.

Furthermore, these interviewees confirm the relevance of mentoring, the accompaniment by someone who values their ideas, believes in their potential and helps them take their first Ent_Act steps. By way of example, they also state internships are more beneficial whenever they generate practical repercussions that give rise to implementation measures and potential benefit to the entity hosting the internship. They also recommend the final coursework integrating the development of a business model, perceiving this as a point of greater practical applicability.

Within their mission of providing support to potential entrepreneurs - students, academics, staff and alumni - Ent_Uni have been configuring Ent_Eco embracing a set of activities (e.g., educational programs, business incubators and other infrastructures) (Guerrero et al., 2020). Other informal approaches to knowledge transfer with industry partners might involve internships, mentoring, industry talks, transdisciplinary research platforms, collaborative PhD programs and industry training programs (Dang et al., 2019). Our findings here convey how entrepreneurs consider the scope for meeting and interacting with alumni and more informally discussing issues with someone who followed the same academic path and later developed Ent_Act. Hence, speaking more informally as equals, they hope to demystify the journey, hear about mistakes, ways of overcoming difficulties and how they achieved their goals. Based on the discussion above, this study advances the following research propositions:

RP-4: Entrepreneurs consider the statements involved in the Prepare and Support Entrepreneurs dimension relevant although they point out that preparation and support need providing by individuals with knowledge of entrepreneurial processes.

RP-5: Entrepreneurs need initial accompaniment - mentors, advisors, internships advisors – by those with knowledge about entrepreneurial processes, which demystifies them and unveils means of overcoming the inherent difficulties. This support would help define the limits and simultaneously tell them how, despite the challenges, entrepreneurship remains a feasible option.

RP-6: Entrepreneurs value the support provided by incubator structures, whether or not provided by HEI. Allied to incubation, they perceive that gaining experience in the job market before embracing Ent_Act is an asset that makes them more experienced and knowledgeable about the market.

The increasing digitalization of economies, with technology emerging as a core driver of abrupt changes in organizations, the environment, and society, highlights the need for businesses to perform digital transformations to remain market competitive (Kraus et al., 2021). It is also a focal point for institutions interested in the education of entrepreneurs (Corvello et al., 2022).

Often applied synonymously (Hess et al., 2016), differentiating between the DT and digitization concepts is crucial (Kraus et al., 2021). The digitization concept spans the conversion of information from analog to digital formats and automating processes through information technologies (Kraus et al., 2021). The DT concept must contain a subliminal understanding of the actions necessary when facing changes arising from digital technologies (Singh & Hess, 2020).

Modern HEI should take advantage of the opportunities afforded by digital technologies, which can act as key enablers of innovation and entrepreneurship (OECD/EC, 2018). Furthermore, the same source highlights how successful processes require HEI able to promote digital culture and develop and maintain fit-for-purpose and up-to-date digital infrastructures duly aligned with their strategies and missions.

Regarding the relevance of the statements underlying the Preparing and Supporting Entrepreneurs dimension, the interviewees consider that they are fundamental aspects of the entrepreneurial performance of HEI.

The ongoing COVID-19 pandemic has brought terrifying consequences to labor markets worldwide (Fernandes, Veiga, et al., 2022) even while emerging as an opportunity to

reinforce the importance of Ent_Edu as a holistic process for society that requires the integration of response mechanisms, specifically how recovery and change can take place (Ratten & Jones, 2021). Since the first COVID-19 pandemic lockdown, HEI have abruptly switched to online learning and digital technologies (Nicklin et al., 2022).

Successful DT have to promote an HEI digital culture that inherent depends on developing the digital competencies of staff and students to allow for exploration and exploitation of the opportunities provided by digital technology and tools (OECD/EC, 2018).

Although coping with digitalization is very challenging to any HEI, on the one hand, the empirical evidence demonstrates entrepreneurs are aware of the need to keep updated to remain competitive especially when, in the future, they will compete with a generation born into a digital world and dominates the way this operates. On the other hand, respondents also convey how the challenges faced in their daily lives and routines are so time-consuming that they mostly dedicate their time to maintaining financial stability and avoiding eventual bankruptcy and therefore lack to the time to be constantly updated and fully abreast of current market trends.

There are references to HEI that develop entrepreneurship clubs to promote networking, marketing and technological and financial opportunities (Ricci et al., 2019). This study observes similar comments, especially regarding the importance of intra and inter-HEI clubs, which somehow help fostering entrepreneurial mindsets, conveying knowledge informally and more appropriately and advancing at the pace of their participants unlike events in a conventional classroom.

Therefore, this study advances with the following propositions:

RP-7: Entrepreneurs consider the statements involved in the Digital Transformation and Capability dimension relevant although they propose that for this dimension to fully work, we need communication and training plans to prepare people for the technology. Otherwise, achieving success will remain challenging.

RP-8: Entrepreneurs report a dual need for HEI to collaborate:

RP-8a: On the one hand, working in and with industry, understanding its needs and modes of operating and training human resources capable of responding to the challenges caused by great market high complexity and volatility.

RP-8b: On the other hand, governments need to come up with an HEI financing policy that enables the leveraging of these Ent_Edu processes.

5.6 Conclusions

5.6.1 Theoretical Contributions

The paper puts forward several contributions to the extant literature. First, it is essential to mention that this study stems from original primary data. Subsequently, articulating the concepts contributes to the existing literature on Ent_Uni, Ent_Edu, and Ent_Act. This also contributes to the emerging literature on Ent_Uni and the need to develop and improve measurement scales that generate knowledge about Ent_Uni levels and their inputs and outputs.

We posit education as an essential instrument for fostering entrepreneurship in society (do Paço et al., 2015). Nevertheless, many questions remain to understand how Ent_Uni can design Ent_Edu programs able to simultaneously create entrepreneurial knowledge, skills and competencies as well as new ventures and jobs (Clark et al., 2021).

The literature predominantly approaches HEInnovate, aiming to depict and convey the existence and relevance of Ent_Uni structures and the need to evaluate them (Henry, 2015).

Applying the HEInnovate tool - an accessible and widely used HEI self-evaluation tool determining their levels of innovativeness and entrepreneurialism and, as a proxy, their preparedness for delivering Ent_Edu - involves certain challenges. In addition to raising awareness of the continued need for evaluation, future study needs to explore ways to strengthen its accuracy and value (Henry, 2015). This study extends HEInnovate and details some of its particularities of relevance to entrepreneurs. The proposed framework allows for visualizing the interrelationship among the various RP formulated. Thus, the findings offer practical guidelines to render HEI more robust in their Ent_Edu provision.

Based on empirical evidence and in response to the research questions established, this presents a framework illustrating the articulation of these themes and their positioning within the scope of mutual TH dynamics. These findings confirm the results of *Clark et al.* (2020) that describe Ent_Uni as an emerging academic unit, essential to developing

an Ent_Eco through their deployment of resources and expertise. They require aligning with macroeconomic policies and priorities and leveraging partnerships, which enable them to access other entrepreneurial players, resources and networks.

Through recourse to the HEInnovate self-assessment tool, this study applied a graduate-centered approach to examine the relevance of three of the HEInnovate dimensions - (1) Entrepreneurial Teaching and Learning, (2) Preparing and Supporting Entrepreneurs and (3) Digital Transformation and Capability - in further developing Ent_Act. The responses to the research questions enable recognition of the multiple aspects involved in the university entrepreneurial structures underlying the HEInnovate scale. This also recognizes the need for changes in the way Ent_Uni structure Ent_Edu and the support for the Ent_Act of its graduates. Furthermore, the findings illustrate how the research propositions emerge within the framework of TH dynamics.

5.6.2 Implications for Practice

This study presents several implications for HEI and policymakers. The findings convey how entrepreneurial graduates are aware of the need for university-industry collaboration and the dependence on government policy and funding.

Policymakers are in a position that, in recognizing Ent_Uni as catalysts of economic and social development, they must prioritize investment in Ent_Edu and advance the Ent_Eco. The findings suggest the need for more funding to enable HEI to successfully deploy DT. The results also convey how, rather than coping with digitalization, it is essential to acknowledge the future is undoubtedly digital and the crucial nature of developing a digital culture that nurtures digital competencies in staff and students, enabling digital affordances.

HEI are capable of fostering more successful Ent_Edu, which can no longer continue as a privilege for certain study fields, particularly management. Furthermore, given the cross-disciplinary applicability of entrepreneurship, entrepreneurs require knowledge about law, economics, and management. Only thus can they interpret all the business information they have to deal with when developing their Ent_Act and participating in informed and conscious decision-making processes. HEI should promote Ent_Edu that derives from the harmonious articulation of theory and practice. More specifically, the results reveal how the interviewees considered it advantageous to experiment and see the practical applicability of theoretical contents. Simultaneously, combining

theoretical and practical approaches would benefit the development of critical spirits and problem-solving orientations. As entrepreneurs, they consider university-industry cooperation essential given the potential to generate new knowledge and interactions between the contents taught in the classroom with experience in industry, thus strengthening problem-solving capacities.

Promoting cooperation between industry and academia requires structuring according to entrepreneurial dynamics contextualized within ecosystem contexts. In these dynamics, there emerges the need to consider the initial objectives among which we would emphasize the relevance of mentoring in keeping with how entrepreneurs value the support of those who value their ideas, believe in their potential and help them take the first steps towards Ent_Act. HEI are capable of helping provide this more targeted support that requires interlinking with incubator structures.

5.6.3 Limitations and Research Outlook

This study presents several limitations. First, we focus on a single self-assessment institutional evaluative framework – HEInnovate – which may be a factor of limitation. Eventually, we might benefit from comparatively analyzing institutional evaluative frameworks (as in the work of Etzkowitz, 2016). Had we taken this approach, we might have commented on eventual improvements and which were most suitable according to the reality of each interviewee.

Furthermore, as this study investigates graduate entrepreneurs in a single culture, it is essential to recognize and analyse how context-specific factors influence theorization and delimit the context and impact of its findings. The role of context on the theoretical, managerial and policy implications of entrepreneurial innovation has been widely studied and reporting stimulating and significant effects on the outcomes of entrepreneurial innovation (Autio et al., 2014).

Recognizing our study's limitations becomes essential when considering how we are simultaneously defining the scope of research and raising awareness about future lines of research. After identifying the RP, developing similar research studies is essential across two different vectors. Firstly, raising the number of interviews and now applying closed-ended questions to generate more targeted responses to the RP addressed issues. Secondly, broadening the context of interview respondents to include distant cultural realities would permeate the study with context-specific factors.

While understanding the impact of funding limitations on the daily realities of HEI, exploring ways of operationally deploying the RP remains important. Hence, we might assist HEI adopt more efficient and effective measures in the ways they administer Ent_Edu and support their entrepreneurs. This then necessarily requires the assessment of: how to harmonize theoretical and practical-oriented courses? What are the advantages of university-industry cooperation in this harmonization? How could we best apply internships in these dynamics? How might we attractively involve faculty in mentoring programs?

Chapter 6. Sensing and Seizing Digitalization towards Digital Transformation and Capability: A Triple Helix Approach

Abstract

Higher education institutions (HEI) find themselves in the eye of the digital revolution storm, facing an ongoing digital transformation driven by the Industrial Revolution 4.0, which forces them to deal with changes in the ways they teach, research and in terms of developing their entrepreneurial activities. Despite the great complexity and the challenges inherent to technological advances that require digital transformation (DT), there is still limited academic guidance for developing and leveraging capabilities during such transformations. However, there is recognition that being or becoming an entrepreneurial higher education institution may provide some of the answers to these newly emerging challenges. This study aims to enhance our comprehension of how the HEInnovate digital transformation and capability (DTC) dimension effectively reflects the vital characteristics of a university that promotes entrepreneurship and fosters optimal Triple Helix (TH) dynamics and impacts. Based on 15 interviews with triple helix institutional actors - university, industry, government, and other hybrid entities involved in their networks, we developed a qualitative inductive study that integrates the inputs of TH networks within the framework of developing a practical perspective on this theme. Our research identifies three key areas of focus that are all crucial for ensuring successful DT processes – (a) focus on overcoming the barriers; (b) focus on capitalizing on knowledge; (c) focus on coping with change – facets essential to understanding the role of DTC in securing the overall success of DT processes.

Keywords

Entrepreneurial University, Higher Education Institution, Triple Helix, Entrepreneurial Activity, Digital Transformation Capacity

"...entrepreneurial universities are managing new digital trends for being competitive in both traditional and digital higher education market".

(Guerrero & Urbano, 2021)

6.1 Introduction and Background Literature

Higher education institutions (HEI) are in the eye of the digital revolution storm and facing an ongoing digital transformation (DT) where no sector or organization can remain immune to the effects (Hess, Benlian, Matt, & Wiesböck, 2016). Therefore, the technological revolutions and transformations are driving HEI' need for provide new means of value creation, delivery, and capture, particularly in the educational context of globalization and technicalization (Zhang, Adams, & Lee, 2022). Despite the growing body of research on DT, the literature acknowledges the limitations on the academic guidance available for developing and leveraging capabilities during such transformations (Ghosh, Hughes, Hodgkinson, & Hughes, 2021). However, there is now recognition that the world's contextual complexity represents a constant challenge to HEI and act of being or becoming an entrepreneurial HEI may constitute an answer to some of these challenges (Gibb, Hofer, & Klofsten, 2018). To create entrepreneurial and innovative universities, we need to understand the key factors and their respective effects on institutional change. This includes studying the various different approaches to university entrepreneurship and developing tools to guide universities and policymakers in setting entrepreneurial agendas (Etzkowitz, 2016). It becomes even more relevant if we consider that the essence of digital transformation in the institutional structures of the higher education sector is a complex process that affects almost all spheres of socio-economic interaction. To better illuminate this complex path, the European Commission, in partnership with the Organisation for Economic Cooperation and Development (OECD/EC), developed the HEInnovate instrument (www.heinnovate.eu). This self-assessment tool enables HEIs to evaluate the different components of their entrepreneurial capacities and ascertain areas requiring improvement (Voolaid, Ehrlich, & Kallaste, 2019). Spanning multiple dimensions, HEInnovate represents an analytical and conceptual background framework, setting out a holistic perspective for exploring the entrepreneurial and innovative potential of universities as the basis for change and future development. Achieving the designated entrepreneurial HEI implies adopting a specific institution as a reference within a given socioeconomic context and policy framework and identifying just what entrepreneurial and innovative HEIs actually do (OECD/EC, 2018). This contextualization and self-knowledge represent the main departure point for a progressive and reflective process,

highly influenced by culture, the ways of doing things, governance, and organizational structures, which impact the capacity to change (Gibb et al., 2018).

