THIRD MISSION ADVANCEMENT IN HIGHER EDUCATION

DEVELOPING AND ENVISIONING ENTREPRENEURIAL PATHWAYS FOR HIGHER EDUCATION INSTITUTIONS

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'Change will not come if we wait for some other person or some other time. We are the ones we have been waiting for. We are the change we seek' Barack Obama

Abstract

In 1983, Henry Etzkowitz coined the term 'entrepreneurial universities' to explain the strategic developments taking place at some American higher education institutions (HEIs) that have engaged in industry partnerships and generating revenue from new sources, such as patents. The involvement of HEIs in economic activities has led scholars to propose that HEIs currently have a third mission beyond the traditional two missions of teaching and researching. In the past few decades, this phenomenon has attracted the attention of policy-makers, researchers, and HEI leaders, with new developments being documented in many countries around the world. Nevertheless, one aspect of this phenomenon that remains poorly understood is the entrepreneurial pathways pursued by HEIs in their attempt to strategically develop their third mission. Therefore, the overarching research question addressed in this dissertation is: how can HEIs become more entrepreneurial and strategically advance their third mission?

The purpose of this dissertation is to envision and develop entrepreneurial pathways for HEIs, contributing to the research domain of higher education entrepreneurialism from a managerial perspective. This dissertation comprises three studies:

(1) a systematic literature review of the transformation journey of 36 HEIs across the globe establishes the researching status quo, proposes core entrepreneurial pathways and an action-framework, and identifies specific research avenues for the topic;

(2) an international foresight study adds a novel perspective by proposing five future scenarios for HEIs based on the interests, preoccupations, and expectations of entrepreneurial ecosystem stakeholders from sixteen countries; and

(3) a confirmatory study which identifies two mechanisms through which dynamic capabilities translate into third mission strategic advancements.

Combined, these studies shed light on the strategic choices HEIs must take when developing their third mission, effectively explaining how HEIs can become more entrepreneurial. This dissertation thereby contributes concomitantly to the theory on entrepreneurial universities and HEIs' management practice.

Kuzzusammenfassung

Henry Etzkowitz prägte bereits 1983 den Begriff 'Entrepreneurial Universities', um die strategischen Entwicklungen an einigen amerikanischen Hochschulen zu erklären, die sich in Industriepartnerschaften engagierten und Einnahmen aus neuen Aktivitäten, bspw. in Form von Patenten erzielten. Die Einbeziehung wirtschaftlicher Aktivitäten veranlasste die Wissenschaftler zu dem Vorschlag, dass die Hochschulen auch einen dritten Auftrag haben, der über die traditionelle Lehre und Forschung hinausgeht. In den letzten Jahrzehnten hat das Phänomen die Aufmerksamkeit von politischen Entscheidungsträgern, Forschern und Hochschulleitungen auf sich gezogen, und seine Entwicklungen wurden in vielen Ländern der Welt dokumentiert. Dennoch bezieht sich ein Aspekt dieses Phänomens, der immer noch wenig verstanden wird, auf die unternehmerischen ('entrepreneurial') Entwicklungspfade, die die Hochschulen bei ihrem Versuch verfolgen, eine dritte Mission strategisch zu entwickeln. Die übergreifende Forschungsfrage, die in dieser Dissertation behandelt wird, lautet daher: Wie können die Hochschulen unternehmerischer (im Sinne des Begriffs Entrepreneurship) werden und ihre dritte Mission strategisch weiterentwickeln?

Das Ziel dieser Dissertation ist es, unternehmerische Entwicklungspfade für Hochschulen zu entwerfen und zu entwickeln, um einen Beitrag zum Forschungsbereich des

Hochschulunternehmertums aus einer strategischen Perspektive zu leisten. Diese Dissertation umfasst drei Studien:

(1) Ein systematischer Literaturüberblick zeichnet die Transformation von 36 Hochschuleinrichtungen weltweit nach und bildet den Status Quo in der Forschung ab. Auf dieser Basis werden Entwicklungspfade für Entrepreneurial Universities und ein Handlungsrahmen vorgeschlagen sowie spezifische künftige Forschungswege für dieses Thema identifiziert.

(2) Eine internationale Vorhersagestudie ergänzt bisher nicht existente bzw. betrachtete Forschungsperspektiven, indem sie fünf Zukunftsszenarien für Hochschulen vorschlägt, die auf den Interessen, Sorgen und Erwartungen von Stakeholdern in Entrepreneurship-Ökosystemen in 16 Ländern basieren.

(3) Eine konfirmatorische Studie identifiziert zwei Mechanismen, durch die dynamische Fähigkeiten in strategische Fortschritte der dritten Mission umgesetzt werden können.

Zusammengenommen beleuchten diese Studien die strategischen Entscheidungen, die Hochschulen bei der Entwicklung ihrer dritten Mission treffen müssen, und erklären so, wie die Hochschulen unternehmerischer werden können. Somit leistet diese Dissertation einen Beitrag zur Theorie der unternehmerischen Hochschule (‘Entrepreneurial Universities’) und zur Managementpraxis der Hochschulen.

Table of Contents

List of Figures

List of Tables

Abbreviations

AVE	-	Average Variance Extracted
CERQual	-	Confidence in Evidence from Reviews of Qualitative Research
DCs	-	Dynamic Capabilities
EE(s)	-	Entrepreneurial Ecosystem(s)
e.g.	-	For Example
H	-	Hypothesis
HEI(s)	-	Higher Education Institution(s)
i.e.	-	That is to say
MIT	-	Massachusetts Institute of Technology
PLS-SEM	-	Partial Least Square – Structural Equation Modelling
R^2	-	Coefficient of Determination
SDGs	-	Sustainable Development Goals
TTO(s)	-	Technology Transfer Office(s)
UK	-	United Kingdom
US(A)	-	United States of America

1. Introduction

1.1. Higher Education Sector and the Emergence of Entrepreneurial Universities

In the 19th century, European higher education institutions (HEIs) underwent a transformational wave towards research-based learning, influenced by the German Humboldtian model. This transformation is referenced as the 'second mission' for integrating teaching and research in HEIs (Etzkowitz et al., 2000; Etzkowitz, 2003a). Around this time, the United States started to develop a higher education sector by adapting existing European models. The German Humboldtian model was primarily combined with liberal education elements from the Anglo-Saxon model and the vocational principles of the Napoleonic model (Sam and Sijde, 2014).

Until the early 20th century, American public funding for academic research was primarily available for the agriculture field. For instance, a number of American HEIs were founded thanks to the Land Grant Law, which supported academic institution foundation, with practical intent, by granting them with land ownership to establish the necessary infrastructure. It was only with the advent of the World War I and II that academic research in technical fields started to be actively public funded, mostly for military purposes. In this context, William Barton Rogers founded the Massachusetts Institute of Technology (MIT) in 1891, with a land grant in Boston, a region that had already developed textile and machinery industries. With the support of policy-makers and donations from industrialists, Rogers established an engineering school with a close university-industry relationship based on consultancy and applied research that would lead to intellectual property and future licencing agreements. This was the incipient emergence of academic technology transfer. By the 1920s, MIT technology had also led to the formation of new firms. Thanks to early successes and the

initiative of its president, MIT gained public support from the New England Council to establish a University-Industry-Government network in the 1930s, today referred as the first example of the Triple Helix model. The network provided, on a larger scale, mentoring and capital for MIT's spin-offs, resulting in the conceptualisation and operationalisation of venture capital (Etzkowitz, 1983, 2003a, 2004; O'Shea et al., 2007).

On the American west coast, Stanford University was established as a foundation on the Stanford family land in Palo Alto, in the late 19th century. As a poorly endowed regional private university, Stanford founders believed in the need to integrate its engineering school with high-tech industries. Since this was non-existent in the area, they initiated its creation. For instance, two professors privately funded a Stanford graduate to found the Federal Telegraph Company in 1910. A MIT doctoral graduate that directly and indirectly experienced the emerging models of technology transfer and venture capital, Frederick Terman, became Dean of the Stanford University engineering school (1930-1954) and later University Provost (1955-1970), transferring the models to the context of Stanford. In 1951, Stanford Industrial Park was created to contribute to the emergence of a regional high-tech entrepreneurial ecosystem –Silicon Valley (Etzkowitz, 1983, 2004, 2013c; Leih and Teece, 2016).

In 1983, Henry Etzkowitz first addressed this narrative, defining entrepreneurial universities as HEIs that 'are considering the possibilities of new sources of funds to come from patenting the discoveries made by scientists holding academic appointments, from the sale of knowledge gained by research done under contract with commercial firms, and from entry into partnership with private business enterprise' (Etzkowitz, 1983, p.198). This was the first reference to this emerging phenomenon, which 'transcends and incorporates previous academic dichotomies (ivory-tower/polytechnic; research/teaching) in a new synthesis' (Etzkowitz, 2004, p. 65).

MIT and Stanford were 'formerly misinterpreted as academic anomalies, that would inevitably conform to the research university model' (Etzkowitz, 2004, p.67). Now considered epitomes of the entrepreneurial university model, their developments have influenced policy-making, such as instance the 1980 US Bayh-Dole Act in the United Stated that gave universities intellectual property ownership of public funded research outputs and motivated HEIs around the world to try to emulate them. In this sense, the Anglo-American model of higher education evolved to 'take on several roles in society and in the innovation (eco) system' (Sam and Sijde, 2014, p. 901), incorporating a third mission to teaching and research: economic and social development. The import of this evolved higher education model by other countries has pushed towards a global convergence in the sector. However, there are dramatic limitations to replication strategies, due to differences in universities' external environment and internal resources and capabilities, as pointed out by Etzkowitz (2003a, 2004); Jacob, Lundqvist and Hellsmark (2003); Lazzeretti and Tavoletti (2005); Etzkowitz and Zhou (2008); Philpott et al. (2011); Stensaker and Benner (2013); and Leydesdorff, Etzkowitz and Kushnir (2015).

The bottom-up emergence of entrepreneurial universities in the United States, based on MIT and Stanford's industry relations and knowledge transfer commercialisation, led the characterisation of the phenomenon to be initially considered an extension of HEIs' research mission; this limited the concept to research universities and polytechnics with applied-research capabilities. However, the transference of the model to the European context of stronger welfare culture and systems, in which professors are public servants perceived as having limited entrepreneurial orientation, demanded a key adaption: for the third mission to emerge as an extension of the teaching mission (Etzkowitz et al., 2000; Etzkowitz, 2003b; Leydesdorff, Etzkowitz and Kushnir, 2015).

Beyond the US and Europe, the phenomenon of emerging entrepreneurial universities has been documented, among others, in Brazil (Almeida, 2008; Amaral, Ferreira and Teodoro, 2011), Chile (Bernasconi, 2005), Canada (Bramwell and Wolfe, 2008), China (Zhou and Peng, 2008), Iran (Aidin Salamzadeh and Farsi, 2015), Japan (Yokoyama, 2006), Malaysia (Ahmad et al., 2018), Turkey (Beyhan and Findik, 2018), Singapore (Wong, Ho and Singh, 2007), South Africa (De jager et al., 2017), and United Arab Emirates (Bhayani, 2015). Particularly in emerging economies, as for instance Brazil, Iran or South Africa, a key factor in enabling this emergence is either a combination of policy development and availability of public funding or university autonomy and financial independence (Almeida, 2008; Amaral, Ferreira and Teodoro, 2011; Aidin Salamzadeh and Farsi, 2015; De jager *et al.*, 2017).

Many countries have conducted reforms in their higher educational system, making significant changes regarding HEIs' autonomy, public financing, mission, and accountability (Audretsch and Keilbach, 2004; Gibb and Hannon, 2006). Today, perceived as catalysts for regional economic and social development, HEIs are being pushed towards entrepreneurialism. The entrepreneurial university model is perceived as a response to technological, economic, and social demands of knowledge societies. The production of human, knowledge, and entrepreneurship capital is increasingly driving innovations, increasing competitiveness, and consequently positively influencing economic growth (Guerrero, Cunningham and Urbano, 2015). Ultimately, the purpose of HEIs, in the context of 'entrepreneurial societies', is to ensure that its citizens thrive in their endeavours (Audretsch, 2014).

Nevertheless, this model is not without criticism regarding legitimacy issues and a perceived distortion of the research university model and conflicts, conceptual and operational, between HEI's three missions: teaching, research, and economic and societal development (Tuunainen, 2005; Powell, Owen-Smith and Colyvas, 2007; Slaughter and Rhoades, 2009;

Goldstein, 2010; Philpott et al., 2011; Stensaker and Benner, 2013). Without unanimous agreement that HEIs must become more entrepreneurial, many institutions have embarked on a journey replete with challenging organisational changes (Clark, 2004; Guerrero, Kirby and Urbano, 2006; Mcgowan, Sijde and Kirby, 2008). The remaining question is how this ideal can be effectively achieved.