We recognize the challenges to HEIs attempting to integrate increasingly advanced digital technologies coupled with the need to reinforce the measurements enabling HEI to holistically evaluate the different components of their entrepreneurial governance and management capacities (Gibb et al., 2018). Nevertheless, HEI are facing critical organizational changes in tangible and intangible structures where it isn't all about technology, and it is essential to look at the human side of the story (Rocha, Gonçalves, da Silva, Teixeira, & Silva, 2022). The literature furthermore includes several different studies on DT (e.g., see the works by Ghosh et al., 2021 and Kraus et al., 2021) as well as works applying this theme specifically to HEI (Guerrero, Heaton, & Urbano, 2021), the socio-economic impacts of entrepreneurial HEI (Urbano & Guerrero, 2013), and as amplified by the mutualism prevailing in Triple Helix (TH) dynamics (Schaeffer, Guerrero, & Fischer, 2021).

The literature portrays the existence of different research gaps in our understanding of how DT drives change in various contexts. These include the need for new theories able to explain the current era of radical change in innovation and DT, a greater focus on the socio-cultural aspects and impacts of DT, and a better understanding of how DT affects institutional change. Such research areas may be beneficial both to governments and to private sectors in helping them adapt to disruptive changes (Kraus et al., 2021).

In this context, two key questions require answering: (i) Does the Digital Transformation and Capability (DTC) HEInnovate dimension represent the key characteristics of an entrepreneurial HEI for optimal TH dynamics? And (ii) how can entrepreneurial HEI best deploy these features to leverage TH dynamics and their economic and social impacts on ecosystems?

To address these research questions, our study draws on 15 semi-structured interviews with triple helix institutional actors – from university, industry and government alongside other hybrid entities involved in their networks.

Despite the sharp focus on researching and understanding DTs, and even while we were able to assess several standard definitions of DT, we still consider that the boundaries best able to help to define this remain blurred, intermingles among a vast set of business contexts and digital technologies (Kraus et al., 2021). One potential DT definition describes such processes as "the combined effects of several digital innovations bringing about novel actors (and actor constellations), structures,

practices, values, and beliefs that change, threaten, replace, or complement existing rules of the game within organizations, ecosystems, industries, or fields (Hinings, Gegenhuber, & Greenwood, 2018 p.52).

To explore the DT theme, it is firstly essential to establish the difference between the concepts of digitalization and DT. Digitalization usually refers to converting information from the analogic to the digital world or automating processes through information and communication technologies. Arising from the digitalization process, DT concerns the changes that digital technologies bring about to business models, products, processes, and organizational structures, with observable repercussions for individual and organizational contexts (Hess et al., 2016). DT success depends on grasping the requirements necessary for digitalization (Deutsch, Gottlieb, & Pongratz, 2021). Another central aspect stems from developing a DT strategy to enhance this process structured around four key dimensions - (1) the application of technologies reflects the approaches and capabilities for exploring and exploiting new digital technologies, (2) the repercussions of the influence of digital transformation over value creation, (3) structural changes related to the modifications in organizational structures, processes and skill sets inherent to the processes of dealing with and exploiting these new technologies, and (4) the financial dimension that simultaneously involves the need for action in response to developments in the core business as well as the ability to finance the actions and processes leading to DT (Hess et al., 2016).

Industrial Revolution 4.0 only captures the surface-level advancements in technology and digitalization but hides the larger essence of the knowledge revolution, which involves a radical change in teaching and learning processes at all levels of the educational system (Nicolescu & Nicolescu, 2021). Within this context, entrepreneurial HEI are managing DT to remain competitive in both the traditional and the digital higher education markets (Guerrero & Urbano, 2021). To achieve this, such HEI need to, in keeping with all the diversity existing, analyze a set of key characteristics that depict and shape entrepreneurial and innovative HEIs (Gibb et al., 2018).

Accompanying this context of global economic changes, the TH dynamics of innovation have assisted in dealing with the pressures on each of the three helices – university, industry, and government (Smith & Leydesdorff, 2014). Characterized as an innovative ecosystem, the TH also evolves (Pique, Berbegal-Mirabent, & Etzkowitz, 2018). Thus, it becomes increasingly vital that HEI make the most out of the opportunities afforded by digital technologies, presented as critical enablers of innovation and entrepreneurship, ensure their full dedication to fostering positive digital cultures and develop and

maintain fit-for-purpose and up-to-date digital infrastructures able to fully exploit the opportunities generated by DT (Gibb et al., 2018).

To explore this theme, and following this introduction, the structured of this study is as follows: the next section focuses on the theoretical overview, addressing the literature that we consider pertinent for framing the HEInnovate dimensions under analysis. Afterwards, we set out our research methodology. Finally, we present our findings and put forward a discussion of our results and conclusions.

6.2 Methodology

This study deployed the inductive grounded theory methodology (Corbin and Strauss 2015) to approach, in a more fine-grained manner, the relevance of the university DTC HEInnovate dimensions to TH collaboration and the generation of mutualistic flows among the TH participants. This approach returned knowledge on the suitability of the items included in the DTC HEInnovate and their relevance to TH dynamics.

In collecting and analyzing data, articulating creative imagination and systematic rigor, we applied the approach described by Gioia, Corley, & Hamilton (2013) for conducting qualitative, grounded theory research. Their results stress the potential of articulating grounded theory through the development of comprehensive 1st-order terms, organizing these 1st-order codes into 2nd-order theory-centered themes before assembling the latter into overarching theoretical dimensions and placing the terms, themes, and dimensions into a "data structure".

6.2.1 Research Design, Case Description, and Context

The primary data collection process derived from the need to deepen the relevance of the DTC HEInnovate dimensions and account for the key characteristics of entrepreneurial HEIs displaying optimal TH dynamics and how entrepreneurial HEIs can apply these features to leverage the TH dynamics and their impacts on the respective surrounding economic and social ecosystem.

There is currently the understanding that HEIs are already deploying digital technologies to explore the uptake and integration of DT within the scope of efforts to grasp how digital technologies might best work as key enablers of innovations and entrepreneurial activities (OECD/EC, 2022). Within this context and based on the literature review and previous interactions with university and industry stakeholders,

we were able to gather those that we consider reflect the key characteristics of this theoretical object of study and integrate them into our sample (Yin, 2018).

Thus, study participants share collaborative links within the context of TH dynamics. The selection criteria for respondents raised the relevance of study findings in keeping with the knowledge and experience they hold on DTC related topics (Eisenhardt & Graebner, 2007). Initially, we approached participants integrated into the university context, associated with the management of these institutions or their information and technology departments that have already integrated DT processes. Subsequently, we addressed the industry perspective through companies collaborating with the university in teaching and research. Finally, we included a Technological Center in our approach, an entity currently operating within the university's own facilities, and the coordinators of a digital innovation hub, who are now coordinating a consortium that integrates universities within the framework of supporting public service DT processes.

Table 6.1 summarises the methods and the interviewees, the main topics approached during the interview alongside aspects related to data codification.

Table 6.1 Methodological Summary and Interviewees.

Methodological Orientation	Qualitative Exploratory research Discourse analysis						
Technique	Case study						
Number of cases	Single case study						
Primary source of information	Individual interviews Semi-structured interview guide						
Fieldwork	Interviews: between June 2022 and January 2023						
Participant selection	Purposive sampling Criteria: TH entity, function, and position						
Main topics approached during the interview	Relevance of DTC HEInnovate dimension DTC factors that could serve as entrepreneurial facilitators DTC barriers DTC as TH collaboration facilitator DTC TH mutualistic aspects						
Data codification	Primary codes: themes Secondary codes: Sub-topics Aggregate dimensions resulting from data analysis						
Number of Interviewees	15	3	4	1	2	4	1
Interviewee work position	Total	Digital Project Collaborators	HEI Campus Coordinations	Local Government	Digital Innovation Hubs	Industry Executives	Technological Center Coordinator
Abbreviations used in text		DPC1 DPC2 DPC3	U1 U2 U3 U4	LG1	DIH1 DIH2	IE1 IE2 IE3 IE4	TCC1

6.2.2 Data Collection

The study incorporated primary data collected between June 2022 and January 2023. This phase included preparation for data collection, interviews, observations, and transcription activities. We meticulously applied the three principles of data collection put forward by Yin (2009). We applied multiple sources of evidence, created a case study database, and maintained a chain of evidence. Its application facilitated study development and enabled the addressing of questions regarding the validity of the data and constructs (Denzin & Loncoln, 2011).

Carrying out a case study stands out as a promising option allowing for deeper understandings of issues and there has been a growing trend in its application (Yin,

2018). These semi-structured interviews returned the primary source of data. We conducted 15 semi-structured interviews, characterized by a script (Appendix F) to help the interviewer develop the interview while allowing for randomness in the order of placing the questions and thus enabling adaptation to each individual interviewee. Hence, when conducting the interview, the interviewer holds responsibility for keeping the discourse within the intended thematic line but allowing flexibility in order to clarify some aspect or to address appropriate and relevant topics and thereby creating feedback loops enriching the validity of the interpretations made. The interviews were audio-recorded following prior authorization by the interviewee with their contents subsequently transcribed.

6.2.3 Data Analysis

Our study adopted the inductive grounded tradition (Corbin & Strauss, 2015) as detailed and applied in reference publications (Pankov et al., 2021; Shankar & Clausen, 2020).

The analysis made recourse to MAXQDA Analytics Pro 2022, a computer-assisted data analysis software program that facilitates coding and supports the development of a hierarchical code system. This system can benefit grounded theory research (Given, 2008). During our data analysis process, we constantly interacted with the emerging data and coded the results in a sophisticated and dynamic approach. This involved the researchers reading and rereading the information multiple times. This process helped us to grasp the information reflected in the perspectives of the interviewees, leading to the grounded data interpretation that generated the initial set of codes (Corbin & Strauss, 2015).

The study advanced through the constant overlapping of data collection and data analysis (Strauss & Corbin, 1998) through which we identified the first-order codes, with an open-coding approach (Corbin & Strauss, 2015) identifying the key topics concerning the relevance and influence of DT in TH dynamics.

Figure 6.1 displays the data structure enabling the visualisation of the underlying themes of this concept.

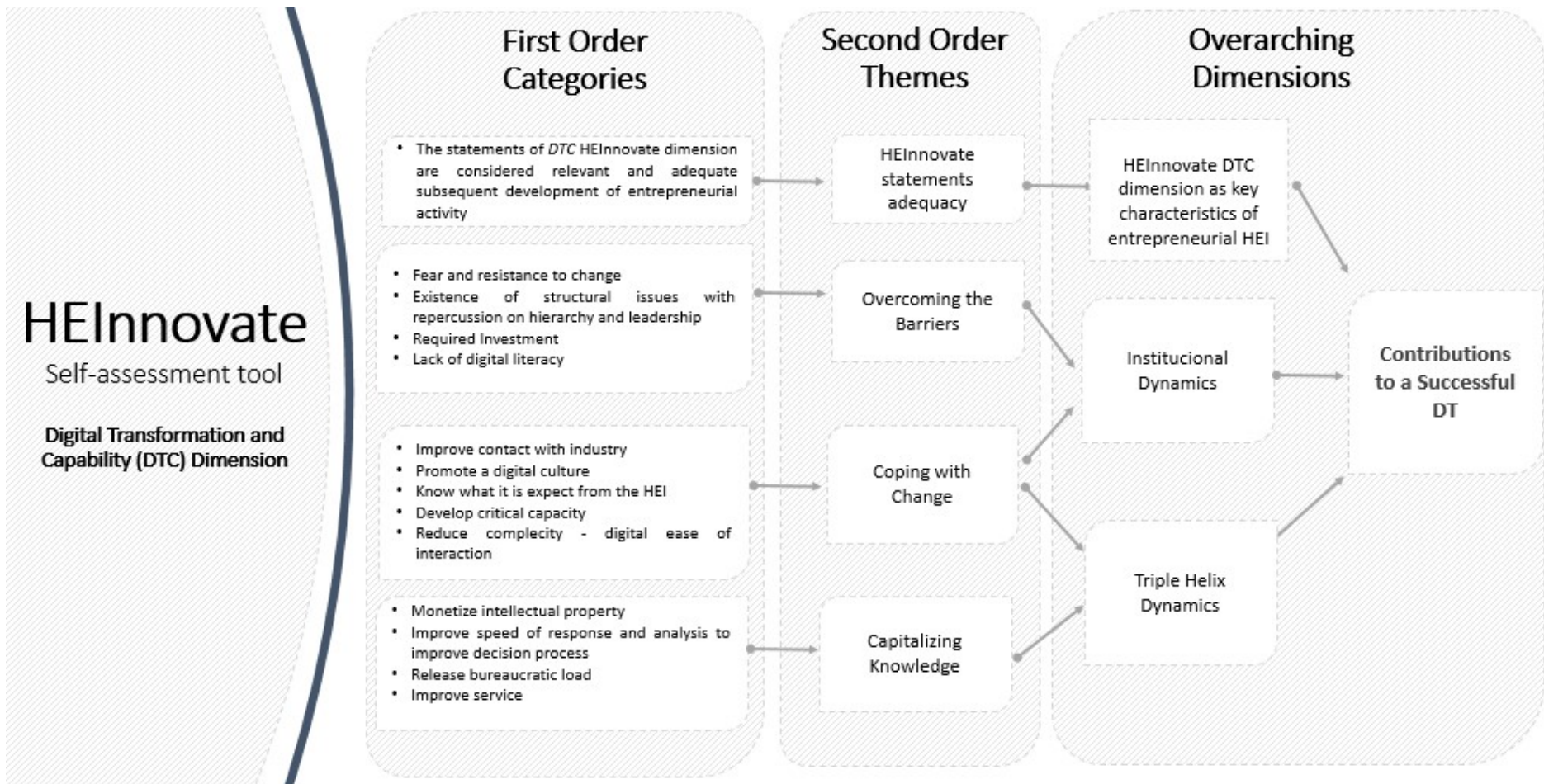


Figure 6.1 Data structure

6.3 Findings

The findings resulting from our analysis provide deeper and more nuanced knowledge on DTC. Thus, this opens up perspectives on the debate around the DTC HEInnovate dimensions and how far they account for the key characteristics of entrepreneurial HEI, optimal TH dynamics and the impacts resulting for the TH ecosystem.

6.3.1 Digital Transformation and Capability HEInnovate Dimension Representing the Key Characteristics of an Entrepreneurial HEI

All our respondents agree that the statements involved in the DTC HEInnovate dimensions are essential facets to leading entrepreneurial HEI through successful DT.

Before presenting our findings, it is essential to explain the expectations around DT, establishing the assumption that we were referring to a context involving the presence of digital enablers – readiness, lightness, openness, and trust on process digitalization, connectivity, data-informed decisions and digital innovation (Mikheev et al., 2021). This accounts for the perspective on our discussion and assist in establishing the concept in order to explore its nuances in later interviews.

Recognizing the paramount importance of DTC to success and based on our findings, in DT it is essential to (a) focus on overcoming the barriers; (b) focus on capitalizing knowledge; and (c) focus on coping with change. Table 6.2 sets out the most representative sample quotations that reinforce the three dimensions contributing to successful DTC.

Table 6.2 Digital Transformation and Capability 2nd Order Themes - representative quotations

Focus on overcoming the barriers
<ul style="list-style-type: none">• There are the structural issues of HEI, in addition to the fact they are organizations whose resources hold power - where there is no hierarchical subordination. (DIH1) HEI end up taking on very pyramidal organizational structures. (DIH2) The issue related to the leadership of processes, where our organization facilitates a clear definition of leadership. (DPC2)• Another barrier is the existence of a certain fear of changing to digital, a fear that ended up being diminished by the increased difficulties in the context of the pandemic and which ended up helping to relativize this fear. (G1)• The investment necessary is a barrier. (TC1) There still has to be available financing. This is essential. In some sectors, this availability does not exist and higher education effectively depends on the projects you apply for. (G1)• Currently, everything that has to do with digitalization requires considerable investment and, therefore, if there is no investment, it isn't easy to achieve digitalization without being willing to invest in the essential means of doing so. (I3)• Not having a clear idea of the benefits of these new systems. When the potentials are not immediately perceived, as is the case with dematerialization and accelerating internal processes, we see resistance to change. (DPC2)
Focus on capitalizing knowledge
<ul style="list-style-type: none">• The industry needs to be more and more innovative to enhance its products and to be able to reach where others do not reach competitively. I see this mutuality in a very enthusiastic way. (I4)• DT will be translated into speed of response and analysis, through digital means, to make the best decisions. (G1)• Institutions are increasingly attentive to monetizing the property generated in the HEI. (DIH1)• If we look at reality and from the moment that HEI knows the ecosystem around it well, it manages to monetize its training offer by locating, in addition to its internal resources, external resources of recognized capacity. (TC1)• The objective is always to improve the services provided, both for the internal community and for the external community, allowing for development. (U2)• That's why we release a huge bureaucratic load when we need to because facing the future is often analysing the past and we now manage to go to that platform and see what has been done and what has happened, which helps us a lot. (U5)
Focus on coping with change
<ul style="list-style-type: none">• How HEI can, in their training content, connect to what the real world needs. (I4)• Digital culture has to be promoted. We can even acquire certain software or infrastructures that later, if the transition goes too fast or if there is no effective change management, creates a certain resistance and then people do not make effective use of it. (DPC3)• It is necessary to communicate the purposes and how we are going to adopt a new tool. (DIH1)• HEI have to follow the evolution in the industry. The world is not the same as it was ten years ago and the people getting trained must imperatively keep up this change. We will have to make the changes and developments expected as professionals insofar as the requirements requested are ever greater. (I1)• Something that I think should be easy is dialogue with the user so that, after a training process, this language is easily understood and they start to prefer this new form. We will have to unlock these barriers, streamline this connection, and create ease of interaction. (I4)• For the development of entrepreneurial activities, digital capacity does not replace contact with real life, internships, experiences or interactions that must be had. Therefore, in my opinion, it does not replace some aspects of entrepreneurship where there must be a balance between what is done in person and digitally. (G1)• It is very important that the person who organizes the information is accessible digitally and has critical capacities. (G1)• If there is a domain where the state of the art can never be considered as acquired, it is this one. What is good today, is already outdated tomorrow. Learning to learn, learning to discover and learning to develop permanently are what is fundamental. (TC1)

6.3.2 Institutional and TH Dynamics towards the Economic and Social Impacts on Ecosystem

6.3.2.1 Focus on overcoming the barriers

Despite prolific recent research on digital transformation, there is limited scholarly guidance for developing DTC (Ghosh et al., 2021). Considering that DT constitutes one of the greatest challenges, with no sector or organization immune to the ongoing effects (Hess et al., 2016), our findings maintain it is essential to continue focusing on overcoming the barriers.

The first distinguishing aspect identified by respondents relates to the barriers themselves. Respondents mentioned several challenge aspects of DT processes. One such facet identified as a barrier to HEI DT processes stems from structural issues in these institutions (DIH1, and DPC1), with specific issues including the absence of clearly defined leadership (DPC1, DPC2, DPC3, and U4). It became evident that these issues held visible implications for the time taken to carry out processes and comply with deadlines (DPC1). Coupled to this is how, when there is no stoppage period to allow for carrying out certain processes (e.g. software updates and multiple platforms), there is commonly a temporary loss in the quality of the services provided because the employees collaborating more directly with the DT process also maintain their usual functions within the institution (U7). Due to the complexity inherent to DT, HEI have felt the need to complement their know-how by outsourcing to technology companies to provide the necessary process support (I3, DPC3, and U4). Despite feeling they should become more involved in collaborative processes (U3 and DPC3) that enable the identification of synergies in the search for the best solutions (DIH1), there are still institutions that prefer not to do so because they consider they lose power as individual actors (TC1).

Another aspect identified concerns the financial funding necessary to implementing DT (G1, TC1, I3, DPC1, DPC3, and U7). For example, one interviewee stated:

"In some sectors, this financing does not exist and the HEI effectively depends on the projects they apply for." (G1)

Our respondents helped us understand how DT implies significant financial capacity. One of our respondents endorsed this, adding:

"Currently, everything that has to do with digitalization requires considerable investment and, therefore, if there is no investment, it is difficult to achieve digitalization without being willing to invest in the means essential to doing so."
(I3)

This question highlights the need for the advance planning of every stage and adequately integrating them into the digital strategy where "there is prior knowledge of what is effectively intended" (I3). This stems from the need to carry out "a prior re-engineering of processes and workflows" (DPC3) and, in keeping with the financial constraints, "we cannot make investments that later turn out unnecessary (I3).

No less referenced is the barrier related to the fear associated with change. For example, one respondent explained:

"Another barrier is the existence of a certain fear of change to the digital, a fear that ended up being diminished by the increased difficulties in the context of the pandemic that ended up helping to relativize this fear. We were "forced" and had to develop a series of skills that ended up freeing us from this fear of change resulting from the digital transition." (G1)

The fear of change, caused by leaving individual comfort zones, represents a barrier that turns out less significant when users initiate direct contact with the underlying processes and tools and end up recognizing their usefulness (G1, I3, DPC3, U1, and U3).

6.3.2.2 Focus on capitalizing knowledge

The second distinguishing aspect identified by respondents encapsulates the relevance of capitalizing knowledge. In the case of HEI, this aspect may generate repercussions on a series of aspects potentially highly advantageous for the institution. As one respondent also stated:

"Institutions are increasingly attentive to the question of monetizing the property generated in HEI, which can limit this opening or at least ensure it has to go through a sieve so it can then be shared." (TC1)

Thus, we may initially mention that "facing the future often involves analyzing the past" (U2). Within this context, it is essential to reference digitalization and the subsequent DTCs that enable the application of existing information and knowledge to improve

decision-making (G1, U2, and I4). One respondent captured this relationship between the relevance of previous information and decision-making processes when he described:

"We were also able to perceive, with the growth in student numbers and other indicators, we have here an excellent way, through digital means, of being able to make the best decisions." (G1)

This respondent citation captures the relevance of DT in HEI:

"That's why we release very large bureaucratic loads and, when we need to, as facing the future often involves analyzing the past, we are able to go to that platform and see what has been done, what has happened, and that really helps us a lot. The strategy is very much about being able to understand from the past what can be improved or what went wrong and, for this, we have to have records." (U2)

One respondent captured the essence of knowledge capitalization well when stating:

"In the case of HEI, capitalization works in a very particular way. In our case, when the name of our institution appears associated with something innovative, that is our source of income. Thanks to this, we manage to attract students, which gives us high visibility with entities such as the Foundation for Science and Technology – because we were innovative in many projects and commissioned to carry out implementations that other HEI could not do. We were able to publicize these successful implementations in the media – magazines, newspapers, radio – which then allowed us to capitalize on our knowledge. We were able to arouse curiosity about the institution, to project the name of the HEI and establish ourselves as a reference in multiple areas for the future and that reflects in the ecosystems that feed it back in." (DPC1)

The capitalization of knowledge can also refer to relative aspects, such as a greater ability to analyse information and improve response capacities (G1, I3, and U2). DT make it possible to take advantage of existing but otherwise inaccessible knowledge (DIH1 and I4). This opens up access to a wide range of information sources and dissemination possibilities that allow for the interconnection of different areas of knowledge, providing depth of analysis (G1).

We thus recognize that DT make it possible to ignore geography (U1). Thus, HEI can benefit from the absence of certain space-time barriers that would exist should we have to be physically present. In this context, one respondent added:

"Sometimes it is difficult to ask an entrepreneur to participate in a certain class, in order to present particular content; with digital, it is easy because you don't even need to leave your workplace to make that presentation. If we look at reality and from the moment that the HEI knows the ecosystem around it well, it manages to monetize its training offer by locating, in addition to its internal resources, external resources of recognized capacity." (DIH1)

Despite different perspectives, all respondents agreed upon the relevance and existence of greater HEI openness concerning the capitalization of knowledge. One respondent highlights the following aspects:

"DT leverages knowledge capitalization. I think it does so on several levels. The question of open science and the practice of open data is an area in which we are making a lot of progress. In addition to being important, it is increasingly becoming mandatory and, without a doubt, it makes us more entrepreneurial, which leads us to share more information, for example with the business community." (U3)

6.3.2.3 Focus on coping with change

All our respondents agree on the relevance of HEI DTC and their repercussions for increasing the mutualism present in HT dynamics. These processes always strive to improve the services provided, both to the internal and external communities, enabling their development (DPC2, I2, DPC2, and DPC3) through an exponential relationship between the digital world and entrepreneurial capacities. (I4)

To provide a perspective on the DT challenges and the need for constant updating, one respondent explained:

"If there is a domain where state of the art can never be considered as acquired, it is this one. What is good today is already outdated by tomorrow. Learning to learn, learning to discover, and learning to permanently develop is the fundamental factor. In addition, this is the part where Portugal fails – we produce talent and those who best take advantage of this are companies abroad

that are more advanced because they hold intellectual property over sectors and products and that absorb this talent. That is, we carry out the production of talent that we necessarily have to interconnect with intellectual property." (TC1)

This needs to understand that in DT processes, particularly in the case of HEI entrepreneurial activities, digital capacities do not replace contact with real life, internships, experiences or the interactions that remain entirely necessary. Therefore, it does not replace "some aspects of entrepreneurship where there must be a balance between what is done in person and digitally" (G1), a balance that also requires consideration when structuring educational programs (I4 and U1).

As regards the factors for taking into account in the DT processes of HEI, fostering a digital culture is essential (U4 and DPC3). Within this context, and alongside the underlying promotion of digital literacy (G1 and I4), it becomes simpler to communicate the necessary changes (TC1, DPC1, and I3) for the appropriate management of change processes (DPC3). This respondent's answer emphasises these aspects:

"DT is a process in which the communication involves the entire ecosystem, highlighting the benefits and caution the organization will take in using the data generated. This is because we are in a changing context and human beings do not favour change." (TC1)

These processes also need to incorporate measures designed to develop critical analysis capacities. This issue essentially relates to the reliability of existing information and the need to deploy staff with the capacity to analyse the large amounts of data generated and who, with in-depth knowledge of the processes, can assess the reasonableness of these outputs (I4, G1, and I3).

DT must therefore serve as facilitators of the links between HEI and industry (G1, I3, I4, U1, U2, and U3) alongside the dynamism of TH relationships (G1 and I4). Despite acknowledgment of the need for staff with specific know-how (DPC2 and I2), the existence of platforms for exchanging information between participant actors, respondents reference their complexity (I4, DPC1, and DPC3), which would benefit from simplification and ensuring user intuitiveness whenever possible (I1, DPC1, DPC2, and I4).

6.4 Discussion

Our research enables us to put forward a framework that clarifies the connections between the themes and the suitability of the DTC HEInnovate dimensions in reflecting the key traits of HEI that nurture entrepreneurship (see Figure 6.2). This framework also examines the extent to which these dimensions can actually leverage entrepreneurial activities and their economic and social impacts on the innovation ecosystem. The framework reflects both how DT is driving dramatic changes to the higher education sector and the capacity of the HEInnovate self-assessment tool to enable institutions to assess their capability of incorporating DT into their operations. Overcoming barriers and adapting to changes is crucial to fully leveraging the potentials of DT.

Promoting digital literacy and fostering an entrepreneurial culture are both key to capitalizing on DT. Overcoming institutional limitations and clearly defining process leadership require finding the appropriate solutions. By prioritizing their third mission and monetizing the knowledge they generate, HEI can attain financial autonomy and assert control over their future direction. DT provides HEI with the opportunity for greater efficiency and competitiveness. Investing in the ease of use and simplicity of interactive platforms involving triple helix actors serves to prevent their functioning from becoming counterproductive. Synergistically deploying DT returns the potential existing in university-industry collaboration and knowledge capitalization, with significant implications for the financial autonomy of HEI.

We next contextualize our findings in relation to the existing literature to establish a reciprocal dialogue and establishing their contribution to our knowledge on the topic under analysis. We subsequently present our suggestions for practitioners and policymakers.