The entrepreneurial university model has risen in popularity among academics and policy makers, thanks to two timely publications: (1) Slaughter and Leslie 1997 critic book *Academic Capitalism: Politics, Policies, and the Entrepreneurial University*, on the impact of commercialisation in HEIs, is the most cited reference, with 7012 citations, on Google Scholar, as of August 2020 (Slaughter and Leslie, 1997). And (2) Burton Clark's study of five European universities in the mid-1990s, in which he proposed 'pathways of transformation' (Clark, 1998a, 1998b). Clark's 1998 book *Creating Entrepreneurial Universities* has become almost iconic (Taylor, 2012) among academics and is the second most used reference, with 6425 citations (Google Scholar, August 2020).

Since then, there has been a blooming literature, which has attempted to understand the different aspects of this phenomenon. Formal and informal mechanisms, economic impact, and endogenous and exogenous forces have influenced the model and its adoption by HEIs and policymakers around the world (Etzkowitz and Leydesdorff, 2000; Jacob, Lundqvist and Hellsmark, 2003; Etzkowitz, 2004; Lazzeretti and Tavoletti, 2005; Gibb and Hannon, 2006; Nelles and Vorley, 2010b; Guerrero, Toledano and Urbano, 2011; Stensaker and Benner, 2013). Furthermore, literature reviews have tried to summarise what is already known about entrepreneurialism in higher education, as for instance Gibb (2002); Rothaermel, Agung and Jiang (2007); Perkmann *et al.* (2013). Nevertheless, few reviews have been conducted from an institutional perspective of the entrepreneurial university model, some examples are Laredo

(2007); Bronstein and Reihlen (2014); Clauss, Moussa and Kesting (2018); and Centobelli et al. (2019).

The attempts from HEIs across the globe to learn from their American counterparts, adapting concepts, teaching, and supporting enterprising students, while being impacted by their environmental contexts, particularly on the policy level, has led to a broader understanding of entrepreneurial universities (Clark, 1998a, 1998b; Kristensen, 1999; Almeida, 2008). Hence, this is potentially applicable to all HEI types in 'an efflorescence of embryonic characteristics that exist 'in potentio' in any academic enterprise (…) with the ability to periodically reinvent itself and incorporate multiple missions' (Etzkowitz, 2013a, p. 487). A current definition of the model evolved into an integrative and systemic view of all university missions, emphasising that 'an entrepreneurial university design integrates project-based learning in the curriculum with an outlook of seeking out the useful as well as the theoretical results of investigation. These results are moved into use through an innovation system that includes a penumbra of public and private actors posing problems, concomitantly with the provision of resources' (Etzkowitz et al., 2019, p. 169). The diversification of organizational attributes related to entrepreneurial universities led (Bronstein and Reihlen, 2014) to identify systematically four archetypes:

- 'Research-preneurial': A research-driven HEI characterized by participatory governance, which is traditionally structured. Its peripheries include science parks and research centres, mainly publicly funded ones. One example is Stanford University (USA);
- 'Techni-preneurial': Focused on applied sciences and close university-industry relationships. This archetype plays a significant role in regional economic development by supporting small- and medium-sized enterprises through triple-helix cooperation. One example is the University of Joensuu (Finland);

- ‘Inno-preneurial’: Financially diversified, project-driven, and service-oriented, this archetype has autonomous governance with flexible ad hoc structures that enable the emergence of interdisciplinary and novel approaches. Examples are Warwick University (UK) and the Copenhagen Business School (Denmark);
- ‘Commerce-preneurial’: Traditionally located in knowledge-intensive regions and evolving from traditional elite research universities. They are characterised by novel and flexible, but rather complex structures. Focusing on knowledge commercialisation through a series of specialized research centres, incubators and business units, they are supported by triple-helix collaborations and organised by a performance-oriented professional steering core. An example is the University of Twente (Netherlands).

This historical narrative of the emergence of the entrepreneurial university model, with the adoption of a third mission, provides an historical overview of higher education’s mission evolution. It presents a key perspective to the understanding of how Stanford University and MIT became epitomes of the entrepreneurial university model and the American higher education system has increased its global influence. This contextualisation is also necessary to explain why HEIs around the world embarked in such transformation endeavour influenced by these institutions.

1.2. HEIs’ Entrepreneurial Pathways

Entrepreneurial pathways refer to the strategic choices taken by HEIs’ (i.e. its leaders) to demonstrate commitment and involvement with innovative entrepreneurship initiatives emerging inside the institution (Klofsten et al., 2019). Pathways for transformation were an incipient proposition by Burton Clark on his influential study of five European entrepreneurial universities in the 1990s. He identified five elements of transformation that become pathways

through their interaction, as alone, each element, is possibly insignificant (Clark, 1998b). Despite the influence of Clark's seminal work, a series of critics were outed by scholars, as for instance Smith (1999); Deem (2001); Finlay (2004); Pilbeam (2008); and Shattock (2010), who were concerned with the overall confidence placed on the outcomes, due to shortcomings identified in its research methodology. For instance, the homogeneity of the five selected European universities, as these were all: (a) perceived as successful and 'self-confessed' entrepreneurial universities; (b) middle-sized with a limited range of disciplines; and (c) relatively young institutions with circa 30 years of existence in their current institutional formats at the time. Furthermore, critics also pointed to limitations in the data collection process, which lacked crosscheck measures, and interviewees were small in number and homogenous in profile.

In addition to Clark, two further authors propose pathways by conceptualising elements of transformation. Etzkowitz (2014) suggested the following four elements: interaction (HEI engages in triple-helix collaborations); independence (HEI is not dependent of another institutional sphere); hybridisation (HEI creates hybrid organisational formats, as e.g. centres and parks); and reciprocity (HEI continually revises its structures and triple-helix relationships). Nelles and Vorley (2010) constructed an 'entrepreneurial architecture', as a 'blueprint' for HEIs aiming to become more entrepreneurial. The blueprint is composed of five elements: structures (entrepreneurial support infrastructure, as e.g. incubators and technology transfer offices); systems (networks connecting different departments/actors); strategies (Institutional goals supported by incentive and measurement schemes); leadership (orientation and support from universities leaders towards the third mission); and culture (entrepreneurial attitude in institutional, departmental and individual levels).

Overall, there is widespread agreement in the literature regarding the transformation's non-linearity, characterised by innovation processes with experimental approaches in a steady state of institutional change (Etzkowitz and Leydesdorff, 2000; Clark, 2003; Etzkowitz, 2013a). In this sense, a series of actions to transform HEIs into entrepreneurial universities have been proposed by Kirby (2006) based on his attempt to understand how the developed theory around the elements of transformation was being translated into practice in the form of strategic actions. Furthermore, a recent updated study from Stanford University, (Etzkowitz et al., 2019) suggested three strategic actions to determine advancements in the entrepreneurial university. These are introduction of project-based experiential learning, the introduction of more applied-oriented research with support to move results into actual user-cases, and the development of public-private partnerships that bridge real-life problems, academia competencies and skills, and the necessary resources to tackle identified problems.

Three further propositions suggest developmental stages for the transformation process. The first regards the case of Newcastle University (UK) as an empirical example (Benneworth, 2007). In its endeavour to become more entrepreneurial, this institution went through four stages: 'naïve' (development of services to local industries); growth (attempt to promote its own spin-offs due to weak demand from local industries); consolidation (make knowledge transfer deals with large corporations to increase revenues); and outreach (attempt to open itself to outside users).

The second stage-based proposition is a simplified synthesis, comprised of three complementary development stages (one, two and three) that do not necessarily occur in a specific order (Etzkowitz, 2013a). These are (1) the adoption of an institutional vision, (2) the development of transfer capabilities, and (3) taking a proactive role in the regional entrepreneurial ecosystem development.

The third proposition based on developmental stages is based on a quantitative cluster analysis of 69 European HEIs (Markuerkiaga, Igartua and Errasti, 2018). The authors clustered their sampled institutions based on their transformation status quo, as either: 'advanced entrepreneurial universities (14 HEIs from the sample, already consolidated); 'emerging entrepreneurial universities' (10 HEIs from the sample starting the entrepreneurial pathway; and 'en route entrepreneurial universities' (45 HEIs from the sample were 'in the middle').

Beyond these contributions, the combined work of Maribel Guerrero throughout the last decade has helped scholars to understand the development of entrepreneurial universities and their economic impact in their regions. Take for instance the following studies: Guerrero, Toledano and Urbano (2011); Urbano and Guerrero (2013); Guerrero *et al.* (2014) and (2016); and Guerrero, Cunningham and Urbano (2015). Guerrero conducted her doctoral research on the topic and continued to explore it as a professor in Spain and currently in the UK. Her work initially aimed at introducing robust theoretical frameworks to understand entrepreneurial universities.

Together with David Urbano, Guerrero applied a resource-based view of the phenomenon to explain the internal factors (resources and capabilities) that generate a competitive advantage. Moreover, she combined it with an institutional perspective to analyse formal and informal environmental factors (Guerrero and Urbano, 2012). As a result, the authors proposed a conceptual model for entrepreneurial universities (Figure 1.1) and applied it to nine Spanish universities in a quantitative study with a structural equation modelling technique; segmenting the nine cases into three developmental stages, they deemed the initial, development, and consolidation phases.

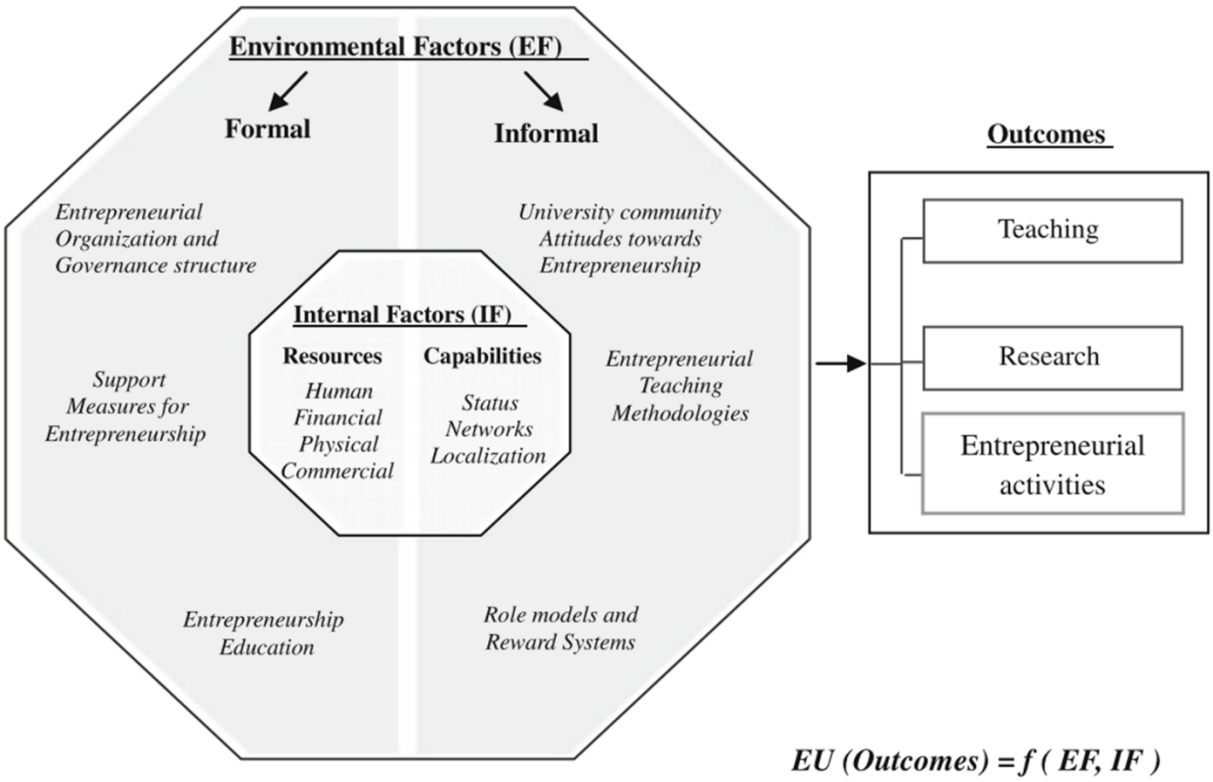

Figure 1.1: Conceptual model of entrepreneurial universities

(Guerrero and Urbano, 2012, p.47)

1.3. Research Gap and Dissertation Purpose

The previous introductory sub-chapter contextualised the emergence of the entrepreneurial university model and summarised what is known about entrepreneurial pathways for HEIs aiming to become more entrepreneurial. It indicates that still little is known about the ways in which HEIs attempt to transform themselves into more entrepreneurial institutions to strategically advance their third mission. In this regard, a 2019 special issue at Technology Forecasting and Social Change (impact factor 2019: 5.846) guest edited by prominent professors leading the research on this phenomenon – namely Magnus Klofsten, Alain Fayolle, Maribel Guerrero, Sarfraz Mian, David Urbano and Mike Wright – listed the understanding of entrepreneurial pathways for HEIs as one of five main agenda topics for future research. Specifically, the guest-editors proposed the following research questions on this topic:

- ‘How should universities balance exploration and exploitation in their evolutionary path toward an entrepreneurial mode?
- How can the experience of good practice entrepreneurial pathways in one university be transferred to universities with different academic traditions and regional conditions?
- What are the core entrepreneurial pathways that apply in any university context? Can we systematically identify which additional pathways apply in different types of context?
- How can entrepreneurial pathways be developed that match requisite resources with activities in order to achieve effectiveness? and
- What are the most effective forms of accelerators, incubators, and innovation parks to support the range of entrepreneurial activities in different types of entrepreneurial universities?’ (Klofsten *et al.*, 2019, p.156);

Motivated by these research avenues, the overarching research question addressed in this dissertation is how can HEIs become more entrepreneurial and strategically advance their third mission?

The understanding of entrepreneurial process remains a promising research topic within entrepreneurship research (Kuckertz and Prochotta, 2018), and its understanding within the context of HEIs and its third mission advancement remains underexplored. Furthermore, there is a clear need to establish links between entrepreneurship and public enterprises to develop a modern theory of public enterprises (Tremml, 2019) and hence also for HEIs that operate in a highly regulated sector, regardless of being public or private-held.

Therefore, the purpose of this dissertation is to envision and develop entrepreneurial pathways for HEIs. Hence, contributing to the research domain of higher education entrepreneurialism by (a) investigating used entrepreneurial pathways to propose a meta-

level action-framework to explain the underlying process, (b) conducting a foresight exercise from an ecosystem perspective to envision future possible scenarios, and (c) identifying mechanisms that effectively enable HEIs' third mission advancement. This dissertation encompasses three studies addressing specific research questions associated with these three goals.

Study 1 takes into account the proposed research avenue by indicating the need to develop a core entrepreneurial pathway regardless of HEI's context (Klofsten *et al.*, 2019) and the limitations of existing entrepreneurial pathways propositions (chapter 1.2) to address two research questions: (1) How do HEIs transform into more entrepreneurial institutions? and (2) which gaps and blind spots remain in the understanding of this transformation process?

A systematic literature review was conducted to answers these questions, having as main purpose to improve the theoretical understanding on HEIs' transformation process, establishing a specific research agenda to guide the following studies. Specifically, study 1 intended to identify communalities among cases of HEI's transformation process into more entrepreneurial institutions, to propose a core entrepreneurial pathway that could contribute concomitantly to academia and to practice. This purpose was achieved by identifying three core entrepreneurial pathways and explaining the process through an action-framework proposition.

Study 2 builds upon an identified research gap from the first study (Stolze, 2021). Taking into the account the lack of foresight research on the future of entrepreneurial HEIs, it addresses: (a) how should HEIs, regardless of their current level of entrepreneurialism, evolve in the long-term to address the preoccupations and interests of entrepreneurial ecosystem stakeholders? and (b) what are the opportunities and risks for HEIs in pursuing entrepreneurial pathways?

Study 2 has the purpose of adding a yet inexistent foresight perspective to the academic discussions on HEIs' transformation into more entrepreneurial institutions. Specifically, it builds upon strategic management research on scenarios planning and takes an entrepreneurial ecosystem perspective to construct five scenario propositions for the future of entrepreneurial HEIs, thus providing HEIs' decision makers with insights and foresights to inform their vision of future development.

Study 3 address the research avenue associated with HEIs' ability to balance exploration and exploitation to advance their entrepreneurial path (Klofsten *et al.*, 2019). Taking into account the transformational nature of this process, since HEIs' must add a third mission to the existing teaching and research, this study asks: how can dynamic capabilities (DCs), i.e. the ability to sense, seize, and transform, be translated into HEIs' strategic third mission advancements?

Study 3 consists of a quantitative study with key decision makers inside German HEIs, who are driving their institutions third mission strategic advancement. Its purpose is to identify mechanisms through which DCs might advance HEIs' third mission. The study identified leadership and agreement on vision and goals as mechanisms that promise to transform dynamic capabilities into third mission advancements.

The three studies combined shed light on HEIs' transformation process towards becoming more entrepreneurial. The overarching dissertation contribution is the proposition of a strategic management model that explains HEIs' how HEIs advance their third-mission through entrepreneurial pathways (chapter 5 | Figure 5.1), by making the necessary strategic choices to introduce and advance HEIs' third mission.

1.4. Dissertation Structure

This dissertation attempts to shed light on how can HEIs become more entrepreneurial and strategically advance their third mission by envisioning and developing entrepreneurial pathways and paving the way for new research avenues. It comprises three studies, preceded by this introduction (chapter 1). Combined, these studies elucidate how HEIs become more entrepreneurial institutions and strategically advance their third mission (Table 1.1).

The first study (chapter 2) presents a systematic literature review on HEIs' transformation into more entrepreneurial institutions. It applies a meta-ethnographic approach (Noblit and Hare, 1988) to synthesise the transformation journey of 36 HEIs across 18 countries. It identifies three core entrepreneurial pathways that occur through the development of (1) ecosystem initiatives, (2) new education programs, and (3) changes to the governance structure. Furthermore, it explains the transformation process through a four-stage iterative non-linear action-framework proposition. This suggests that exogenous and endogenous forces constantly influence HEIs, which in response, produce initiatives (i.e. experiments), requiring stakeholders' sensitisation to be consolidated and later institutionalised. The iterative characteristic of this proposition suggests that the transformation process of HEIs into become more entrepreneurial institutions is in fact endless, as new initiatives require a long timeframe to consolidate due to rather slow progress and cautious strategic decision-making.

Thus, the contributions of study 1 are threefold: First, it contributes to academia by providing an improved theoretical understanding of and research into HEIs' transformation process. Second, it suggests a specific research agenda for further research on HEIs' entrepreneurial pathways. Third, it proposes a core entrepreneurial pathway composed of three paths (ecosystem, education, and governance). These pathways are steered through an iterative

non-linear action-framework proposition, which can serve as an analytical tool for HEIs' decision makers strategic planning, thus contributing significantly to practice.

Overarching research question:

How can higher education institutions become more entrepreneurial and strategically advance their third mission?

Chapter	Title	Specific Research Questions	Methods	Sample	Author(s)
2	A meta-ethnography on HEIs' transformation into more entrepreneurial institutions: towards an action-framework proposition[1]	How do HEIs transform into more entrepreneurial institutions? Which gaps and blind spots remain in the understanding of this transformation process?	Systematic literature review applying the meta-ethnographic method	33 peer-reviewed articles with 36 cases (HEIs) from 18 countries	Audrey Stolze

[1] Article published online first, as open access, on the journal Industry & Higher Education (Scopus CiteScore: 1.400) under the DOI 10.1177/0950422220922677. An earlier version was presented at the XVII Triple Helix Conference (2019) and at the 23rd Annual Interdisciplinary Conference on Entrepreneurship, Innovation and SMEs | G-Forum (2019).

Overarching research question:

How can higher education institutions become more entrepreneurial and strategically advance their third mission?

Chapter	Title	Specific Research Questions	Methods	Sample	Author(s)
3	An international foresight reflection on entrepreneurial pathways for higher education institutions[2]	How should HEIs, regardless of their current level of entrepreneurialism, evolve in the long-term to address the preoccupations and interests of entrepreneurial ecosystem stakeholders? What are the opportunities and risks for HEIs in pursuing entrepreneurial pathways?	Foresight study applying scenario planning as a research method	35 key informants from 16 countries representing all spheres from entrepreneurial ecosystems	Audrey Stolze and Klaus Sailer
4	Advancing HEIs' third-mission through dynamic capabilities: the role of leadership and agreement on vision and goals[3]	How can dynamic capabilities be translated into HEIs' strategic third mission advancements?	Quantitative study, applying partial least squares – structure equation modelling	45 key informants from German HEIs	Audrey Stolze and Klaus Sailer

Table 1.1: Dissertation structure

[2] Article accepted for publication on the journal Industry & Higher Education (Scopus CiteScore: 1.400). An earlier version was presented at the XVIII Triple Helix Conference (2020) and at the 24th Annual Interdisciplinary Conference on Entrepreneurship, Innovation and SMEs | G-Forum (2020).

[3] Article under review on the Journal of Technology Transfer (Impact Factor 2019: 4.147).

The second study (chapter 3) is exploratory and brings a novel perspective to the current academic discussion. It presents an international foresight reflection on entrepreneurial pathways for higher education institutions, employing scenario planning as a research method. This study was structured in four macro-phases: preparation, scenario exploration, scenario development, and scenario utilisation (Frith and Tapinos, 2020). The exploration phase consisted of two reflection exercises that included 35 key informants from 16 countries, representing all the spheres of entrepreneurial ecosystems. The data collected led to the development of five scenario propositions–namely worldwide, transdisciplinary, adaptive learning, blended and ecosystem–which are driven by the current and potential impact of internationalisation, digital transformation, and collaborative networks for co-creation. Four internationally renowned experts on the phenomenon of HEIs' entrepreneurialism individually assessed these five propositions to inform its utilisation. Hence, this study's main contribution regards the insights it provides for HEIs and policymakers to make strategic choices and thus frame decision-making agendas related to possible entrepreneurial pathways.

The third and last study (chapter 4) offers a confirmatory analysis, employing partial least squares – equation structure modelling (Hair *et al.*, 2019) as a method, on the advancement of HEIs' third mission by employing dynamic capabilities (DCs). A survey of 45 key informants from German HEIs, who lead third mission advancements in their institutions, demonstrates that DCs result in third mission strategic advancements through the mediating roles of leadership and agreement on vision and goals. Thus, this study's contributions are threefold:

- it further explains the relationship between DCs and HEIs' third mission;
- it identifies two mechanisms for effectively transforming DCs through third mission advancement; and

- it offers managerial insights HEI decision-makers can draw on to advance their institution's third mission.

Finally, a discussion on the combined contribution of this dissertation presents a model for third mission advancement at HEIs is presented, avenues for future research are proposed, and final conclusions are offered (chapter 5).

2. A meta-ethnography on HEIs' transformation into more entrepreneurial institutions: Towards an action-framework proposition

Author: Audrey Regina Stolze

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Journal: Industry and Higher Education (Scopus CiteScore 1.400) available on https://journals.sagepub.com/home/ihe

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Higher education institutions (HEIs) are experiencing a challenging era due to demand–response imbalances. An assumed means of responding to the challenge is through the entrepreneurial university model, which adds a third mission to HEIs: to contribute to economic, technological and social development. Therefore, governments across the globe promote this ideal through system reforms and funding schemes, while HEIs ignite institutional changes. Publications also explore the entrepreneurial university model, although some scholars have criticized the new mission and its implied commercial orientation. However, little is still known about how HEIs are applying the model to become more entrepreneurial. Therefore, this article presents a systematic literature review comprised of a meta-ethnography on the transformation journey of 36 HEIs across 18 countries. The outcome is a four-stage iterative action-framework proposition, suggesting that exogenous and endogenous forces constantly influence HEIs which, in response, ignite experiments, requiring sensitization to be consolidated and later institutionalized, in an endless, long and rather slow process. This article contributes to theory by explaining the meta-level of HEIs' entrepreneurial pathway process and to practice by providing policymakers and decision makers in HEIs with an analytical framework.

2.1. Introduction

In recent decades, countries have carried out higher education reforms and developed policies that have changed the autonomy, public financing, mission and accountability of higher education institutions (HEIs). Now, HEIs are expected to be enterprising and to actively contribute to developing entrepreneurial ecosystems (Oh et al., 2016; Etzkowitz, 2019). The ideal, expressed by the entrepreneurial university model, incorporates and transcends existing dichotomies in a new synthesis: ivory tower–polytechnic, research–teaching (Etzkowitz, 2004). It gives HEIs a third mission to respond to knowledge societies' economic,

technological and social demands, producing human, knowledge and entrepreneurship capitals that generate innovations, increase competitiveness and positively affect economic growth (Etzkowitz, 2014a; Guerrero, Cunningham and Urbano, 2015). Nevertheless, the model has also been subject to criticism regarding its legitimacy and conflicts between the three missions of HEIs (Tuunainen, 2005; Powell, Owen-Smith and Colyvas, 2007; Philpott et al., 2011; Stensaker and Benner, 2013). Without consensus, many HEIs have embarked on a journey replete with challenging organizational changes (Clark, 2004; Mcgowan, Sijde and Kirby, 2008).