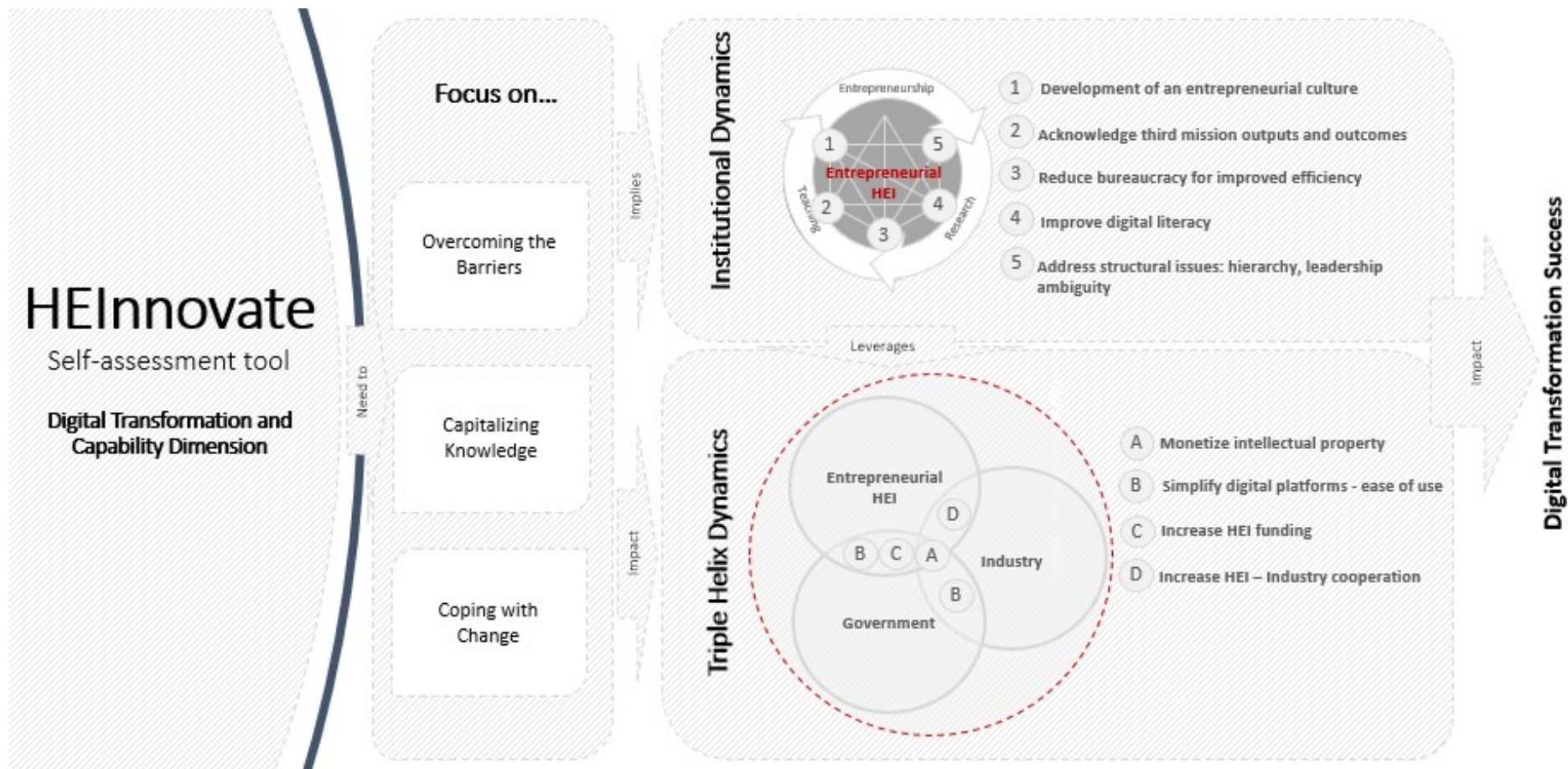


Figure 6.2 HEInnovate Digital Transformation and Capability dimension – opportunities and challenges

6.4.1 Contributions to the Literature on Digital Transformation and Capacity Influences

The literature foresees that DT imply technological disruptions that trigger a strategic response, which takes place concomitantly with changes in its value creation paths, which in turn shape the positive and negative outcomes of DT processes, a dimension requiring examination in light of the role of dynamics capabilities (Vial 2019).

The eight dimensions of the HEInnovate self-assessment tool approach the key characteristics that, according to the OECD/EC (2022), should orient an entrepreneurial HEI performances. Our study focuses on the HEInnovate DTC dimension, which the OECD summarizes as how the "HEI is already deploying digital technologies, however, the uptake and integration varies among and within institutions. HEIs should make the most out of the opportunities presented by digital transformation and consider digital technologies as a key enabler. This section of the self-assessment provides a number of statements to reflect on HEI's digital capability, defined as the ability to integrate, optimize and transform digital technologies to support innovation and entrepreneurship" (OECD/EC 2022).

Our study findings identify at least three aspects that require focusing on whenever approaching this DTC HEInnovate dimension: essentially, (a) focus on overcoming the barriers; (b) focus on capitalizing knowledge; (c) focus on coping with change. This conceptual systematization constitutes the main contribution of our study, which produces implications for the literature on DTC and repercussions for the relational dynamics established between TH actors. We therefore structure our approach in keeping with the five DTD dimension statements.

The DTC dimension involves a process of HEI self-analysis across five different statements (OECD/EC 2018). The first declares that HEIs should reflect on how "HEI fosters a digital culture and implements and monitors a digital strategy supporting innovation and entrepreneurship". The perceived transition of society, essentially guided by the "digital" generations emphasizes the importance of developing an entrepreneurial mindset that enables acknowledgment of a metacognitive process in which entrepreneurs resort to formulating and informing "higher-order" cognitive strategies to strive for entrepreneurial goals (Haynie et al. 2010). We live in an age of digitalization in which digital and media literacy gains greater relevance as a confluence of insights and experiences from the media education and digital literacy domains. Involved in multimodal literacy, digital and media literacy demand constant updating of concepts and skills, especially in response to the evolving information environment

and the increasing diversity and prevalence of digital technologies, emphasizing the importance of primary, secondary, and higher education (Koltay 2011). The digitalization of HEI entails significant changes and the need to integrate increasingly advanced digital technologies, giving rise to significantly different realities from those these institutions currently experience (Zhang, Adams, and Lee 2022).

The second statement conveys how "the HEI invests in, manages and continuously improves the fit-for-purpose digital infrastructure". DT implies the appropriate level of investment – with the acquisition of equipment and non-tangible assets like investment education and capacity, security, and cybersecurity (Gruber 2017). Perceived as both an opportunity and an obstacle for DT processes, depending on the budget allocation to the transformation, it is necessary to balance the financial aspects of DT and their implications for value creation and structural changes (Matt, Hess, and Benlian 2015).

The third statement relates to how the "HEI actively supports the use of digital technologies to enhance quality and equity in teaching, learning and assessment". HEI DT changes the form of student-lecturer and teaching-learning interaction, creating digital environments that enable students and teachers to identify market opportunities through dynamic skills which, as dependent on the idiosyncratic characteristics of individuals, must reach beyond developing business models and enable the continuous perceiving and seizing of opportunities and empowering students for decision-making processes in uncertain environments (Teece 2014).

The fourth statement leads HEI to question whether it "actively uses open educational resources, open science, and open data practices to improve the performance of the institution and increase its impact on its ecosystem". In this scenario, digital contexts acquire a preponderant role in current educational practices where innovation requires constant digital updating and exploitation of technology, replacing more traditional teaching-learning processes, which clearly represents a challenge for teachers and students (Zhang, Adams, and Lee 2022). In this context, DTC development implies internal readjusting - within the organization - and externally - with ecosystem partners - to achieve favourable DT (Ghosh et al. 2021).

The fifth statement addresses how "the HEI makes full use of its digital capacity to promote sustainable and inclusive innovation and entrepreneurship". HEI are called upon to respond to increasingly complex and simultaneous demands, which include sustainable development, a challenge that demands strategic approaches. One feasible approach stems from Graves' model of systemic development (see the work of Ferreira, 2020) - which is based on two primary strategies: (a) promoting the general systemic

development of a given HEI, progressively opening up to various stakeholders and focusing on co-creative collaboration, and (b) participating in inter-organizational networks to find inspiration for dealing with challenging trends. The answer lies in adopting the University 4.0 multi-dimensional model to leverage the capacity to deal with complexity, to new educational technologies, and to the require of new skills are demanded, where HEI are expected to play a new role (Rocha et al. 2022).

6.4.2 Contribution to Practitioners and Policymakers

Firstly, it is essential to understand, when discussing DT in HEI, that these involve long-term processes and that no short-term results will become immediately visible. These institutions need well-articulated digital strategies that align with their needs, capabilities, and goals. Crucially, this requires the fostering of a digital culture that nurtures the vital knowledge about the digital landscape, thus enabling the individuals involved in the DT process both to be prepared for change and to act as facilitators. Additionally, HEI should apply metrics and parameters to allow for self-assessment and evaluation, enabling them to understand their current position in keeping with the parameters fundamental to DTC processes. Within this context, our findings deem the DTC dimension of the HEInnovate self-assessment tool as suitable and relevant to DTC process success.

Secondly, clearly communicating any changes and actively involving all the parties affected by the change process represents another crucial facet. Building digital literacy and fostering critical thinking skills are also essential in this context. By doing so, we become entirely able to leverage technology and correspondingly apt at analysing and understanding the relevance of data and deploying only the most timely and essential information in support of decision-making processes. Additionally, enhancing critical thinking skills also allows for the integration of different fields of knowledge, resulting in new perspectives and insights across various fields of expertise.

Thirdly, DT success depends on mutually beneficial relationships prevailing between the TH actors. To achieve this, HEI must allocate the resources necessary to continually generating knowledge and thereby contributing to their technological development while also providing training and teaching capable of helping individuals adapt to constant technological evolution. Industry, in turn, must provide financial and technical resources and present challenges that can help HEIs remain connected to the realities of their respective industry and its needs, ensuring their capacity to provide constantly relevant and up-to-date solutions. In this collaborative process, policymakers must also play a key role by encouraging and regulating the promotion of

technology and innovation. The government must invest in infrastructures and digital technologies to enable DT processes as well as boosting ease of access to specialized knowledge and human resources dedicated exclusively to these processes without overburdening the resources of institutions. Investment in infrastructures will also serve to alleviate the burden on existing systems, allowing for the implementation of new technologies without entering into conflict with those existing ones and avoiding the need to interrupt ongoing procedures for testing. Additionally, the platforms hosting interactions between actors require improving, emphasizing their simplicity and intuitiveness, critical factors for successful DT processes.

6.5 Conclusion, Limitations, and Future Research

It is essential to acknowledge that we are now living in a reality that means integrating the concepts of the digital and entrepreneurial ecosystems is critical to institutional sustainability. To fully understand the interactions of actors and users requires articulating the ideas around digital infrastructure governance, digital user citizenship, digital entrepreneurship and digital marketplaces (Sussan and Acs 2017).

A biomimetic analogy gains in relevance through approaching entrepreneurship as an outcome of interactions between biotic and abiotic entities (Song 2019). Within the context of global economic changes, the TH dynamics are constantly changing, revealing the pressures on and exerted by each of the three agents, which together condition the potential synergies (Smith and Leydesdorff 2014). Our findings confirm the contributions made by the ongoing collaboration among TH agents, thus making it necessary to deepen our knowledge about institutional relations. Within this context, it is also vital to explore the mechanisms capable of leading to an 'enterprising state' in which the different actors can innovate by generating solutions to global economic challenges, thus synergistically aligning the functions of wealth generation, organized knowledge production, and normative acts of control (Smith and Leydesdorff 2014). There are reasons to believe that entrepreneurial HEI hold the capacity to develop strategies capable of fostering and deepening entrepreneurial ecosystems over time (Bedó, Erdős, and Pittaway 2020).

Based on our findings, we may affirm the DTC dimension of the HEInnovate self-assessment tool is adjusted and relevant to DT process success. Throughout our inductive study, we identified at least three new focuses – (a) focus on overcoming the barriers; (b) focus on capitalizing on knowledge; (c) focus on coping with change - to

illuminate the self-assessment of the DTC dimension to aid successful DT processes. We believe our study advances our understanding of HEI DTC through highlighting the particular importance of capitalizing on knowledge, of overcoming the existing barriers and of institutions being able to keep up with the changes made internally and externally in such complex and dynamic contexts as DT. In addition to theoretical contributions, the study returns new nuances in the analysis that HEIs may consider in their self-assessment processes targeting the DTC dimension as well as providing policymakers with the notion that they should promote regulation and platforms for TH actors and agents to interact simply and intuitively.

Our findings stem from data on a single context - Portugal - and a single case, which may limit the generalizability of our findings. Another limitation arises from the analysis exclusively including qualitative data, which might also represent a constraint. Aware of the limitations presented, we were meticulous in the selection of interviewees and always kept in mind the methodological aspects detailed in the methodology section.

Nevertheless, the limitations described also stand out as possibilities for future research. Our findings present new nuances related to the HEInnovate DTC dimension that can now serve as a starting point for future investigations. Recognizing the paramount importance of the repercussions of DT, there is the need to continue investing in the new measurement units required to effectively evaluate DT processes within HEI contexts (Etzkowitz 2016; Henry 2015). Our findings reveal the need to integrate the relevance of the human dimension, specifically critical thinking abilities, within the scope of analysing DT generated data. The multiple actors should consider the oncoming technological advances, specifically regarding the current developments in artificial intelligence applications for critical data analysis, which require taking into consideration in keeping with the need for data reliability and rationality. Achieving the right balance between the digital and non-digital facets is also important coupled with a strategic balance between actions eligible for digital development and those that, by their nature, require a human dimension of proximity and should therefore continue as in-person activities. Another future line of research derives from the need to foster cooperation and sharing, aligned with the perspective of mutualism (Schaeffer, Guerrero, and Fischer 2021). Lastly, and seeking to combat the multiple challenges highlighted in the findings, governments have to be aware of the barriers caused by the complexity of platforms and address structural issues within public organizations, particularly HEIs. There is also relevance in developing studies addressing the structural issues inherent to the functioning of HEI, particularly those dependent on

government funding. This issue interrelates with the need to provide unambiguous leadership in DT processes and the importance of improving communication in the DT and change management processes of institutions.