The concept of the entrepreneurial university was introduced in 1983, based on developments at the Massachusetts Institute of Technology (MIT) and Stanford University. An entrepreneurial university was defined as an institution that explored new sources of funds, like patents, research contracts and industry partnerships (Etzkowitz, 1983). MIT and Stanford were initially considered anomalies that would eventually conform to the research model (Etzkowitz, 2004), but they are now seen as epitomizing the entrepreneurial university. Their developments influenced policymaking and motivated HEIs worldwide to emulate them and Silicon Valley (Etzkowitz, 2003a, 2004, 2019), thus making the American academic model evolve to assume many roles in society and within innovation ecosystems (Sam and Sijde, 2014). The concept's bottom-up emergence in the United States led it to be considered an extension of a university's research mission, while its emergence in Europe's welfare context required it to develop as a teaching mission extension (Etzkowitz et al., 2000; Etzkowitz, 2003b). Beyond the United States and Europe, this phenomenon has been documented in, among others, Brazil (Almeida, 2008; Amaral, Ferreira and Teodoro, 2011), Chile (Bernasconi, 2005), China (Zhou and Peng, 2008), Iran (Aidin Salamzadeh and Farsi, 2015), Japan (Yokoyama, 2006), Malaysia (Ahmad et al., 2018), Turkey (Beyhan and Findik, 2018), South

Africa (De jager et al., 2017) and the United Arab Emirates (Bhayani, 2015). Its export has led to global convergence (Etzkowitz et al., 2000), though replication strategies are dramatically limited by environmental, resource and capability differences among HEIs (Lazzeretti and Tavoletti, 2005; Etzkowitz and Zhou, 2008; Philpott et al., 2011; Stensaker and Benner, 2013).

It is currently understood that the entrepreneurial university ideal is applicable to all HEI types in 'an efflorescence of embryonic characteristics that exist 'in potentio' in any academic enterprise (...) with the ability to periodically reinvent itself and incorporate multiple missions' (Etzkowitz, 2013a, p.487). In this sense, a current definition proposes a systemic interpretation:

'an entrepreneurial university design integrates project-based learning in the curriculum with an outlook of seeking out the useful as well as the theoretical results of investigation. These results are moved into use through an innovation system that includes a penumbra of public and private actors posing problems, concomitantly with the provision of resources.' (Etzkowitz et al., 2019, p.169)

The popularity of the entrepreneurial university concept was increased by two timely publications: Slaughter and Leslie's (1997) 'Academic Capitalism: Politics, Policies, and the Entrepreneurial University' and Clark's (1998a) 'Creating Entrepreneurial Universities', which became 'almost iconic' (Taylor, 2012). A growing body of literature developed, which literature reviews summarized – for example, Gibb (2002), Rothaermel, Agung and Jiang (2007), Perkmann et al. (2013). However, few of these reviews were conducted from an institutional perspective – for example, Laredo (2007), Bronstein and Reihlen (2014), Clauss, Moussa and Kesting (2018), Centobelli et al. (2019). Additionally, little is known about how HEIs adopt and adapt the entrepreneurial university concept. Understanding HEIs'

entrepreneurial pathways remains a main agenda for future research (Klofsten et al., 2019), as existing propositions are limited in explaining the underlying change management process, leaving this aspect undertheorized.

This article presents a systematic literature review with a meta-ethnographic approach, providing a compendium of 36 manifestations of the entrepreneurial university concept from 18 countries, shedding light on how this emerging global ideal translates into practice. Specifically, the research asks:

- How do HEIs transform into more entrepreneurial institutions?
- Which gaps and white spots remain in the understanding of this transformation process?

The resulting contributions are threefold:

- An improved theoretical understanding of and research into HEIs' transformation process.
- A proposed research agenda.
- Core entrepreneurial pathway propositions composed of three paths (ecosystem, education and governance) steered through an action-framework proposition.

The article begins by providing the topic's theoretical foundation. Next, it uses meta-ethnography to synthesize the experience of 36 HEIs across 18 countries, proposing three paths and an action-framework to empirically explain the process and to serve as an analytical resource for HEI decision makers and policymakers. The findings are then discussed and the limitations of the study are considered with regard to expanding the conceptualization and development of the entrepreneurial university ideal – ultimately suggesting a research agenda before concluding.

2.2. Prologue: Theoretical Foundation

Existing concepts and framework propositions explaining HEIs' entrepreneurial pathways are generalizations, which fall short of clarifying how transformation happens in practice and defining the processual stages and required steps. Nevertheless, there is an overall understanding of the complexity and non-linearity of this process, characterized by experimental approaches in a steady state of institutional change (Clark, 2003; Etzkowitz, 2013a). Pathways for transformation are an incipient proposition developed by Burton Clark. He identified the following five elements, which become pathways through their interaction, as the elements alone would not be significant (Clark, 1998b):

- 'Strengthened Steering Core': a dynamic and flexible decision-making process enabled by formal and informal leadership, independent of the institutional governance structure being centralized or decentralized.
- 'Enhanced Developmental Periphery': a matrixed organizational structure with units, centres and parks beyond the traditional institutional structures, extending its boundaries to connect with the ecosystem.
- 'Diversified Funding Base': reduced government dependency, increased autonomy (i.e. self-determination) and active budgetary management to increase the total amount of resources through service commercialization and partnerships with the private sector.
- 'Stimulated Academic Heartland': academic departments and professors becoming entrepreneurial by connecting with the ecosystem and generating new income streams.
- 'Entrepreneurial Culture': an integrated organizational culture that embraces changes, diffused from the academic heartland, steered by core leaders at the university and in its peripheral units to respond to new demands and produce new income streams.

Attempting to understand how developed theory was being translated into practice, Kirby (2006) identified the following strategic actions for enterprising British HEIs: endorsement from senior staff, who act as role models; incorporation of entrepreneurial elements into university levels/departments; development of entrepreneurial targets that are monitored; effective communication, also via publications; support mechanisms via infrastructure, process, training and mentoring; aligned models for equity sharing and staff promotion; cross-disciplinary research and teaching; and promotion via role models and competition. Also in Britain, Newcastle University's transformation towards entrepreneurialism serves as a pathway example, divided into four main stages (Benneworth, 2007): Naïve' – the development of services to local industries; 'Growth' – the attempt to promote its own spinoffs due to weak demand from local industries; 'Consolidation' – knowledge transfer deals made with large corporations to increase revenue; and 'Reach-out' – the attempt to open itself to outside users.

Another proposition, developed by Nelles and Vorley (2010), presents an 'entrepreneurial architecture blueprint' composed of Structures (entrepreneurial support infrastructure such as incubators and technology transfer offices (TTOs)); Systems (networks connecting different departments/actors); Strategies (institutional goals supported by incentive and measurement schemes); Leadership (orientation and support from university leaders with regard to the third mission); and culture (entrepreneurial attitude at institutional, departmental and individual levels).

In a simplified synthesis, Etzkowitz (2013a) suggests three complementary and non-sequential development stages to explain, in broad terms, HEIs' paths to entrepreneurialism: University Entrepreneur One (HEI adopts new vision and begins to diversify funding and increase autonomy); University Entrepreneur Two (HEI develops transfer capabilities, actively enabling,

sourcing and commercializing intellectual property); and University Entrepreneur Three (HEI uses Triple Helix collaborations to take a proactive role in regional development). This path is supported by four interrelated propositions, which characterize entrepreneurial universities (Etzkowitz, 2014a): Interaction (HEI engages in Triple Helix collaborations); Independence (HEI is not dependent on another institutional sphere); Hybridization (HEI creates hybrid organizational formats such as centres and parks); and Reciprocity (HEI continually revises its structures and Triple Helix relationships). Furthermore, in an updated study on Stanford University, , Etzkowitz et al. (2019) suggest a threefold strategy for entrepreneurial transformation: project-based experiential learning in teaching; applied research with support mechanisms for transfer; and various public and private partnerships. Finally, Markuerkiaga, Igartua and Errasti (2018) analysed characteristics and actions to propose three clusters based on the transformation status quo of 69 European HEIs. They conducted a quantitative study with institutions as the unit of analysis and technology office managers as key informants. The resulting statistical clusters are as follows: Advanced Entrepreneurial Universities (14 sampled HEIs consolidated the ideal); Emerging Entrepreneurial Universities (10 sampled HEIs were taking initial steps towards entrepreneurialism); and En-route Entrepreneurial Universities (45 HEIs were somewhere 'in the middle'). This analysis illustrates the complexity of defining what it means to be an entrepreneurial university and how this ideal can be achieved. That most of the sampled HEIs were placed 'in the middle' demonstrates the challenge of distinguishing developmental stages.

2.3. Review Method

This systematic literature review adopts a replicable and transparent search process among published studies on the phenomenon of entrepreneurial universities. The meta-ethnographic constructionism approach was best suited to form hypotheses on the transformation

processes of HEIs, enabling the emergence of an action-framework combining empirical evidence with the author's own expert practitioner insights (Noblit and Hare, 1988; Mays, Pope and Popay, 2005; France et al., 2014; Lee, Hart and Watson, 2015). Meta-ethnography was developed by Noblit and Hare (1988) to provide methodological rigour when deriving substantive interpretations from qualitative studies, facilitating a line of argument by interpreting findings across studies to produce new models (Noblit and Hare, 1988; Atkins et al., 2008; Campbell et al., 2011; Booth, Sutton and Papaioannou, 2016). The present author iteratively adopted the original seven steps (Noblit and Hare, 1988), while following enhanced strategies for case selection, analysis and synthesis (Doyle, 2003). After defining the topic and research questions (step 1), the author selected studies to read (steps 2 and 3) by purposively sampling case studies describing HEIs' transformation, with the institutions as the analysis unit (Figure 2.1). Afterwards, she determined how studies were related (step 4), following the recommendation to apply selective case boundaries to increase rigour (Doyle, 2003). This resulted in 33 publications reporting on 36 cases (Table 2.1). Through coding via the ATLAS.ti software (Friese, 2014), the author identified and categorized common themes across studies, HEIs and countries. Towards the end of this step, initial assumptions about the relationship between studies were made (Noblit and Hare, 1988), meaning that the author could, based on the emerging categories, explore the topic's many manifestations. This iterative process facilitated a conceptual leaping through bricolage (Klag and Langley, 2013) to develop an action-framework explaining how HEIs are transforming into more entrepreneurial institutions.

Next, the author translated all studies into one another (step 5) by comparing the cases' narratives, treating accounts as analogies. To do so, she reviewed the cases, applying the

developed action-framework to all 36 HEIs (online appendix[4]). She then synthesized the findings (step 6), considering that synthesis in meta-ethnography 'does not mean transferability of similar findings on a case by case basis, but rather a reconceptualization across studies' (Doyle, 2003, p.323). Finally, she expressed the synthesis (step 7) in this article, following up-to-date recommendations (Noyes et al., 2018; France et al., 2019).