Part III

Chapter 7. General Conclusions

7.1 Conclusions

This chapter summarizes the thesis's key findings, including theoretical and practical implications for managers, universities, and governments. Additionally, it highlights the study's limitations and suggests potential avenues for future research.

Universities face pressure to perform their third mission as catalysts of technological change and innovation, leading to the emergence of the entrepreneurial university (Ent_Uni). These universities collaborate with government and industry as equal partners to create innovation and bridge the gap between academic organizations and entrepreneurial ecosystem (Ent_Eco). Higher education institutions (HEI) play a key role in these ecosystems as knowledge providers and capability aggregators, catalyzing economic and social development. However, they must balance their traditional teaching and research missions with entrepreneurial performance (EP), making it important to understand how entrepreneurial teaching and learning and digital transformation impact the development of entrepreneurial activities. The ongoing digital revolution and industrial revolution 4.0 are forcing HEI to adapt and transform digitally, creating challenges and complexity and recognising that becoming an Ent_Uni can address these challenges. Given the scope and relevance of the impacts, we must contribute to deepening the understanding and understanding of the established dynamics between the themes under study. In this sense, the thesis integrates five studies to answer the defined research questions.

The first research question concerns the need to systematize the existing literature on entrepreneurial universities and entrepreneurial ecosystems. Chapter 2, a SLR entitled “How universities’ dynamics and initiatives are related to entrepreneurial ecosystems: A Systematic Literature Review”, formed the foundation for the rest of the chapters, contributing to the literature state of the art. The SLR and the articles’ analysis comprehensively characterise the existing literature that explores both Ent_Uni and Ent_Eco. Through Bibliographic Coupling, we identified six clusters: (1) University Entrepreneurial Anatomy and Ent_Eco, (2) Universities' Third Mission Performance and Impacts, (3) Balancing Ent_Uni Different Roles, (4) Entrepreneurial Education and Ent_Uni Support, (5) University Entrepreneurial Mindset, and (6) Entrepreneurial Orientation and Knowledge Capitalization

The second research question concerns the analysis of the influence of university education on the development of entrepreneurial activity (Ent_Act). This thesis presented a study entitled “Unlocking the Connection between Education, Entrepreneurial Mindset, and Social Values in Entrepreneurial Activity Development”. This study analysed the relationship between the Total Early Stage Entrepreneurial Activities of graduate individuals (TEAed4) and their entrepreneurial attitudes and social values towards entrepreneurship. It applied data from the Global Entrepreneurship Monitor (GEM) report on innovation-driven countries. The main research findings stem from the regression models (Study 1) and Fuzzy Set Qualitative Comparative Analysis (fsQCA) (Study 2), returning evidence that the likelihood of adult graduates setting up firms or owning young companies rises whenever such individuals deem they hold the knowledge/skills required to start a business. The results also stressed the importance of devoting high media attention to entrepreneurship and fostering entrepreneurial cultures that foster economic growth and prosperity.

The third research question concerns assessing university entrepreneurial perception based on the HEInnovate scale. In Chapter 4, this thesis presented a study entitled “University Entrepreneurial Performance: A Fuzzy Set Qualitative Comparative Analysis (fsQCA)”. This study, based on HEInnovate, explored the benefits of university entrepreneurial metrics, analyzing HEI EP as a discriminant function of the HEInnovate dimensions complemented with a qualitative approach using fsQCA. The analysis provided valuable details, presenting recipes based on the HEInnovate dimensions or combinations of dimensions to achieve an HEI ML.

The fourth research question concerns understanding how students perceive the importance of entrepreneurial activities developed by their higher education institution because of their impact on their subsequent EP. In Chapter 5, this thesis presented a study entitled “Bridging University Entrepreneurial Education and Support with Entrepreneurial Activity: A Graduate-centered Approach”. This study sought to understand how entrepreneurial teaching and learning, preparing and supporting entrepreneurs, and digital transformation and capabilities (HEInnovate dimensions) influence the development of entrepreneurial activities. Based on several interviews with graduate entrepreneurs, this study revealed the multiple aspects involved in the university entrepreneurial structures approached by the dimension of the HEInnovate scale. This study discussed how entrepreneurial universities might train their graduates to develop entrepreneurial activities through investment in entrepreneurial education and a strong link between theoretical and practical aspects, thereby incorporating greater cooperation with industry and the government. The findings conveyed how

entrepreneurial graduates know the need for university-industry (Uni_Ind) collaboration and the dependence on government policy and funding.

The fifth research question concerns exploring the repercussions of digital transformation and capability on the dynamics of triple helix (TH) interactions. In Chapter 6, this thesis presented an essay entitled “*Sensing and Seizing Digitalization Toward Digital Transformation and Capability: A Triple Helix Approach*”. This essay aimed to enhance our comprehension of how the HEInnovate digital transformation and capability (DTC) dimension effectively reflects the vital characteristics of a university that promotes entrepreneurship, fostering optimal TH dynamics and impacts. Based on agents and other hybrid entities involved in their networks, Our research identifies three key areas of focus that are all crucial for ensuring successful DT processes – (a) focus on overcoming the barriers; (b) focus on capitalizing on knowledge; (c) focus on coping with change – essential to understanding the role of DTC in securing the overall success of DT processes.

7.2 Implications and Contributions

This thesis offers valuable insights into both theoretical advances and practical applications, contributing to the growth of both society and the scientific community.

The essay developed in Chapter 2 identified six clusters. The cluster identification and analysis of their themes enable the creation of a conceptual framework to visually show the connections among the main dimensions in each reviewed cluster (Figure 7.1).

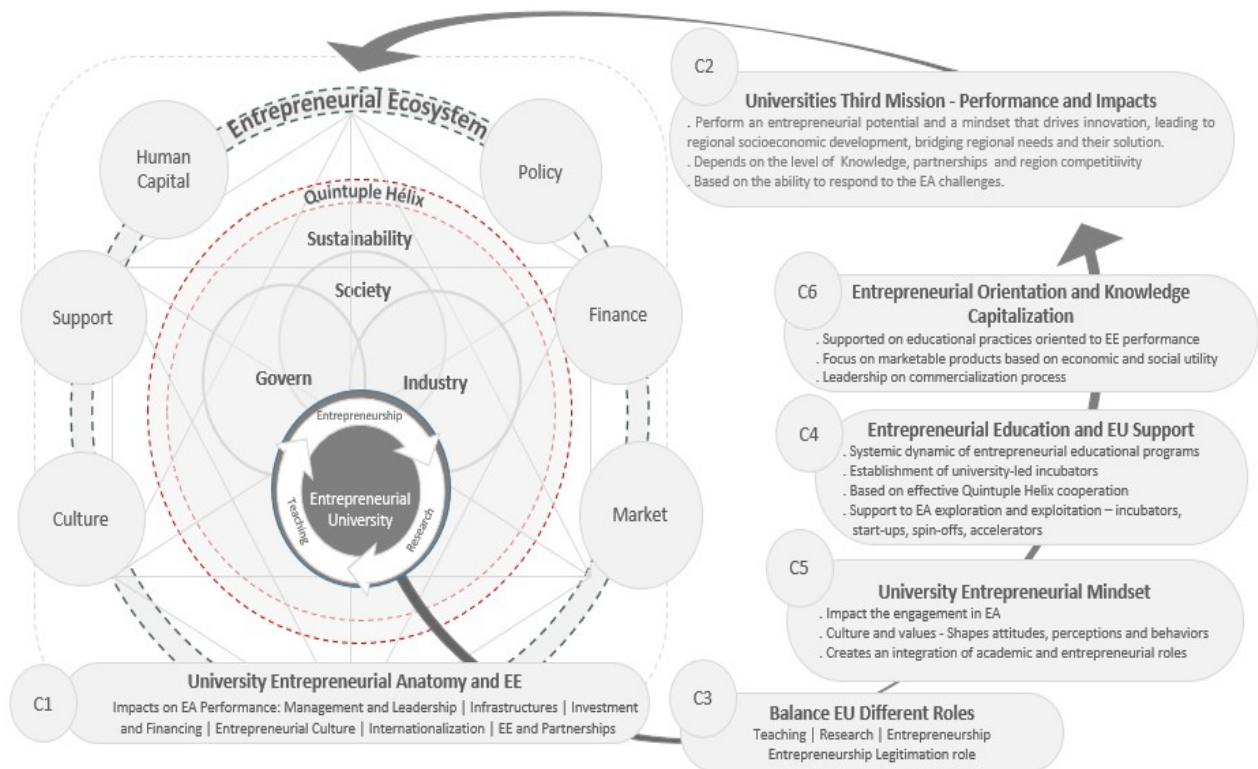


Figure 7.1 Conceptual Framework on Entrepreneurial University and Ecosystems.

The conceptual framework outlines six distinct literature paths on Ent_Uni and Ent_Eco. One of the identified research paths was *University Entrepreneurial Anatomy and Ent_Eco (C1)*, which examines the development of entrepreneurial anatomy and the interplay between Ent_Uni and Ent_Eco concepts to tackle the challenges of Ent_Act. A "Mode 3" university, a new and advanced type of Ent_Uni, can effectively address current and future challenges through strong linkages with Ent_Eco and collaboration between universities, local stakeholders, and the TH dynamics. Considering the dynamics established between Ent_Uni and Ent_Eco, the TH model must be extended to consider a 'fourth helix' - civil society - and a "quintuple helix" that considers the environmental dimension - sustainability.

Another identified research path was the *Universities' Third Mission Performance and Impacts (C2)*. There is no denying the pressure on universities to fulfil behaviour their third mission. To effectively carry out their third mission, universities must possess the capability to address the entrepreneurial challenges discussed in C1. Cultivating a broader sense of knowledge exchange is crucial, encompassing research commercialization, Uni_Ind partnerships. This requires a comprehensive approach to entrepreneurship centred on "problem-solving" (Abreu et al., 2016), with a positive

impact on graduates' employment opportunities and their risk aversion. Entrepreneurship should be fostered at all university levels representing a third mission execution through collaboration and integration of the various actors in the Ent_Eco, where universities are the engines of economic growth, driving essential dynamics to enhance knowledge generation and transfer (Guerrero, Urbano, & Fayolle, 2016).

Balance Ent_Uni Different Roles (C3) – is a research path where Ent_Uni is seen as an economic actor able to balance knowledge creation correctly, dissemination, and exploitation in a correct alignment between education and local needs. The balance of multiple roles may raise tensions (Genç et al., 2020), and Ent_Uni must focus on developing an entrepreneurial mindset, leadership, and strategic vision, performing an entrepreneurial transformation, and the balance of Ent_Uni roles affect Uni_Ind cooperation.

C4 – Entrepreneurial Education and Entrepreneurial University Support – focuses on the importance of entrepreneurship education and support for the transition towards an Ent_Uni, with the establishment of dynamic and systemic entrepreneurship education programs, creating an environment to support the exploration and exploitation of entrepreneurship activities, where incubators, startups, university spin-offs, and accelerators play a crucial role.

C5 – University Entrepreneurial Mindset – focuses on the Ent_Uni entrepreneurial mindset and the evaluation of faculty engagement with Ent_Act in diverse forms and intensity levels but always to capitalize on their Ent_Act results as a source of funding and in the sense of working towards financial independence. The behaviours towards research activities are positively influenced when applied to real problems, facilitating knowledge management and challenging Uni_Ind cooperation. It becomes evident that the ability of academics to transfer knowledge affects university EP and needs a balanced university role performance, making the interconnection with C3 evident.

C6 – Entrepreneurial Orientation and Knowledge Capitalization – focuses on viewing universities as "quasi-firms" able to capitalize on their knowledge production based on their economic and social value (Etzkowitz, 2003). The attainment of a university entrepreneurial status is a gradual process, and in connection with C4, it is possible to see that universities are shifting focus to vocational education and embracing entrepreneurship activities to achieve financial independence demonstrating that Ent_Act effectiveness could influence university and students' perceptions of opportunities.

In summary, Chapter 2 allows a comprehensive understanding of the relationship between Ent_Uni and Ent_Eco by synthesizing existing literature and reducing fragmentation. This systematic approach to research areas is a valuable practical contribution, allowing Ent_Uni and Ent_Eco stakeholders to make more informed decisions in a highly complex and competitive knowledge economy. Our findings reveal Ent_Uni and Ent_Eco as a mutualistic interaction with a reciprocal exchange of resources and capabilities (Schaeffer et al., 2021). This interaction is influenced by the academic environment, highlighting the significance of fostering a supportive entrepreneurial environment for improved EP (Guerrero, Liñán et al., 2021).

The SLR allowed us to become familiar with different lines of research that we aim to develop further in subsequent chapters.

Chapter 3 makes substantial theoretical contributions to the literature. The main research findings arise from the regression models (Study 1) and fsQCA analysis (Study 2), evidencing that the likelihood of adult graduates setting up firms or owning young companies rises whenever such individuals deem they hold the knowledge/skills required to start a business. The results also stress the importance of devoting high media attention to entrepreneurship and fostering entrepreneurial cultures that foster economic growth and prosperity. The findings reinforce the applicability and suitability of fsQCA analysis of GEM data. Furthermore reinforce the importance of institutional or organizational factors as determinants of entrepreneurship and the need to focus on the linkage between entrepreneurial attitudes, entrepreneurial intentions, and entrepreneurial behaviours.

In a scenario where HEI are facing the need to balance the performance of their traditional missions - teaching and research - with the pursuit of EP, Chapter 4 brings awareness to the use of the HEInnovate scale, where it is possible to highlight the importance of the digital transformation and capability dimension to EP and university ML. This brings awareness of the need to pay particular attention to HEI EP and how to measure it. Based on HEInnovate, this study explores the benefits of university entrepreneurial metrics, analyzing HEIEP as a discriminant function of the HEInnovate dimensions complemented with a qualitative approach using fsQCA. The analysis provides valuable details, presenting recipes based on the HEInnovate dimensions or combinations of dimensions to achieve a ML. It is possible to highlight the importance of the digital transformation and capability dimension to EP and university ML.