[4] Available on https://www.doi.org/10.1177/0950422220922677

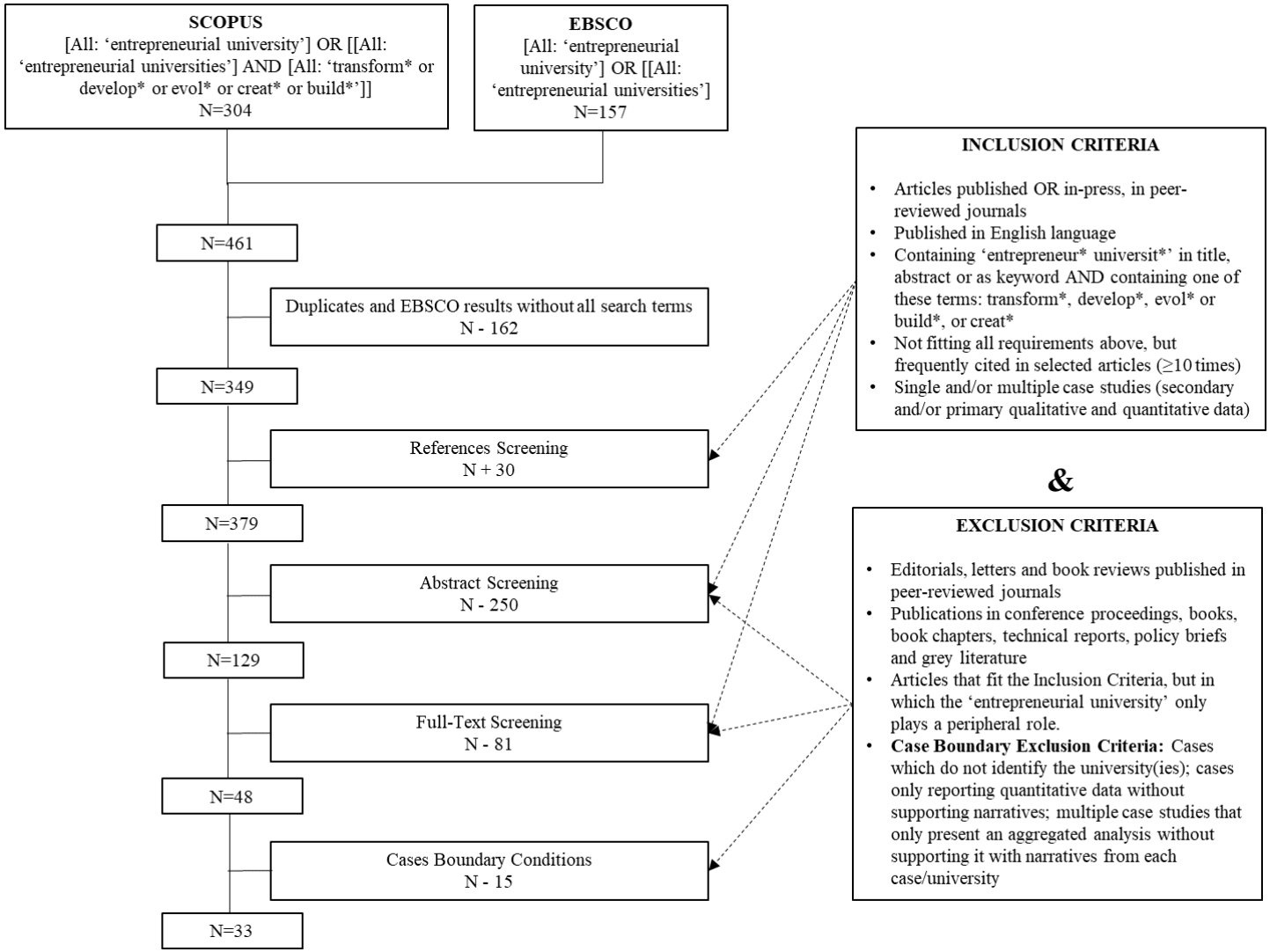

Figure 2.1: The sampling process

COUNTRY	INSTITUTION	TYPE	REFERENCE
Poland	WSB University	2C	(Pawlowski, 2001)
Sweden	Chalmers University of Technology	2B	(Jacob, Lundqvist and Hellsmark, 2003; Berggren, 2011)
	Luleå University of Technology	1B	(Ylinenpää, 2013)
Netherlands	University of Twente	1B	(Lazzeretti and Tavoletti, 2005; Mcgowan, Sijde and Kirby, 2008)
United Kingdom	Warwick University	1A	(Taylor, 2012)
	University of Surrey	1A	(Kirby, 2006; Yokoyama, 2006; Mcgowan, Sijde and Kirby, 2008)
	Nottingham Trent University	1A	(Yokoyama, 2006)
	University of Ulster	1A	(Mcgowan, Sijde and Kirby, 2008)
	University of Derby	1BD	(Rae, Gee and Moon, 2009)
	Newcastle University	1A	(Benneworth, 2007)
Denmark	Aarhus University	1A	(Pinheiro and Stensaker, 2014)
	Copenhagen Business School	1C	(Kristensen, 1999)
Italy	University of Salento	1A	(Elia, Secundo and Passiante, 2017)
Belgium	Free University of Brussels	2A	(Mathieu, Meyer and van Pottelsberghe de la Potterie, 2008)
Spain	Polytechnic University of Catalonia	2B	(Guerrero *et al.*, 2014)
	Autonomous University of Barcelona	3A	(Guerrero, Toledano and Urbano, 2011; Guerrero *et al.*, 2014)
Ireland	National University of Ireland – Galway	1A	(Guerrero *et al.*, 2014)
	University of Limerick	1A	(Guerrero *et al.*, 2014)
Serbia	University of Novi Sad	1A	(Stankovic, 2006)
Japan	University of Tokyo	1A	(Yokoyama, 2006)
	Waseda University	2A	(Yokoyama, 2006)

COUNTRY	INSTITUTION	TYPE	REFERENCE
Singapore	National University of Singapore	3A	(Wong, Ho and Singh, 2007)
Iran	University of Tehran	1A	(Salamzadeh and Yadolahi Farsi, 2013)
South Africa	Central University of Technology	1B	(De jager *et al.*, 2017)
Brazil	Catholic University of Rio de Janeiro	2A	(Almeida, 2008)
	Federal University of Itajubá	1A	(Almeida, 2008)
	Federal University of Minas Gerais	1A	(Almeida, 2008)
	Regional University of Volta Redonda	1B	(Amaral, Ferreira and Teodoro, 2011)
Chile	Catholic University of Chile	2A	(Bernasconi, 2005)
USA	University of Arkansas	1A	(Vickers *et al.*, 2001)
	Stanford University	2A	(Etzkowitz, 2003a, 2004, 2013c; Leih and Teece, 2016)
	Massachusetts Institute of Technology	2B	(Etzkowitz, 2003a, 2004; O'Shea *et al.*, 2007)
	University of California at Berkeley	1A	(Leih and Teece, 2016)
	Garfield State University	1A	(Mcclure, 2016)
	Stony Brook University	1A	(Wolf, 2017)
Canada	University of Waterloo	1A	(Bramwell and Wolfe, 2008)

Types: 1: Public; 2: Private; 3: Autonomous; A: Research University; B: Technology/Technical University; C: Business School; D: Arts University

Table 2.1: Sampled Cases

2.4. Entrepreneurial Pathways for HEIs

The 36 reviewed cases are contextually different and present a wide range of elements characterizing the actions HEIs take to become more entrepreneurial. The author coded and grouped these into 13 categories (Table 2.2). Exploring relationships between these categories

(Table 2.2) enabled the identification of the following three complementary, not mutually exclusive, core entrepreneurial pathways propositions:

- Ecosystem path: establishing industry relations, in some cases benefiting from strong alumni relationships (G) leads to forming Triple Helix regional, national or international networks (A). These are combined with technology transfer services (B) and venture capital (C), connecting entrepreneurship centres' services such as incubation (D), with research centres' outputs (E), inside the university and/or at parks (F). The expected outcome is resources and capabilities synergy at the meso- and micro-levels
- Education path: outreach events, such as business idea competitions (H), sensitizing students to student and alumni networks (G), dissemination support and role models (J). Entrepreneurship education offers (I) are developed in many formats – for example, online, boot camps, undergraduate/postgraduate degrees and interdisciplinary curricular courses (stand-alone or integrating entrepreneurship education learning outcomes with existing courses). The expected outcome is human capital constituted by resourceful individuals with entrepreneurial competences and skills.
- Governance path: to minimize development problems related, for instance, to internal conflicts and communication (M), HEI leaders must establish effective governance structures that empower staff members, offer incentives and provide clear performance measurements (L) combined with an aligned staff hiring strategy and training opportunities (K). The expected outcome is a dynamic, proactive and promptly responsive institution.

HEI	ECOSYSTEM PATH							EDUCATION PATH			GOVERNANCE PATH		
	A	B	C	D	E	F	G	H	I	J	K	L	M
Chalmers Institute of Technology	X		X	X			X		X	X	X		X
Luleå University of Technology	X		X		X	X			X		X		
Warwick University	X										X		X
University of Surrey	X	X		X		X			X				
Newcastle University	X	X	X								X		X
Nottingham Trent University	X							X	X				
University of Ulster				X				X	X		X	X	
University of Derby	X			X				X	X		X		X
University of Twente	X	X		X		X	X			X		X	
Aarhus University	X				X								
Copenhagen Business School	X			X	X	X			X				
WSB University	X								X		X	X	
University of Salento	X			X					X				
Free University of Brussels	X	X	X	X	X					X			X
Polytechnic University of Catalonia	X							X	X			X	
Autonomous University of Barcelona	X	X		X					X				X
National University of Ireland – Galway	X	X		X	X					X	X	X	
University of Limerick	X	X			X				X	X	X		
University of Novi Sad	X	X	X						X		X	X	
University of Tokyo	X												
Waseda University	X								X				X

HEI	ECOSYSTEM PATH							EDUCATION PATH			GOVERNANCE PATH		
	A	B	C	D	E	F	G	H	I	J	K	L	M
National University of Singapore	X	X		X				X	X		X	X	
University of Tehran													X
Central University of Technology	X			X				X	X		X		
Catholic University of Rio de Janeiro	X	X		X					X				
Federal University of Itajuba	X			X				X	X				
Federal University of Minas Gerais	X			X					X				
Regional University of Volta Redonda	X												X
Catholic University of Chile	X				X						X		
University of Arkansas	X	X		X	X				X	X			
Stanford University	X	X	X		X	X	X	X	X	X	X	X	X
Massachusetts Institute of Technology	X	X	X	X	X				X				
University of California – Berkeley	X	X											X
Garfield State University	X	X		X		X			X				
Stony Brook University	X	X	X	X					X				
University of Waterloo	X		X	X	X		X		X				

(A) Industry-Relations and/or Triple-Helix Networks, (B) Technology Transfer, (C) Venture Capital, (D) Entrepreneurship Centre or Institute, (E) Research Centre, (F) Science Park, (G) Student or Alumni Association, (H) Outreach Events (e.g. Competitions), (I) Entrepreneurship Education, (J) Role Models, (K) Strategy for Staff Training and/or Hiring, (L) Governance, Empowerment, Performance Measurement, (M) Development Problems (Conflicts, Lack of Communication/Leadership, etc)

Table 2.2: Entrepreneurial pathways summary per case

2.5. Transformative action-framework

These identified paths move into action through a nonlinear, long-term process constantly influenced by exogenous and endogenous forces (Figure 2.2). Despite the reviewed HEIs having widely different contexts, the meta-ethnographic method allowed a meta-level proposition to emerge, transcending individual organizational and contextual differences (e.g. developed versus developing countries and HEIs' entrepreneurial maturity).

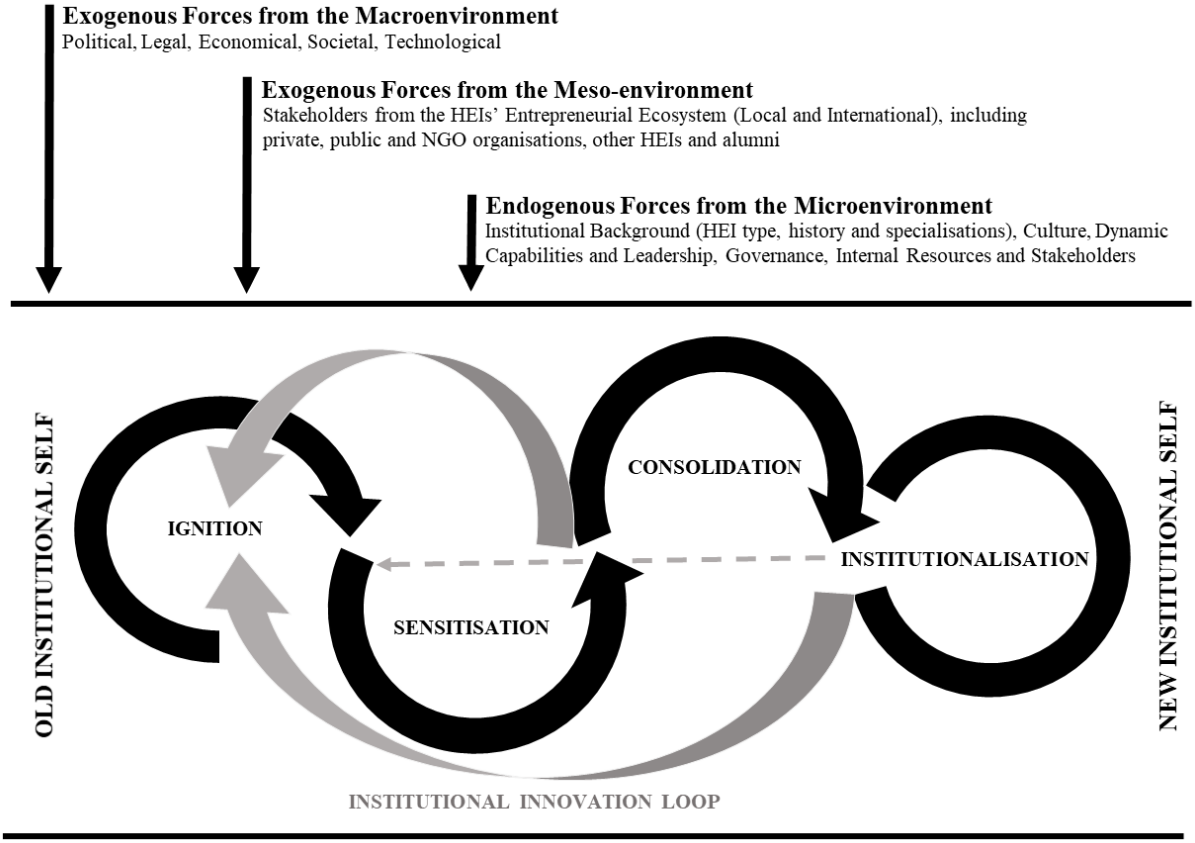

Figure 2.2: The action-framework

The action-framework proposition takes an institutional perspective, thus accounting for the exogenous and endogenous forces influencing the transformation of HEIs. Higher education is highly regulated, and political changes influence that transformation. For example, consider Brazil and Chile where military regimes have pushed HEIs towards technology research. In Chile, this inspired a 'neo-liberal agenda', characterized by privatization and a new

technological research fund, while in Brazil it meant creating technology parks. The return to democracy increased public funding in Chile while the new Brazilian Constitution (1988) defined teaching, research and 'extension activities' as the missions of HEIs (Bernasconi, 2005; Almeida, 2008; Amaral, Ferreira and Teodoro, 2011). Similarly, the return to democracy in Serbia (2000) led to a new Higher Education Law (2002), increasing the autonomy of HEIs and locally enabling the Bologna process (Stankovic, 2006).