Thus, Chapter 5 discusses – in a graduate centered approach - how Ent_Uni may train their graduates to develop Ent_Act. This essay stems from original primary data. Subsequently, it articulates the concepts of Ent_Uni, Ent_Edu, and Ent_Act, exploring the need to develop and improve measurement scales that generate knowledge about Ent_Uni levels and their outputs and outcome. The use of HEInnovate conveys the existence and relevance of Ent_Uni structures and the need to evaluate them. The proposed framework allows for visualizing the interrelationship among the eight RP formulated within the scope of mutual TH dynamics, offering practical guidelines to render HEI more robust in their Ent_Edu provision. Based on empirical evidence, in response to the research questions established and resulting from the established research propositions, Chapter 5 presents a framework illustrating the articulation of these themes and their positioning within the scope of mutual TH dynamics. The findings convey how entrepreneurial graduates know the need for university-industry (Uni_Ind) collaboration and the dependence on government policy and funding. The findings suggest the need for more funding to enable the successful deployment of digital transformation (DT) in HEI and the promotion of Ent_Edu, which benefits critical thinking and problem-solving. HEI should promote Ent_Edu, which derives from the harmonious articulation of theory and practice, aiding the development of essential spirits and problem-solving orientations. The findings reinforce the relevance of mentoring in keeping with how entrepreneurs value the support of those who value their ideas, believe in their potential, and help them take the first steps towards Ent_Act.

Thus, according to Chapter 6 findings, it is possible to confirm the contributions made by the ongoing collaboration among TH agents, thus making it necessary to deepen our knowledge about institutional relations and the synergistically aligning the functions of wealth generation, organized knowledge production, and management. Entrepreneurial HEI hold the capacity to develop strategies capable of fostering and deepening entrepreneurial ecosystems over time, a process where the DT process success plays a crucial role. HEI may consider in their self-assessment processes targeting the digital transformation and capability (DTC) HEInnovate dimension and provide policymakers with the notion that they should promote regulation and platforms for TH actors and agents to interact simply and intuitively. There are at least three new focuses that we have identified, three key areas that are crucial for ensuring a successful DT process – (a) focus on overcoming the barriers; (b) focus on capitalizing on knowledge; (c) focus on coping with change – essential areas for understanding the role of DTC in the overall DT success.

7.3 Limitations and Future Research Agenda

This study has limitations that can also serve as opportunities for future research. Despite making significant contributions to the academic discussion on entrepreneurship in universities and the entrepreneurial ecosystem, we recognize that our SLR approach (Chapter 2) may have limitations. Our research protocol limited our analysis to peer-reviewed articles to ensure quality, thus excluding other sources such as book chapters, conference papers, and reviews. We attempted to broaden our search scope by selecting relevant keywords for the simultaneous analysis of the topics of entrepreneurship in universities and the entrepreneurial ecosystem. However, this approach may have excluded important publications that address these topics separately.

Chapter 3 holds limitations that further investigations may overcome. Our analysis only applies to GEM TEAed4 data on innovation-driven countries and TEAed4. The existing limitations are related to the fact that we could have considered other typologies, namely the Efficiency-driven and Factor-driven economies. As part of the research conducted in Chapter 3, we have established a research agenda. Therefore, we consider it important to develop this analysis as Ent_Act, considering whether these originated by necessity or opportunity.

Moreover, the need to work on measuring the performance of Ent_Uni remains outstanding, as despite the existence of instruments that allow for institutional self-analysis, such as HEInnovate, there remains a need to ascertain the tools to evaluate universities and their performance in accordance with entrepreneurship. This type of evaluation might direct students with more entrepreneurial aptitudes towards universities more qualified for teaching and providing future support for entrepreneurial activities. Equally relevant, and according to the 2021/2022 GEM Global Report (GEM, 2022), recognizing the paramount importance of entrepreneurship as a critical driver of economic development and recovery, there is also a need to understand the impacts on entrepreneurship driven by the COVID-19 pandemic. It could also be considered that, given positive media attention, it may significantly impact Ent_Act, exploring utilizing all digital infrastructures. The pandemic highlighted the relevance of this research line, which highlighted the importance of digital ecosystems as 'invisible infrastructures' that encourage emerging entrepreneurs (C. Fernandes, Ferreira, et al., 2022). Lastly, considering the digital context, where metaverse technology appears as a future centre of gravity for online

social interactions (Kraus et al., 2022), it is crucial to approach how entrepreneurs can be better prepared to deal with it with the new reality of opportunities and challenges.

Regarding the limitations identified in Chapters 4 to 6 - related to the sample dimension used and particularities associated with the databases used - we sought to use robust and consistent methodologies not to weaken the analysis process. Therefore, it is vital to outline a contextual and methodological agenda for future research to gain a deeper understanding and knowledge of Ent_Uni and Ent_Eco dynamics.

Chapter 4 has limitations related to the fact that the analysis is restricted to Portuguese HEI and related to the sample size. Future research could conduct studies that use the HEInnovate scale on larger samples. Furthermore, given the importance of training and digital adaptation for HEI, it is crucial to develop instruments that enable self-reflection on the conditions required for effective training, allowing continuous improvement. Analysing changes in institutional entrepreneurial solutions over different periods would also be a helpful step forward in empirically enriching our understanding of entrepreneurial anatomy composition and evaluation. Future research could analyse ML processes at an ecosystem level to explore the factors that positively and negatively influence the ML process.

Chapter 5 also has limitations that future research could overcome. Firstly, focusing on a single institutional evaluative framework - HEInnovate - may be a limiting factor. It might be beneficial to comparatively analyse institutional evaluative frameworks, as in the work of Etzkowitz (2016). Secondly, this study only investigates graduate entrepreneurs in a single culture, so it's important to recognize and analyse how context-specific factors influence theorization and limit the context and impact of the findings. Thirdly, considering the identified research propositions, we believe it's first relevant to develop complementary studies that increase the number of interviews and apply closed-ended questions to generate more targeted responses. Secondly, broadening the context of interview respondents to include distant cultural realities is also crucial. Additionally, understanding the impact of funding limitations on the daily realities of HEI and exploring ways of operationally deploying the RP is important. We would need to evaluate how to harmonize theoretical and practical-oriented courses, what the advantages of university-industry cooperation are in this harmonization, how to best apply for internships in these dynamics, and how to involve faculty in mentoring programs attractively.

Chapter 6 findings are based on data from a single context, Portugal, and a single case, which may limit the generalizability of the findings. Another limitation is that the

analysis exclusively includes qualitative data, which could also be a constraint. Despite these limitations, we sought to be meticulous in selecting interviewees. The HEInnovate DTC dimension can now serve as a starting point for future investigations, but there is a need to continue developing metrics to effectively evaluate DT processes within HEI contexts (Etzkowitz, 2016; Henry, 2015). It is crucial to integrate the relevance of the human dimension (Rocha et al., 2022), specifically critical thinking abilities when analysing DT-generated data.

Additionally, it is crucial to explore how to achieve the right balance between digital and non-digital facets. Another important aspect of addressing is the need to foster cooperation and sharing, aligned with the perspective of mutualism (Schaeffer et al., 2021). It is also crucial to explore the barriers caused by the complexity of platforms and address structural issues within public organizations, particularly HEI. Furthermore, there is relevance in developing studies addressing the structural issues inherent in the functioning of HEI, particularly those dependent on government funding. This requires providing unambiguous leadership in DT processes and addressing challenges in institutional management processes and communication of DT.

We can better understand the underlying dynamics by exploring how universities can be better prepared to leverage existing synergies and overcome their challenges. The five developed essays made a concrete and relevant contribution to deepening current knowledge on entrepreneurship in higher education institutions and entrepreneurial ecosystems. The first essay reveals six distinct research lines that illustrate the dynamics identified in the literature. Within these dynamics, several aspects can be identified that enhance synergies - such as the existence of an entrepreneurial university anatomy that we aim to explore through HEInnovate - as well as aspects that benefit from synergies created by entrepreneurial performance - such as the legitimation of university missions and the cooperative relationships established between the agents of the triple helix. In both the development of dynamics and the enhancement and development of synergies, emerging challenges are visible, which must first be identified so that more and better ways of overcoming them can be explored.

There are still relevant questions regarding the need to develop metrics to assist HEIs in their entrepreneurial development process. First and foremost, we must define aspects related to the structure, leadership, and communication in which entrepreneurial processes are developed. After identifying the dimensions to be

considered and the issues to be evaluated in the HEI entrepreneurial development, we need to determine who should address these questions. Who should take on the burden of classifying the institution? Which individuals possess the information and autonomy required to do so?

It is crucial that we explore the dynamics of university entrepreneurship and entrepreneurial ecosystems to understand how innovative ideas emerge, evolve, and reshape society, while facing challenges and leveraging synergies to capitalise on opportunities to generate significant social and economic impact.

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Appendix A - HEInnovate Dimensions

Dimension

Leadership and Governance | Strong leadership and good governance are crucial to develop an entrepreneurial and innovative culture within an HEI. Many HEI include the words ‘enterprise’ and ‘entrepreneurship’ in their mission statements, but in an entrepreneurial institution, this is more than a reference. This section highlights some of the important factors an HEI may consider in order to strengthen its entrepreneurial agenda.

Organizational Capacity: Funding, People and Incentives | The organizational capacity of an HEI drives its ability to deliver on its strategy. If an HEI is committed to carrying out entrepreneurial activities to support its strategic objectives, then key resources such as funding and investments, people, expertise and knowledge, and incentive systems need to be in place to sustain and grow its capacity for entrepreneurship.

Entrepreneurial Teaching and Learning | Entrepreneurial teaching and learning involves exploring innovative teaching methods and finding ways to stimulate entrepreneurial mindsets. It is not just learning about entrepreneurship, it is also about being exposed to entrepreneurial experiences and acquiring the skills and competences for developing entrepreneurial mindsets.

Preparing and Supporting Entrepreneurs | HEI can help students, graduates and staff consider starting a business as a career option. At the outset, it is important to help individuals reflect on the commercial, social, and environmental or lifestyle objectives related to their entrepreneurial aspirations and intentions. For those who decide to proceed to start a business, or other type of venture, targeted assistance can then be offered in generating, evaluating and acting upon the idea, building the skills necessary for successful entrepreneurship, and importantly finding relevant team members and getting access to appropriate finance and effective networks. In offering such support, an HEI should ideally act as part of a wider business support ecosystem rather than operating in isolation.

Digital Transformation and Capability | HEI are already deploying digital technologies, however the uptake and integration varies among and within institutions. HEI should make the most out of the opportunities presented by digital transformation and consider digital technologies as a key enabler. This section of the self-assessment provides a number of statements to reflect on HEI’s digital capability, defined as the ability to integrate, optimize and transform digital technologies to support innovation and entrepreneurship.

Knowledge Exchange and Collaboration | Knowledge exchange is an important catalyst for organizational innovation, the advancement of teaching and research, and local development. It is a continuous process, which includes the ‘third mission’ of an HEI, defined as the stimulation and direct application and exploitation of knowledge for the benefit of the social, cultural and economic development of society. The motivation for increased collaboration and knowledge exchange is to create value for the HEI and society.

The Internationalized Institution | Internationalization is the process of integrating an international or global dimension into the design and delivery of education, research, and knowledge exchange. Internationalization is not an end in itself, but a vehicle for change and improvement. It introduces alternative ways of thinking, questions traditional teaching methods, and opens up governance and management to external stakeholders. Therefore, it is linked very strongly to being entrepreneurial. It is not possible for an HEI to be entrepreneurial without being international, but the HEI can be international without being entrepreneurial or innovative.

Measuring Impact | Entrepreneurial/innovative higher education institutions need to understand the impact of the changes they bring about in their institution. The concept of an entrepreneurial/innovative HEI combines institutional self-perception, external reflection and an evidence-based approach. However, impact measurement in HEI remains underdeveloped. The current measurements typically focus on the quantity of spin-offs, the volume and quality of intellectual property generation and research income generation, rather than graduate entrepreneurship, teaching and learning outcomes, retaining talent, the contribution to local economic development or the impact of the broader entrepreneurial agenda. This section identifies the areas where an institution might measure impact.

Source: Adapted from <https://heinnovate.eu/en> accessed on 8th February 2022

Appendix B – Questionnaire – Chapter 4

Empreendedorismo e Ecosistemas Empreendedores - Uma Perspetiva das Instituições de Ensino Superior

Caro(a) participante

Esta investigação está inserida no âmbito da tese de Doutoramento em Gestão subordinada à temática Instituições de Ensino Superior (IES) Empreendedoras e Ecosistemas Empreendedores, a realizar pela aluna Lurdes Duarte Patrício da Universidade da Beira Interior, sob orientação do Professor Doutor João José Matos Ferreira.

Queremos desde já agradecer a sua participação nesta investigação!

O principal objetivo passa por aferir, a perceção que a IES detém do seu potencial de inovação e posteriormente aferir a importância deste na legitimação dos papéis da instituição – Ensino, Investigação e Empreendedorismo. O questionário centra-se, na sua maioria, no HEInnovate – uma ferramenta que possibilita que a IES efetue uma autoanálise da sua dimensão empreendedora (<https://heinnovate.eu/pt>).

A análise da informação recolhida visa a caracterização da capacidade empreendedora percebida pelas IES Portuguesas. A investigação a desenvolver não tem objetivos de benchmarking. Não existe nenhum risco implícito associado à participação neste estudo.

O preenchimento do questionário demorará sensivelmente 15 minutos, sendo constituído por 14 questões.

O presente questionário respeita totalmente a liberdade de escolha de cada participante. A sua participação voluntária, existindo a possibilidade de, a qualquer momento, o participante deixá-lo sem qualquer consequência.

Relativamente à proteção dos seus dados, é cumprido o estipulado no Regulamento Geral de Proteção de Dados (RGPD), estando assegurada a segurança, proteção, anonimato e confidencialidade de todos os dados facultados pelos participantes. Os dados serão apenas acedidos pela investigadora do estudo.

Caso tenha alguma dúvida, poderá entrar em contacto através do email: lurdes.duarte.patricio@ubi.pt

Caracterização da Instituição

Natureza da Instituição - Tipologia de Ensino *

Escolha uma das seguintes respostas

Por favor, selecione **apenas uma** das seguintes opções:

- Politécnico
- Universitário

Setor de Atividade. *

Escolha uma das seguintes respostas

Por favor, selecione **apenas uma** das seguintes opções:

- Público
- Público Militar e Policial
- Privado

Localização Geográfica da IES - Indique Distrito/Região. *

Escolha uma das seguintes respostas

Por favor, selecione **apenas uma** das seguintes opções:

- Açores
- Aveiro
- Beja
- Braga
- Bragança
- Castelo Branco
- Coimbra
- Évora
- Faro
- Guarda
- Leiria
- Lisboa
- Madeira
- Portalegre
- Porto
- Santarém
- Setúbal
- Viana do Castelo
- Vila Real
- Viseu

Liderança e Governança

Uma liderança robusta e uma boa governança são cruciais para o desenvolvimento de uma cultura empreendedora e inovadora no seio de uma instituição de ensino superior (IES). Muitas IES incluem as expressões «empresa» e «empreendedorismo» na sua declaração de missão, mas numa instituição empreendedora essas expressões são mais do que uma simples referência. A presente secção salienta alguns dos fatores importantes que uma IES pode ter em conta de modo a reforçar a sua agenda empreendedora.