For HEIs in developed economies, political reforms result mainly in increased autonomy, public funding changes and pushes toward the third mission, as in the United Kingdom (1988) (Yokoyama, 2006), Denmark (1993; 2003) (Kristensen, 1999; Pinheiro and Stensaker, 2014) and Sweden (1997) (Berggren, 2011). Many countries have also created specific policies to promote innovation directly affecting HEIs. In Spain, a 2007 reform regulated the use of research output, enabling academic entrepreneurship (Guerrero, Toledano and Urbano, 2011; Guerrero et al., 2014), while the US Bayh-Dole Act ignited the creation of TTOs in several HEIs in the early 1980's (Etzkowitz, 2003a). In many countries, public development agencies have also emerged, becoming major stakeholders for HEIs, such as Sweden's VINNOVA (Ylinenpää, 2013), Denmark's Globalization Council (Kristensen, 1999), Brazil's FINEP (Amaral, Ferreira and Teodoro, 2011) and Chile's FONDECYT (Bernasconi, 2005).

The lack of such policies and agencies is a major hindrance to the emergence of entrepreneurial universities (Salamzadeh and Yadolahi Farsi, 2013; De jager et al., 2017). A favourable business environment and the cultural proximity of business from HEIs are further influencers from the meso-environment, due to the importance of Triple Helix collaborations (Amaral, Ferreira and Teodoro, 2011; Salamzadeh and Yadolahi Farsi, 2013). In more neoliberal contexts, the absence of strong local economies creates opportunities for HEIs to

support the emergence of entrepreneurial ecosystems, as with Stanford, Newcastle, Twente, Novi Sad and WSB, or the current attempt by the Central University of Technology.

Endogenous forces directly affect an institution's ability to ignite the process and be promptly responsive. It is relevant to consider an HEI's type, size, location and historical background. In this sense, a middle-sized technical university founded in the second half of the 20th century in a region with developed industries might be a natural fit for developing into an entrepreneurial university – for example, Luleå and Surrey. This does not mean that other HEI types may not transform, but they may face harder challenges, as have the University of Tokyo and the University of California–Berkeley. A more feasible entrepreneurial pathway, which the Free University of Brussels has followed, might involve specialized entrepreneurial efforts in specific fields.

Pursuing entrepreneurial pathways requires long-term commitment, clearly defined missions and visions, supportive leadership and enabling governance structures. In almost all the cases, this study has analysed, with the exception of Tokyo and Tehran, the universities added the 'third mission' and edited their visions accordingly. Furthermore, HEIs with matrixed organizational structures that empower individuals to be enterprising and professors to run their departments as 'quasi-firms' seem better prepared to navigate the process – for example, Stanford and Aarhus.

To establish these elements, it is essential for supportive leadership to provide the necessary guidance. Throughout the journeys of the sampled HEIs, a number of individuals have played crucial roles. The main example is Frederick Terman (Stanford), who is 'hyperbolically' considered the 'father of Silicon Valley' (Etzkowitz, 2003a). Others include the founders of MIT and Chalmers; the decision makers (e.g. chancellor/president) at Warwick, Itajuba and

Garfield State; and informal leaders, such as the small entrepreneurial team at Derby University.

The process influenced by these forces is non-linear, encompassing four stages: ignition, sensitization, consolidation and institutionalization. One or more forces influence an HEI's first actions, triggering the process. For some in this study, the triggering force was their founding principles, as at MIT and Chalmers (whose founders provided vision and leadership), Nottingham Trent and Derby (accession to university status) and Aarhus (after merger). In many countries, policy reforms, reducing public funding and/or requesting HEIs to pursue the third mission ignited the process, forced HEIs to react, as in Brazil (Catholic University of Rio de Janeiro), Chile (Catholic University), Japan (Waseda and Tokyo), Singapore (National University), Belgium (Brussels Free University) and the United Kingdom (Ulster and Surrey). More proactive ignitions, setting a new vision influenced by HEI leaders, occurred at Stanford, Novi Sad, Minas Gerais, Itajuba, the Autonomous University of Barcelona and Catalonia's Polytechnic. Proactive leadership also ignited further waves of transformation at MIT, Chalmers, the National University of Singapore and the Catholic University of Chile.

Once the process has begun, sensitization is the most critical phase, when actions (i.e. projects) are conceptualized in response to influencing forces. These can be seen as pilot experiments, which require validation to consolidate. At this stage, the main aim is to sensitize stakeholders towards the third mission, developing an entrepreneurial culture, one experiment at a time. It requires leadership and the empowerment of key individuals. If these are weak or absent, emergence of the entrepreneurial culture is hindered, and the performance of pilot experiments is negatively affected, as at the University of Tehran and the University of Tokyo. A lack of effective and sustainable sensitization can have the same

negative effect, an issue observed even in mature entrepreneurial universities such as Stanford and Chalmers.

The transformation process is non-linear and fuzzy and there is no clear-cut point between the sensitization and consolidation stages, as development speed can make them overlap in a process characterized by transformation waves. Thus, the availability of resources and capabilities dedicated to each project, especially supported by steady funding, can accelerate the process towards consolidation. This means that the consolidation and sensitization stages of the same project may occur concomitantly, rather than linearly. Consolidation is, therefore, a fuzzy continuum from sensitization, characterized by the expansion of successful ecosystem, education and governance actions, which have different meanings for each HEI. In general, this involves infrastructure building, the development of complementary offers, the identification and dissemination of role models and governance formalizations. For example, consider the following:

- Infrastructure: the Federal University of Minas Gerais merged two technical incubators and developed a business incubator. Stanford and MIT created TTOs, since their activities emerged informally.
- Complementary offers: Stanford, MIT, Stony Brook, Lulea and Novi Sad included venture capital initiatives to accelerate technology transfer and spin-off development.
- Governance actions: a new Vice-Principal position was created to consolidate Chalmers's fragmented system. A New Business Development Directorate was formed at Surrey to concentrate non-academic entrepreneurial activities. A Corporate Service Unit was developed at Newcastle, whose Director is an Executive Board member.

- Role models: successful spin-offs have been devised – for example, HP and Google (Stanford). Key entrepreneurial individuals are recognized, such as Torkel Wallmark (Chalmers), or even entire departments, such as at the Free University of Brussels.

Once consolidated, these actions become an integral part of an institution, constituting an entrepreneurial (eco)system and resulting in a new culture and positioning with aligned values, mission and vision. The narratives of only 12 of the sampled cases characterize institutionalization – eight 'fully-fledged' (Chalmers, Warwick, Surrey, Newcastle, Autonomous University of Barcelona, Stanford, MIT and Waterloo) and four 'smart specialized', focusing on entrepreneurial efforts in selected fields (Twente, Free University of Brussels, Lulea ˚ and Stony Brook). A possible explanation for this is the incipience of the entrepreneurial university concept, as many HEIs and policymakers began the process in the late 1990s. Therefore, institutions are still igniting, sensitizing and consolidating the first projects in a complex and relatively slow process, influenced by volatile exogenous and endogenous forces. Examples of institutionalization include the following:

- Waterloo: the university institutionalized an entrepreneurial network, which is a catalyst in the regional high-tech economy and is perceived as a 'good community player'.
- Free University of Brussels: this case suggests that HEIs can be entrepreneurial and contribute to economic regional development without transforming into a 'fully-fledged' entrepreneurial university. As a large, traditional, comprehensive university, this institution opted to concentrate its entrepreneurial efforts and outputs in the medicine and life science departments.
- Warwick: the 'Warwick Way' motto illustrates its institutionalization.

The present author further proposes that this process contains an institutional innovation loop, represented in the action-framework by iterations back to ignition, demonstrating endlessness. This iteration also occurs due to a need for sustainable communication to raise awareness. A dotted arrow from consolidation and institutionalization back to sensitization depicts this characteristic in Figure 2. Of the sampled cases, 21 presented narratives describing this characteristic, demonstrating how new demands and opportunities ignite new experiments in an iterative innovation process, which enables and fosters entrepreneurialism in HEIs. In this sense, dynamic capabilities for sensing, seizing and transforming are key to recognizing demand and (funding) opportunities. Thus, monitoring and measuring progress is fundamental, as failed projects can teach lessons and ignite new attempts. Examples of the narratives are:

- 'The Chalmers infrastructure for innovation and entrepreneurship has been an ad hoc experiment with little or no directions and guidelines from the main administration' (Jacob, Lundqvist and Hellsmark, 2003, p.1563).
- '[...] these faults meant that each particular attempt proved unsuccessful, and that failure in turn stimulated a further attempt [...]' (Benneworth, 2007, p.494).
- 'The formative and reflective learning experiences of the team as practitioners were a process of entrepreneurial action learning through sensemaking, featuring 'critical incidents' and 'practical theories' developed from praxis' (Rae, Gee and Moon, 2009, p.188).
- 'To respond to new opportunities, university leaders must also act entrepreneurially [...] Plans must not be wooden [...] continuous updating [...] In the dynamic capabilities framework, transforming involves what is called asset orchestration and asset repurposing. These activities are associated with the breaking up of established ways

of doing things to align capabilities with new needs and new opportunities in the broader environment. Universities, like all organizations, must undergo some level of continuous renewal [...]' (Leih and Teece, 2016, p.200).

2.6. Discussion and research agenda

Scholars have raised concerns about the abilities of HEIs' to follow entrepreneurial pathways, pointing out that this could be a path with no return, leaving HEIs 'doomed to be entrepreneurial' (Stensaker and Benner, 2013). In their cluster analysis, Markuerkiaga, Igartua and Errasti (2018) allocated the majority (45) to a cluster they called 'En route entrepreneurial university'. However, the present researcher wonders if these are, in fact, 'en route' or merely 'stuck in the middle' - a transformation risk suggested by Ylinenpää (2013). Assuming an HEI successfully becomes an entrepreneurial university, it still risks facing the 'paradox of success', as has Stanford (Etzkowitz, 2013c; Etzkowitz *et al.*, 2019). Hence, HEIs are 'facing both new challenges and old ones with new levels of urgency. Survival and future development will depend on how well universities adapt to unpredictable environments that are becoming global, instead of isolationist; international, instead of domestic; and competitive, instead of regulated' (Klofsten et al., 2019, p.150).

At the same time, the Entrepreneurial University paradigm is still in developmental infancy, even at those institutions that epitomize it like Stanford (Etzkowitz et al., 2019), and so new developments and setbacks are surfacing. For instance, Newcastle University was found to be reverting to an ivory tower stance due to setbacks in its science park development (Etzkowitz and Zhou, 2018). This indicates that it might be necessary to take the entrepreneurial ecosystems metaphor seriously (Kuckertz, 2019) and actively manage HEIs' transformation processes with a stakeholder perspective, establishing meaningful institutional metrics

(Etzkowitz, 2016; Balven et al., 2018; Roundy, Bradshaw and Brockman, 2018; Gianiodis and Meek, 2019).

Moreover, the concept's incipience means that elements that will ultimately constitute entrepreneurial HEIs, are still emerging. The 'Networked University' (Witt, 2010), 'Engaged University' (Breznitz and Feldman, 2012) and the 'Civic University' (Goddard et al., 2016) are just some examples of surfacing propositions encompassing and extending the Entrepreneurial University paradigm. These further account for the external environment and give HEIs a refreshed sense of purpose in knowledge societies.