As afirmações foram elaboradas para que cada instituição se possa classificar numa escala de 1 a 5. Na escala, 1 representa a pontuação mais baixa e 5 a

pontuação mais alta. Uma opção 'não aplicável' (n / a) também está disponível. *

Por favor, selecione a posição apropriada para cada elemento:

	N/a	1	2	3	4	5
1. O empreendedorismo é uma parte importante da estratégia da IES.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Existe um compromisso de alto nível relativamente à execução dos objetivos empreendedores.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Existe um modelo de coordenação e integração das atividades empreendedoras em todos os setores da IES.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. A IES incentiva e apoia as faculdades e unidades no sentido de adotarem uma atitude empreendedora.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. A IES é uma força motriz para o empreendedorismo e a inovação no âmbito do desenvolvimento regional, social e comunitário.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Capacidade Organizacional: Financiamento, Pessoas e Incentivos

A capacidade organizacional de uma IES impele a sua capacidade de pôr em prática a sua estratégia. Se uma IES estiver empenhada em realizar atividades empreendedoras para apoiar os seus objetivos estratégicos, então deve estar pronta a utilizar recursos essenciais como financiamento e investimento, pessoas, competências especializadas e conhecimentos, bem como sistemas de incentivo, de forma a manter e aumentar a sua capacidade para o empreendedorismo.

As afirmações foram elaboradas para que cada instituição se possa classificar numa escala de 1 a 5. Na escala, 1 representa a pontuação mais baixa e 5 a pontuação mais alta. Uma opção 'não aplicável' (n / a) também está disponível. *

Por favor, selecione a posição apropriada para cada elemento:

	N/a	1	2	3	4	5
1. Os objetivos empreendedores são apoiados por uma vasta gama de fontes de financiamento e investimento sustentáveis.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. A IES tem a capacidade e a cultura necessárias à construção de novas relações e sinergias em toda a instituição.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. A IES está aberta à contratação e ao recrutamento de indivíduos com atitude, comportamento e experiência empreendedoras.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. A IES investe no desenvolvimento do pessoal de modo a apoiar os seus objetivos empreendedores.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. São fornecidos incentivos e recompensas ao pessoal que apoia ativamente os objetivos empreendedores.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ensino e Aprendizagem do Empreendedorismo

O ensino e a aprendizagem do empreendedorismo envolvem a exploração de métodos de ensino inovadores e a descoberta de formas de estimular uma mentalidade empreendedora. Não se trata apenas de aprender sobre empreendedorismo, mas também de se expor a experiências empreendedoras e adquirir as aptidões e competências necessárias ao desenvolvimento de uma mentalidade empreendedora.

As afirmações foram elaboradas para que cada instituição se possa classificar numa escala de 1 a 5. Na escala, 1 representa a pontuação mais baixa e 5 a pontuação mais alta. Uma opção 'não aplicável' (n / a) também está disponível. *

Por favor, selecione a posição apropriada para cada elemento:

	N/a	1	2	3	4	5
1. A IES proporciona diversas oportunidades de aprendizagem formal para desenvolver aptidões e mentalidades empreendedoras.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. A IES proporciona diversas oportunidades de aprendizagem informal e experiências para estimular o desenvolvimento de aptidões e mentalidades empreendedoras.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. A IES valida resultados da aprendizagem empresarial que orientam a conceção e a execução do programa de estudos de empreendedorismo.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. A IES concebe e oferece o programa de estudos em conjunto com as partes interessadas externas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Os resultados da investigação sobre empreendedorismo são integrados na oferta de educação em empreendedorismo.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Preparar e Apoiar os Empreendedores

As IES podem contribuir para que estudantes, diplomados e funcionários ponderem fundar uma empresa como opção de carreira. Em primeiro lugar, é importante no sentido em que pode ajudá-los a refletir sobre os objetivos comerciais, sociais, ambientais e de estilo de vida relacionados com as suas intenções e aspirações empresariais. Às pessoas que decidam fundar uma empresa, ou outro tipo de empreendimento, poderá ser prestada assistência específica para a conceção, avaliação e execução da ideia, para obter as aptidões necessárias para um empreendedorismo bem-sucedido e, não menos importante, para encontrar membros de equipa pertinentes e obter acesso a financiamento adequado e a redes de contacto eficazes. Ao providenciar esse apoio, a IES deve, idealmente, atuar como parte de um ecossistema mais vasto de apoio às empresas, em vez de operar de forma isolada.

As afirmações foram elaboradas para que cada instituição se possa classificar numa escala de 1 a 5. Na escala, 1 representa a pontuação mais baixa e 5 a pontuação mais alta. Uma opção 'não aplicável' (n / a) também está disponível. *

Por favor, selecione a posição apropriada para cada elemento:

	N/a	1	2	3	4	5
1. A IES procura sensibilizar para o valor do empreendedorismo e estimular as intenções empresariais dos estudantes, dos diplomados e do pessoal, no sentido de fundar uma empresa ou um empreendimento.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. A IES apoia os seus estudantes, diplomados e membros do pessoal na passagem da geração de ideias à criação de empresas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. É oferecida formação para prestar assistência aos estudantes, aos diplomados e aos membros do pessoal no arranque, na gestão e na expansão de uma empresa.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Indivíduos experientes associados às instituições académicas ou à indústria oferecem mentoria e outras formas de desenvolvimento pessoal.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. A IES facilita o acesso dos seus empreendedores a financiamento.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. A IES proporciona ou facilita o acesso à incubação de empresas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Partilha de Conhecimentos e Colaboração

A partilha de conhecimentos é um catalisador importante para a inovação organizacional, a evolução do ensino e da investigação e o desenvolvimento local. É um processo contínuo que inclui a «terceira missão» de uma IES, definida como a estimulação e a aplicação e o aproveitamento diretos do conhecimento a favor do desenvolvimento económico, social e cultural da sociedade. A motivação para uma colaboração e uma partilha de conhecimentos acrescidos é a criação de valor para a IES e a sociedade.

As afirmações foram elaboradas para que cada instituição se possa classificar numa escala de 1 a 5. Na escala, 1 representa a pontuação mais baixa e 5 a pontuação mais alta. Uma opção 'não aplicável' (n / a) também está disponível. *

Por favor, selecione a posição apropriada para cada elemento:

	N/a	1	2	3	4	5
1. A IES está empenhada em colaborar e partilhar conhecimentos com a indústria, o setor público e a sociedade.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. A IES revela uma participação ativa em parcerias e relações com um vasto leque de partes interessadas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. A IES possui fortes ligações com incubadoras de empresas, parques científicos e outras iniciativas externas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. A IES proporciona ao pessoal e aos estudantes a possibilidade de participarem em atividades inovadoras com empresas/o ambiente externo.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. A IES integra atividades de investigação, educativas e industriais (comunidade mais vasta), de modo a explorar novos conhecimentos.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Transformação e Capacidade Digitais

As instituições de ensino superior (IES) já estão a fazer uso de tecnologias digitais. Contudo, a adoção e a integração destas varia entre IES e também dentro das mesmas. As IES devem tirar o máximo partido das oportunidades que a transformação digital oferece e considerar as tecnologias digitais como fundamentais para o seu desenvolvimento. Na presente secção apresenta-se um conjunto de declarações destinado a promover a reflexão sobre a capacidade digital das IES, entendida como a sua competência em integrar, otimizar e transformar tecnologias digitais para apoiar a inovação e o empreendedorismo. As afirmações foram elaboradas para que cada instituição se possa classificar numa escala de 1 a 5. Na escala, 1 representa a pontuação mais baixa e 5 a pontuação mais alta. Uma opção 'não aplicável' (n / a) também está disponível. *

Por favor, seleccione a posição apropriada para cada elemento:

	N/a	1	2	3	4	5
1. A instituição de ensino superior promove uma cultura digital e implementa e monitoriza uma estratégia digital que apoia a inovação e o empreendedorismo.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. A instituição de ensino superior investe, gere e melhora continuamente uma infraestrutura digital adequada à sua finalidade.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. A instituição de ensino superior apoia ativamente a utilização de tecnologias digitais, com o objetivo de reforçar a qualidade e a equidade no ensino, na aprendizagem e na avaliação.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. A instituição de ensino superior utiliza ativamente recursos educativos abertos, ciência aberta e práticas de dados abertos, com o objetivo de melhorar o desempenho da instituição e aumentar o seu impacto no respetivo ecossistema.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. A instituição de ensino superior utiliza plenamente as suas capacidades digitais, com o objetivo de promover a inovação e o empreendedorismo sustentáveis e inclusivos.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A Instituição Internacionalizada

Internacionalização é o processo de integração de uma dimensão internacional ou global na conceção e execução da educação, da investigação e da partilha de conhecimentos. A internacionalização não é um fim em si mesma, mas antes um veículo para a mudança e o aperfeiçoamento. Além disso, introduz formas alternativas de pensamento, questiona os métodos de ensino tradicionais e abre a governação e a gestão a partes interessadas externas. Por conseguinte, está fortemente ligada à dinâmica empreendedora. Uma IES não pode ter um espírito empreendedor sem ser internacional, mas pode ser internacional sem ter um espírito empreendedor ou inovador.

As afirmações foram elaboradas para que cada instituição se possa classificar numa escala de 1 a 5. Na escala, 1 representa a pontuação mais baixa e 5 a pontuação mais alta. Uma opção 'não aplicável' (n / a) também está disponível. *

Por favor, seleccione a posição apropriada para cada elemento:

	N/a	1	2	3	4	5
1. A internacionalização é parte integrante dos objetivos empreendedores da IES.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. A IES apoia explicitamente a mobilidade internacional do seu pessoal e dos seus estudantes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. A IES procura e atrai pessoal internacional e empreendedor.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. As perspetivas internacionais estão refletidas na abordagem da IES em matéria de ensino.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. A dimensão internacional reflete-se na abordagem da IES no domínio da investigação.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Medição do Impacto

As IES empreendedoras/inovadoras necessitam de ter plena consciência do impacto na sua instituição decorrente das alterações que decidem empreender. O conceito de IES empreendedora/inovadora combina a sua própria perceção institucional, a reflexão externa e uma abordagem baseada em provas. No entanto, a medição do impacto nas IES permanece pouco desenvolvida. As medições atuais centram-se, normalmente, na quantidade de spin-offs, no volume e na qualidade da produção de propriedade intelectual e na geração de receitas provenientes da investigação, em vez de se centrarem no empreendedorismo qualificado, no ensino e nos resultados da aprendizagem, na retenção de talentos, na contribuição para o desenvolvimento económico local ou no impacto dos objetivos empreendedores mais alargados. A presente secção identifica os domínios em que uma instituição pode medir o impacto.

As afirmações foram elaboradas para que cada instituição se possa classificar numa escala de 1 a 5. Na escala, 1 representa a pontuação mais baixa e 5 a pontuação mais alta. Uma opção 'não aplicável' (n / a) também está disponível. *

Por favor, selecione a posição apropriada para cada elemento:

	N/a	1	2	3	4	5
1. A IES avalia regularmente o impacto dos seus objetivos empreendedores.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. A IES avalia regularmente a forma como o seu pessoal e os seus recursos apoiam os seus objetivos empreendedores.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. A IES avalia periodicamente o ensino e a aprendizagem em matéria de empreendedorismo em toda a instituição.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. A IES avalia regularmente o impacto do apoio às <i>startups</i> .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. A IES avalia regularmente a partilha de conhecimentos e a colaboração.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. A IES analisa regularmente as atividades internacionais da instituição em relação aos seus objetivos empreendedores.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Legitimação

Considero que a IES é empreendedora. *

Por favor, selecione **apenas uma** das seguintes opções:

Sim

Não

Enquanto empreendedora, considero que a IES se encontra numa das seguintes fases: *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:

A resposta for 'Sim' na pergunta '12 [EntrepUnivModel1]' (Considero que a IES é empreendedora.)

Escolha uma das seguintes respostas

Por favor, selecione **apenas uma** das seguintes opções:

Primeira Fase - A IES estabeleceu uma visão estratégica da direção que pretende e adquiriu habilidade no estabelecer das suas prioridades.

Segunda Fase - A IES desempenha um papel ativo na comercialização da propriedade intelectual decorrente das atividades desenvolvidas pelos seus docentes, colaboradores e estudantes.

Terceira Fase - A IES desempenha um papel proactivo na melhoria da eficácia da inovação na envolvente regional, muitas vezes conseguida através da colaboração com a indústria e o Governo.

Expresse o seu grau de concordância com a seguinte afirmação: *

Por favor, selecione a posição apropriada para cada elemento:

	Discordo totalmente	Discordo	Não concordo nem discordo	Concordo	Concordo totalmente
À medida que a instituição se vai tornando mais empreendedora assiste-se a um jogo de legitimação dos papéis universitários - ensino, investigação e empreendedorismo - no qual o dinamismo empreendedor possibilita um desempenho sinérgico que permite a melhoria das funções de educação e investigação.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Agradeço o tempo que despendeu na resposta a este questionário. A sua participação é muito importante para que possamos retratar o empreendedorismo universitário e o dinamismo empreendedor dos seus ecossistemas.

Grata!

Submeter o seu inquérito

Obrigado por ter concluído este inquérito.