The aggregation of case study narratives following a meta-ethnographic approach has enabled the author to identify and make sense of actions taken by the 36 HEIs across 18 countries in their attempts to become more entrepreneurial. This has resulted in two central propositions. First, the author asserts the existence of three complementary, not mutually exclusive, paths: Ecosystem, Education and Governance. These are the fundamental cornerstones for HEIs aiming to become more entrepreneurial. Second, the research has presented a deeper understanding of how the transformation process occur in practice. Combined, these contributions, in practical terms, might serve as insights and analytical tools for HEI decision makers, supporting the agile development of advancement strategies – thus minimizing HEIs' risk of being 'doomed to be entrepreneurial', getting 'stuck in the middle' or facing a 'paradox of success' dilemma.

Therefore, this research contributes to practice by demonstrating how the transformation process of HEIs' is composed of a series of pilot experiments following an iterative, non-linear path, constantly influenced by exogenous and endogenous forces. In this way, the author confirms the initial conceptualization proposed by Etzkowitz and Leydesdorff (2000) regarding

'endless transition' based on 'nonlinear innovation models' of HEIs' transformation processes. She also extends it, encompassing the Triple-Helix model and combining it with the need for 'dynamic capabilities' (Siegel and Leih, 2018; Teece, 2018) to explain the meta-level process enabling organizational change. Therefore, the author's proposition illustrates the innovation process, which recent evidence suggests 'fully mediate[s] the transformation capability–organizational change relationship' in HEIs (Zhang, Wang and O'Kane, 2019, p.12). Nevertheless, the findings also suggest that the researcher's proposition might be lacking a necessary negative iteration back to ignition to depict the risk of failed pilot experiments making a HEI backslide to its old institutional self.

Some limitations of this study open interesting avenues for future research. This meta-ethnography relies on 33 peer-reviewed articles, excluding a vast body of literature on the phenomenon available in other sources. These other resources were excluded to improve confidence about the employed evidence body and keep the body of selected literature manageable for a single researcher. These articles provide a picture from the viewpoints of their authors, which might be incomplete, outdated and partial, as many authors were members of the studied institutions. Nevertheless, it is important to recall that in meta-ethnography synthesized interpretations are 'metaphors' or 'characterizations of the juxtaposition of the author's perspective with the perspectives of those studied' (Thorne et al., 2004, p.1347). Furthermore, not all requirements for an audit trail are present in this research, since the empirical evidence reviewed is combined with the author's own expert practitioner insights (France et al., 2014). However, to mitigate this and the above-mentioned limitations, the author has followed up-to-date guidelines for methodological rigor and for reporting meta-ethnographic studies to improve confidence in the outcomes (Doyle, 2003; Lewin et al., 2018; Noyes et al., 2018; France et al., 2019). Thus, to assess the confidence in

the key findings proposed, the author adopted the CERQual[5] framework to assess the methodological limitations, coherence, adequacy and relevance of the data supporting each finding. Taking into consideration the number of cases supporting each proposition, she rated the findings' confidence levels as low (up to 11 cases), moderate (12-24 cases) and high (more than 25 cases). All propositions were rated as moderate or high. This analysis led to the identification of gaps, suggesting a research agenda to deepen the current understanding of HEIs' changes in management due to entrepreneurialism (Table 2.3).

Proposition	CERQual Confidence Rate	Cases contributing to finding	Related gaps and research agenda
Ignition stage	HIGH	30	• Empirically test the validity and applicability of the proposed action-framework by confronting it with past, current and planned actions from a larger number of HEIs undergoing the transformation process in different contexts • Forecast future entrepreneurial pathways for institutionalised entrepreneurial HEIs by enabling academics, industry leaders and policymakers to envision them collectively
Sensitisation stage	HIGH	36	
Consolidation stage	HIGH	31	
Institutionalisation stage	MODERATE	12	
Innovation loop concept	MODERATE	21	
Influencing exogenous forces	HIGH	34	• Measure the impact of specific large governmental funding schemes that promote entrepreneurialism in HEIs and compare results across nations
Influencing endogenous forces	HIGH	34	• See governance path agenda
Ecosystem Path	HIGH	35	• Understand the impact of HEIs' transformation speeds on the

[5] This is the 'Confidence in Evidence from Reviews of Qualitative Research' approach developed by the Grading of Recommendations Assessment, Development and Evaluation Working Group. It is available from https://www.cerqual.org.

Proposition	CERQual Confidence Rate	Cases contributing to finding	Related gaps and research agenda
			development of entrepreneurial ecosystems • Identify ecosystem synergy opportunities to develop cost-effective entrepreneurial pathways for HEIs • Understand the impact of different ecosystem actors on HEIs' entrepreneurial pathways • Understand HEIs' entrepreneurialism value-added per stakeholder
Education Path	HIGH	29	• Identify drivers leading from project-based teaching to academic entrepreneurship and transfer • Evaluate academic entrepreneurship outcomes of different teaching initiatives (e.g., online vs. classroom; mono- vs multidisciplinary)
Governance Path	MODERATE	22	• Research organisational resilience and how different levels impact HEIs' transformation processes, especially regarding the institutional ability to overcome perceived failed experiments • Research the determinants of HEIs' abilities to respond to demands placed by different exogenous and endogenous forces • Analyse the impact of different leadership styles and governance models on long-term strategic planning for the development of entrepreneurial universities • Analyse the impact of HEI staff members' (administration and professors) entrepreneurial mindsets and orientations on the institutional transformation process

Table 2.3: Findings' confidence rating and research agenda

2.7. Conclusion

The forces influencing HEIs to become more entrepreneurial and contribute actively to economic, social and technological development cannot be ignored or downplayed. As significant public resources fund schemes towards an entrepreneurial agenda, decision makers in HEIs must acknowledge these influencing forces and proactively manage their institutions' entrepreneurial pathways. This article proposes that HEIs' transformations are part of a long-term iterative process, characterized by nonlinear, fuzzily divided stages, constantly influenced by exogenous and endogenous forces. Hence, context matters and there is no ready-made recipe. Rather than trying to emulate Stanford and create a Silicon Valley, each institution must develop its own advancement strategies towards entrepreneurialism. HEIs' abilities to lead proactively this process, being promptly responsive to demands and opportunities, will determine future epitomes. Nevertheless, it is clear that not all HEIs should transform themselves into fully-fledged entrepreneurial universities or will even have the potential to do so. A smart specialization strategy and/ or focus on ecosystem resources and capabilities synergies at the meso-level might be a more feasible path for many HEIs starting the process of institutionalizing an entrepreneurial culture and intending to contribute actively to regional development.

According to Tranfield, Denyer and Smart (2003), the goal of a Systematic Literature Review is to serve both academics and practitioners. This article achieves this goal by contributing to the body of knowledge on entrepreneurial universities with an original methodological approach – systematically and pragmatically explaining HEIs' entrepreneurial pathways and their underlying transformative process.

3. An international foresight reflection on entrepreneurial pathways for higher education institutions

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Recent decades have witnessed many countries reforming their higher education systems, affecting higher education institutions (HEIs) mission and governance. Today, HEIs are expected to produce entrepreneurial capital and be catalysts for regional economic and societal development, taking on significant roles within entrepreneurial ecosystems. Hence, this article addresses entrepreneurial ecosystem stakeholders' preoccupation with and interest in the role of HEIs in the future and assesses the opportunities and risks associated with HEIs pursuing entrepreneurial pathways. We propose five future scenarios in this study, which we term worldwide, transdisciplinary, adaptive learning, blended, and ecosystem. These demonstrate that internationalization, digital transformation, collaborative networks, and co-creation processes are key drivers of higher education advancement and provide guidance for HEIs and policymakers to frame decision-making agendas related to possible entrepreneurial pathways. Based on experts' assessments, we consider the transdisciplinary and blended scenarios to be the most auspicious.

3.1. Introduction

Recent decades have witnessed many countries reforming their higher education systems, making significant changes to the autonomy, public financing, mission, and accountability of their higher education institutions (HEIs) (Clark, 1998b; Salmi, 2001; Jacob, Lundqvist and Hellsmark, 2003). Today's HEIs must produce entrepreneurial capital and be catalysts for regional economic and societal development (Audretsch, 2014; Guerrero, Cunningham and Urbano, 2015). In Europe, European Union directives and national governments' initiatives developed to promote a societal development agenda affect HEIs concomitantly. Examples are the directives from the European Commission (2006a, 2006b, 2013) on the Europe level, , as well as on a national level, the EXIST program in Germany, A+B in Austria, VINNOVA in Sweden, and the Science Enterprise Challenge in the United Kingdom (Shattock, 2010;

Etzkowitz, 2014b; Elia, Secundo and Passiante, 2017). Beyond Europe and the USA, researchers report HEIs moving toward entrepreneurialism in Brazil (Almeida, 2008; Amaral, Ferreira and Teodoro, 2011), Chile (Bernasconi, 2005), Canada (Bramwell and Wolfe, 2008), China (Zhou and Peng, 2008), Iran (Aidin Salamzadeh and Farsi, 2015), Japan (Yokoyama, 2006), Malaysia (Ahmad et al., 2018), Turkey (Beyhan and Findik, 2018), Singapore (Wong, Ho and Singh, 2007), South Africa (De jager et al., 2017) and United Arab Emirates (Bhayani, 2015) among others.

The entrepreneurial university model responds to the needs of a knowledge society (Etzkowitz, 2013b). Nevertheless, the model has been criticized for embodying legitimacy issues, a perceived distortion of the research university model, as well as for the presence of conflicts—both conceptual and operational— between HEI's three missions: teaching, research, and economic and societal development, known as the third mission (Slaughter and Leslie, 1997; Tuunainen, 2005; Powell, Owen-Smith and Colyvas, 2007; Goldstein, 2010; Philpott et al., 2011; Stensaker and Benner, 2013). In the absence of a consensus that HEIs must become more entrepreneurial, many institutions have embarked on a journey featuring challenging organizational changes; yet, how that ideal might be effectively achieved remains an open question (Clark, 2004; Gibb and Hannon, 2006; Guerrero, Kirby and Urbano, 2006; Kirby, 2006; Mcgowan, Sijde and Kirby, 2008). Consequently, understanding the entrepreneurial pathways for HEIs is a main prospective research agenda topic, as there is a need to understand the strategic choices made by HEIs during this transformation journey and their consequences (Klofsten et al., 2019).

At the same time, there is an increased scholarly debate on the transformation of HEIs into organizational actors. In this sense, an understanding of the strategic positioning of HEIs within their meso-environment is key (Fumasoli, Barbato and Turri, 2019). Furthermore,

participative methods with an open strategy enable the 'buy-in into change' of stakeholders facilitating the development and implementation of the strategic choices taken (Schwarz, 2020).

Accordingly, our research was conceptualized as a reflection exercise with the purpose of challenging conventional thinking (Wright, Bradfield and Cairns, 2013) to encourage entrepreneurial ecosystem stakeholders to foresee desirable futures (Martin, 1995) for HEIs systematically, in the long-term, and from their perspectives. In stimulating a wider debate through stakeholder engagement, we clarify the importance of the topic and support the development of education policy as well as the strategic advancement of HEIs by offering insights that 'frame decision-making agendas' (Volkery and Ribeiro, 2009). Specifically, the objective of this study is to generate long-term scenarios (van Notten et al., 2003), in which the 'preoccupations and interests' of entrepreneurial ecosystem stakeholders are considered (Ducot and Lubben, 1980) and resulting propositions are assessed by experts in higher education entrepreneurialism to inform such scenarios' utilization.

The primary research questions addressed are:

- How should HEIs, regardless of their current level of entrepreneurialism, evolve in the long-term to address the preoccupations and interests of entrepreneurial ecosystem stakeholders?
- What are the opportunities and risks for HEIs in pursuing entrepreneurial pathways?

Our results demonstrate that internationalization, digital transformation, collaborative networks, and co-creation processes are key drivers for higher education in the future, and the preoccupation and interest of international ecosystem stakeholders in HEIs encompass all three missions. We propose five scenarios in this study: worldwide, transdisciplinary, adaptive

learning, blended, and ecosystem. These scenarios provide insight for HEIs and policymakers to frame decision-making agendas related to possible entrepreneurial pathways. We suggest that, of these, the transdisciplinary and blended scenarios are the most auspicious.

Our article is structured as follows: We begin with a prologue offering an empirical contextualization of entrepreneurial ecosystems and entrepreneurialism in higher education. Next, we outline our research design, detailing the informants' profiles, the data collection, and the analysis procedures. We then present and assess the resulting scenario propositions, providing a discussion on their policy and institutional implications. We conclude with suggestions for further research by addressing the study's contributions and limitations.