Appendix C - CFA Results

Dimension Number of Items Involved	KMO	Teste Esfericidade de Bartlett	% of variance	Cronbach's Alpha
Leadership and Governance 5 items	0,821	0,000	74,427	0,911
Organizational Capacity: Funding, People and Incentives 5 items	0,753	0,000	60,132	0,826
Entrepreneurial Teaching and Learning 5 items	0,752	0,000	71,740	0,896
Preparing and Supporting Entrepreneurs 6 items	0,812	0,000	71,180	0,915
Knowledge Exchange and Collaboration 5 items	0,633	0,000	61,777	0,826
Digital Transformation and Capability 5 items	0,778	0,000	70,522	0,892
The Internationalized Institution 5 items	0,635	0,000	57,514	0,801
Measuring Impact 6 items	0,811	0,000	63,516	0,878

Appendix D - Descriptive Statistics

		Pontuação 1	Pontuação 2	Pontuação 3	Pontuação 4	Pontuação 5
Leadership and Governance	Entrepreneurship is a major part of the HEI's strategy.		2,5	25	30	42,5
	There is commitment at a high level to implementing the entrepreneurial agenda.		7,5	30	32,5	30
	There is a model in place for coordinating and integrating entrepreneurial activities across the HEI.	5	12,5	40	25	17,5
	The HEI encourages and supports faculties and units to act entrepreneurially.	2,5	7,5	20	55	15
	The HEI is a driving force for entrepreneurship and innovation in regional, social and community development.	2,5	12,5	25	30	30
Organizational Capacity: Funding, People and Incentives	Entrepreneurial objectives are supported by a wide range of sustainable funding and investment sources.	10	27,5	42,5	12,5	7,5
	The HEI has the capacity and culture to build new relationships and synergies across the institution.	2,5	17,5	22,5	32,5	25
	The HEI is open to engaging and recruiting individuals with entrepreneurial attitudes, behaviour and experience.		15	15	42,5	27,5
	The HEI invests in staff development to support its entrepreneurial agenda.	5	10	25	45	15
	Incentives and rewards are given to staff who actively support the entrepreneurial agenda.	12,5	25	32,5	25	5
Entrepreneurial Teaching and Learning	The HEI provides diverse formal learning opportunities to develop entrepreneurial mindsets and skills.		5	32,5	27,5	35
	The HEI provides diverse informal learning opportunities and experiences to stimulate the development of entrepreneurial mindsets and skills.		10	27,5	40	22,5
	The HEI validates entrepreneurial learning outcomes which drives the design and execution of the entrepreneurial curriculum.	15	15	25	40	5
	The HEI co-designs and delivers the curriculum with external stakeholders.	20	20	25	25	10
	Results of entrepreneurship research are integrated into the entrepreneurial education offer.	5	30	25	32,5	7,5
Preparing and Supporting Entrepreneurs	The HEI increases awareness of the value of entrepreneurship and stimulates the entrepreneurial intentions of students, graduates and staff to start-up a business or venture.	2,5	12,5	22,5	32,5	30
	The HEI supports its students, graduates and staff to move from idea generation to business creation.	7,5	25	17,5	30	20
	Training is offered to assist students, graduates and staff in starting, running and growing a business.	17,5	17,5	22,5	27,5	15
	Mentoring and other forms of personal development are offered by experienced individuals from academia or industry.	10	25	25	30	10
	The HEI facilitates access to financing for its entrepreneurs.	20	32,5	32,5	15	
Knowledge Exchange and Collaboration	The HEI offers or facilitates access to business incubation	17,5	22,5	10	30	20
	The HEI is committed to collaboration and knowledge exchange with industry, the public sector and society.		5	2,5	52,5	40
	The HEI demonstrates active involvement in partnerships and relationships with a wide range of stakeholders.		7,5	17,5	40	35
	The HEI has strong links with incubators, science parks and other external initiatives.	5	25	17,5	20	32,5
	The HEI provides opportunities for staff and students to take part in innovative activities with business / the external environment.	7,5	12,5	25	30	25
Digital Transformation and Capability	The HEI integrates research, education and industry (wider community) activities to exploit new knowledge.	5	10	12,5	45	27,5
	The HEI fosters a digital culture and implements and monitors a digital strategy supporting innovation and entrepreneurship.	2,5	7,5	35	40	15
	The HEI invests in, manages and continuously improves a fit-for-purpose digital infrastructure.	2,5	5	30	27,5	35
	The HEI actively supports the use of digital technologies to enhance quality and equity in teaching, learning and assessment.		5	15	42,5	37,5
	The HEI actively uses open educational resources, open science and open data practices to improve the performance of the institution and increase its impact on its ecosystem.		7,5	25	37,5	30
The Internationalised Institution	The HEI makes full use of its digital capacity to promote sustainable and inclusive innovation and entrepreneurship.	2,5	7,5	40	27,5	22,5
	Internationalisation is an integral part of the HEI's entrepreneurial agenda.	5	2,5	7,5	22,5	62,5
	The HEI explicitly supports the international mobility of its staff and students.		2,5	7,5	15	75
	The HEI seeks and attracts international and entrepreneurial staff.	5	2,5	35	40	17,5
	International perspectives are reflected in the HEI's approach to teaching.	2,5	5	15	47,5	30
Measuring Impact	The international dimension is reflected in the HEI's approach to research.			22,5	32,5	45
	The HEI regularly assesses the impact of its entrepreneurial agenda	7,5	17,5	27,5	37,5	10
	The HEI regularly assesses how its personnel and resources support its entrepreneurial agenda.	5	22,5	37,5	30	5
	The HEI regularly assesses entrepreneurial teaching and learning across the institution.	5	17,5	27,5	40	10
	The HEI regularly assesses the impact of start-up support.	25	12,5	40	20	2,5
	The HEI regularly assesses knowledge exchange and collaboration	2,5	10	45	22,5	20
	The HEI regularly assesses the institution's international activities in relation to its entrepreneurial agenda.	2,5	12,5	37,5	32,5	15

Appendix E - Interview Guide – Chapter 5

Guidelines para Entrevista

Baseado nas dimensões HEInnovate

(https://www.heinnovate.eu/sites/default/files/HEInnovate_8D_Portuguese.pdf)

(ODCE | Comissão Europeia)

Entrevistado | Instituição | Curso

PONTO1

Contextualização - Ensino e Aprendizagem do Empreendedorismo

O ensino e a aprendizagem do empreendedorismo envolvem a exploração de métodos de ensino inovadores e a descoberta de formas de estimular uma mentalidade empreendedora. Não se trata apenas de aprender sobre empreendedorismo, mas também de se expor a experiências empreendedoras e adquirir as aptidões e competências necessárias ao desenvolvimento de uma mentalidade empreendedora.

1. A IES proporciona diversas oportunidades de aprendizagem formal para desenvolver aptidões e mentalidades empreendedoras.
2. A IES proporciona diversas oportunidades de aprendizagem informal e experiências para estimular o desenvolvimento de aptidões e mentalidades empreendedoras.
3. A IES valida resultados da aprendizagem empresarial que orientam a conceção e a execução do programa de estudos de empreendedorismo.
4. A IES concebe e oferece o programa de estudos em conjunto com as partes interessadas externas.
5. Os resultados da investigação sobre empreendedorismo são integrados na oferta de educação em empreendedorismo.

Questões Ponto 1

- a) Considera que é relevante que a universidade explore metodologias de ensino inovadoras e que estimule o desenvolvimento de um *mindset* empreendedor?
- b) A sua universidade privilegiava os aspetos referenciados no “ponto 1”?
- c) Quais os aspetos que não se encontram aqui referenciados e que, enquanto empreendedor, considera essenciais para o desenvolvimento dos skills necessários para a atividade empreendedora.
- d) Qual é a sua opinião sobre a eventual necessidade de integração da educação empreendedora entre os diversos níveis educacionais?

PONTO2

Contextualização - Preparar e Apoiar os Empreendedores

As IES podem contribuir para que estudantes, diplomados e funcionários ponderem fundar uma empresa como opção de carreira. Em primeiro lugar, é importante no sentido em que pode ajudá-los a refletir sobre os objetivos comerciais, sociais, ambientais e de estilo de vida relacionados com as suas intenções e aspirações empresariais. Às pessoas que decidam fundar uma empresa, ou outro tipo de empreendimento, poderá ser prestada assistência específica para a conceção, avaliação e execução da ideia, para obter as aptidões necessárias para um empreendedorismo bem-sucedido e, não menos importante, para encontrar membros de equipa pertinentes e obter acesso a financiamento adequado e a redes de contacto eficazes. Ao providenciar esse apoio, a IES deve, idealmente, atuar como parte de um ecossistema mais vasto de apoio às empresas, em vez de operar de forma isolada.

1. A IES procura sensibilizar para o valor do empreendedorismo e estimular as intenções empresariais dos estudantes, dos diplomados e do pessoal, no sentido de fundar uma empresa ou um empreendimento.
2. A IES apoia os seus estudantes, diplomados e membros do pessoal na passagem da geração de ideias à criação de empresas.
3. É oferecida formação para prestar assistência aos estudantes, aos diplomados e aos membros do pessoal no arranque, na gestão e na expansão de uma empresa.
4. Indivíduos experientes associados às instituições académicas ou à indústria oferecem mentoria e outras formas de desenvolvimento pessoal.

5. A IES facilita o acesso dos seus empreendedores a financiamento.
6. A IES proporciona ou facilita o acesso à incubação de empresas.

Questões Ponto 2

- a) Considera que os aspetos referidos são relevantes para que a universidade contribua para que os estudantes considerem o empreendedorismo (iniciar um negócio) enquanto opção de carreira? (Se sim, qual o mais relevante?)
- b) A sua universidade proporcionou um suporte direcionado para a geração e avaliação da ideia inicial, proporcionando os *skills* necessários, a interligação com outros indivíduos que pudessem ser relevantes para o desenvolvimento do projeto, a ter acesso a financiamento ou a networks relevantes para o desenvolvimento do projeto?
- c) A incubação foi proporcionada ou o acesso à incubação foi facilitado pela universidade?
- d) Quais os aspetos que não se encontram aqui referenciados e que, enquanto empreendedor, considera essenciais no que respeita à preparação e ao suporte universitário que considere essenciais para o desenvolvimento da atividade empreendedora?

PONTO3

Contextualização - Transformação e capacidade digitais

As instituições de ensino superior (IES) já estão a fazer uso de tecnologias digitais. Contudo, a adoção e a integração destas varia entre IES e também dentro das mesmas. As IES devem tirar o máximo partido das oportunidades que a transformação digital oferece e considerar as tecnologias digitais como fundamentais para o seu desenvolvimento. Na presente secção apresenta-se um conjunto de declarações destinado a promover a reflexão sobre a capacidade digital das IES, entendida como a sua competência em integrar, otimizar e transformar tecnologias digitais para apoiar a inovação e o empreendedorismo.

1. A instituição de ensino superior promove uma cultura digital e implementa e monitoriza uma estratégia digital que apoia a inovação e o empreendedorismo.
2. A instituição de ensino superior investe, gere e melhora continuamente uma infraestrutura digital adequada à sua finalidade.
3. A instituição de ensino superior apoia ativamente a utilização de tecnologias digitais, com o objetivo de reforçar a qualidade e a equidade no ensino, na aprendizagem e na avaliação.
4. A instituição de ensino superior utiliza ativamente recursos educativos abertos, ciência aberta e práticas de dados abertos, com o objetivo de melhorar o desempenho da instituição e aumentar o seu impacto no respetivo ecossistema.
5. A instituição de ensino superior utiliza plenamente as suas capacidades digitais, com o objetivo de promover a inovação e o empreendedorismo sustentáveis e inclusivos.

Questões Ponto 3

- a) Em que medida é importante a universidade deter capacidade digital que permita a sua integração, otimização e transformação fazendo parte integrante do suporte à inovação e ao empreendedorismo?
- b) A sua universidade detinha e melhorava de forma contínua as infraestruturas digitais *fit-for-purpose*, integrando a sua utilização no ensino e na performance institucional, aumentando o impacto no ecossistema?
- c) De que modo é que o contacto com essas valências impactou o seu envolvimento na atividade empreendedora?
- d) Quais os aspetos que não se encontram aqui referidos e que, enquanto empreendedor, considera essenciais no que respeita à capacitação digital para posterior desenvolvimento de atividade empreendedora?

Appendix F - Interview Guide – Chapter 6

Guidelines para Entrevista

Baseado na dimensão - **Transformação e capacidade digitais** - HEInnovate
(https://www.heinnovate.eu/sites/default/files/HEInnovate_8D_Portuguese.pdf)
(ODCE| Comissão Europeia)

Designação da entidade respondente:

Contextualização da dimensão *Transformação e Capacidade Digitais*

As instituições de ensino superior (IES) já estão a fazer uso de tecnologias digitais. Contudo, a adoção e a integração destas varia entre IES e também dentro das mesmas. As IES devem tirar o máximo partido das oportunidades que a transformação digital oferece e considerar as tecnologias digitais como fundamentais para o seu desenvolvimento. Na presente secção apresenta-se um conjunto de declarações destinado a promover a reflexão sobre a capacidade digital das IES, entendida como a sua competência em integrar, otimizar e transformar tecnologias digitais para apoiar a inovação e o empreendedorismo.

1. A instituição de ensino superior promove uma cultura digital e implementa e monitoriza uma estratégia digital que apoia a inovação e o empreendedorismo.
2. A instituição de ensino superior investe, gere e melhora continuamente uma infraestrutura digital adequada à sua finalidade.
3. A instituição de ensino superior apoia ativamente a utilização de tecnologias digitais, com o objetivo de reforçar a qualidade e a equidade no ensino, na aprendizagem e na avaliação.
4. A instituição de ensino superior utiliza ativamente recursos educativos abertos, ciência aberta e práticas de dados abertos, com o objetivo de melhorar o desempenho da instituição e aumentar o seu impacto no respetivo ecossistema.
5. A instituição de ensino superior utiliza plenamente as suas capacidades digitais, com o objetivo de promover a inovação e o empreendedorismo sustentáveis e inclusivos.

Questões:

- Na sua opinião, estas afirmações refletem os aspetos esperados das IES de modo a que possam integrar uma transformação digital bem-sucedida?
- Quais os aspetos que não se encontram aqui referidos e que considera serem essenciais no que respeita à capacitação digital para posterior desenvolvimento de atividade empreendedora?
- De que modo é que o a transformação digital pode impactar o desenvolvimento de atividade empreendedora dentro das IES e na indústria?
- A literatura designa a cooperação Universidade-Indústria-Governo de Tripla Hélice. Na sua opinião a transformação digital é um facilitador da colaboração? Se sim, em que medida?
- Na sua opinião, quais as principais barreiras à ao processo de transformação digital?