3.2. Entrepreneurial ecosystems and higher education entrepreneurialism

Entrepreneurial ecosystems (EEs) can be defined as 'a regional, complex agglomeration of entrepreneurial activity providing two classes of relevant services, namely: a) enhanced entrepreneurial activity benefiting its larger economic and societal environment; and b) various forms of formal and informal support that generally enhance the probability of success of entrepreneurial activity' (Kuckertz, 2019, p.3). An EE is seen as a key driver of developing innovation-based resilient economies (Spigel, 2017) that encompasses three institutional spheres: industry, academia, and government (Oh et al., 2016). This complex triple-helix interaction has been proposed to explain the emergence of Silicon Valley and Boston EEs (Etzkowitz and Leydesdorff, 2000; Etzkowitz and Ranga, 2010), providing policymakers and practitioners around the world with a possible framework for emulation (Andersson et al., 2004; Etzkowitz, 2019). Even though the Silicon Valley is a contextual singularity (Audretsch, 2019), it provides important insights into the importance of the interaction among the three helices through a culture of permeability promoted by HEIs (Guzman and Stern, 2015). In this

context, American higher education evolved 'to take several roles within society and EEs' (Sam and Sijde, 2014).

As key actors in the development of EEs, HEIs became regional ecosystem organizers (Etzkowitz, 2004), proactively promoting knowledge transfer within the ecosystem (Fuster et al., 2019), as collaboration between internal and external stakeholders is required to establish a successful entrepreneurial university ecosystem (Lahikainen et al., 2019). The import of such concepts to other countries has propelled a global convergence in higher education. However, there are dramatic limitations to replication strategies due to differences in HEIs' external environments and their internal resources and capabilities (Jacob, Lundqvist and Hellsmark, 2003; Etzkowitz, 2004; Lazzeretti and Tavoletti, 2005; Philpott et al., 2011; Stensaker and Benner, 2013). Furthermore, HEIs' entrepreneurialism can also be seen as 'an organizational response to external challenges and pressures' (Hannon, 2013) in which environmental and internal factors are integrated to form the conceptual model of an entrepreneurial university (Guerrero and Urbano, 2012). Accordingly, HEIs now face a multitude of challenges, and their survival and advancement depend on their ability to adapt and evolve (Klofsten et al., 2019).

Based on this challenge, researchers have attempted to make sense of HEIs' strategic advancements towards the so-called 'third mission' and its implied entrepreneurialism. A growing literature developed with publishing of systematic reviews summarizing it throughout the last two decades, as for instance (Gibb, 2002; Laredo, 2007; Rothaermel, Agung and Jiang, 2007; Perkmann *et al.*, 2013; Bronstein and Reihlen, 2014; Clauss, Moussa and Kesting, 2018; Centobelli *et al.*, 2019; Lopes *et al.*, 2020; Stolze, 2021).

Stolze (2020), based on her review of HEIs' transformation into more entrepreneurial institutions, identified three central entrepreneurial paths for HEIs: governance measures;

entrepreneurship education offers; and ecosystem measures. Most experiments developed by HEIs across the globe to become more entrepreneurial related to the ecosystem path, as the formation of alliances and triple-helix networks is a main cornerstone of the process.

Despite advancements, the entrepreneurial university remains a relatively new and evolving paradigm, even at epitomes like Stanford (Etzkowitz et al., 2019). The model is 'an efflorescence of embryonic characteristics that exist 'in potentio' in any academic enterprise…with the ability to periodically reinvent itself and incorporate multiple missions' (Etzkowitz, 2013b, p.487). Hence, a recently proposed updated definition of the model proposes a systemic view: 'An entrepreneurial university design integrates project-based learning in the curriculum with an outlook of seeking out the useful as well as the theoretical results of investigation. These results are moved into use through an innovation system that includes a penumbra of public and private actors posing problems, concomitantly with the provision of resources' (Etzkowitz et al., 2019, p.169).

Burton Clark asserted as early as 1998 that 'new, institutionally defining ideas are typically tender and problematic at the outset of an important change. They must be tested, worked out and reformulated. If they turn out to be Utopian, they are soon seen as counter-productive wishful thinking. If found to be excessively opportunistic, they provide no guidance: any adjustment will do. Ideas become realistic and capable of some steering as they reflect organizational capability and tested environmental possibilities. New organizational ideas are but symbolic experiments in the art of the possible' (Clark, 1998b, p.12). This view remains valid today, as transformational changes occurring in HEIs can be described as an 'endless transition' based on 'nonlinear innovation models' of HEI transformation processes (Etzkowitz and Leydesdorff, 2000). To manage these changes, HEIs need to develop a form of organizational ambidexterity that enables them to explore and exploit (Centobelli et al., 2019)

new paths to deliver their three mission. Hence, dynamic capabilities to sense, seize, and transform have become key to the management of HEIs (Teece, 2018) in addition to the ability of HEI decision-makers to actively manage their institutions with an ecosystem stakeholder perspective and thus incorporate meaningful metrics in their entrepreneurial activities (Etzkowitz, 2016; Balven et al., 2018; Roundy, Bradshaw and Brockman, 2018; Gianiodis and Meek, 2019).

3.3. Research design

3.3.1. Foresight and scenario planning

Foresight methods can support actors' efforts to foresee and create desirable futures systematically and in the long term (Martin, 1995). Accordingly, foresight should be seen as a learning process, moving beyond visioning to seeding change through action (Masini, 2006) by including the creation of alternatives for transformation (Inayatullah, 2008) by bridging foresight, knowledge management, and strategy (Bootz, Durance and Monti, 2019). Moreover, foresight studies support the creation of networks, engaging actors by providing a common language in 'learning spaces where participants are able to explore possible alternatives for their actions, acquire new ideas and knowledge' (Djuricic and Bootz, 2019, p.126).

One of the foresight methods applied most-often by practitioners is scenario planning (Amer, Daim and Jetter, 2013). Scenario planning is seen as a starting point to address the need to supplement empirical evidence with a future perspective built on strategic stakeholder dialogues under 'post-normal' conditions (Ramírez et al., 2015). This method enables systematical insight employment and uncertainties impact exploration (van der Heijden, 2005) to foresee multiple novel yet plausible futures (Bradfield et al., 2005).

Having emerged from practice, this approach is still under development (O'Brian and Meadows, 2013), typologies are often reviewed (Ducot and Lubben, 1980; van Notten et al., 2003; Crawford, 2019), and application guidance and enhanced strategies are emerging, as the ones offered by O'Brien (2004); Amer, Daim and Jetter (2013); Ramírez and Selin (2014); and Hussain, Tapinos and Knight (2017). Among practitioners, variations in scenario planning application led to the emergence of three schools (Intuitive-Logics Model, La Prospective Models and Probabilisctic Modified Trend Models), with the intuitive logic school being the most adopted. The intuitive logic approach enables the development of plausible storytelling narratives about the future, challenging assumptions and promoting mindset change, which improves strategic decision-making processes (Bradfield et al., 2005; van der Heijden, 2005; Varum and Melo, 2010; Wright, Bradfield and Cairns, 2013; Hussain, Tapinos and Knight, 2017; Lang and Ramírez, 2017; Mackay and Stoyanova, 2017).

3.3.2. Data collection

The study's design (Figure 1), based on its goals (Section 3.1) and empirical context (Section 3.2), sets the scene for implementation (O'Brien, 2004). As suggested by Cairns, Wright, and Fairbrother (2016), our process was also not based on a single, extant structured scenario method and was instead structured in four macro-phases: preparation, scenario exploration, scenario development, and scenario utilization (Frith and Tapinos, 2020). The timeframe for execution was six months spanning August 2019 to January 2020, and the data collection employed participatory methods (Crawford, 2019) facilitated by the authors and was divided into three phases: a workshop (Steps 2-3), an individual visioning exercise (Step 4), and an expert assessment (Step 7).

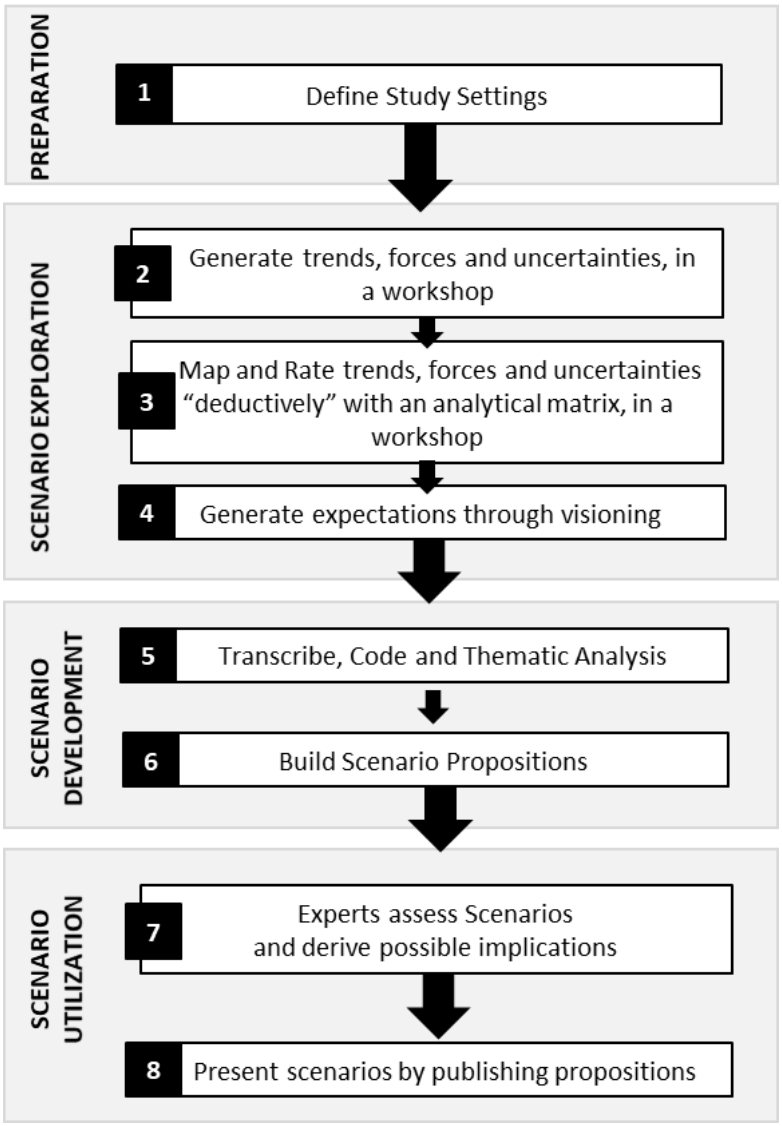

Figure 3.1: Study Design

We recorded the expectations of entrepreneurial ecosystem stakeholders in a workshop format (Steps 2-3) that built upon strategic stakeholder dialogues (Ramírez et al., 2015) followed by an individual free-writing visioning exercise (Step 4). The stakeholder-informants were 35 individuals from 16 countries on four continents who were working on entrepreneurship-related issues across all the institutional spheres associated with entrepreneurial ecosystems: HEIs, research institutes, government agencies, industry, non-governmental organizations, and entrepreneurs. Many of these informants held several roles and operated in more than one sphere.

The first data collection was a 90-minute workshop held during the XVII Triple Helix Conference in Cape Town (South Africa) in September 2019, which was facilitated by the first author and including the second author as a participant. In total, eight participants (50% female/male from Germany, Switzerland, Russia, South Africa, and Kenya) discussed trends, forces, and uncertainties supported by a Wilson matrix illustrating high, medium, and low probability/uncertainty and potential impact levels (Amer, Daim and Jetter, 2013) to aid in deductively rating items. The participants had senior hierarchical profiles and were decision-makers within their organizations. Most were between 40 and 54 years old; six had an average of 13 years of experience in issues related to HEI entrepreneurialism (two participants did not respond to this question).

The second data collection method used creative visualization (Inayatullah, 2008) in an individual free-writing visioning exercise (Step 4). Participants wrote out their visions based on their expectations around HEIs on the last day of two separate international (non-academic) conferences in the Munich/Germany entrepreneurial ecosystem on September and October 2019. In both cases, the participants had been immersed in two full-day discussions on entrepreneurship-related issues and international networking before completing the exercise. In total, 27 informants from 13 countries on two continents completed the exercise, with 30% of the respondents being female. Thirteen informants reported an average of seven years of involvement in HEI entrepreneurialism-related activities (14 did not respond to this question).

The third data collection point presents and assesses the developed scenarios (O'Brien, 2004). For the scenarios' development, the data collected in the first phase was transcribed and, using the software ATLAS.ti, coded for thematic analysis. Later, in November 2019, the authors conducted two separate brainstorming sessions aiming to synthetize the qualitative data

collected to conceptualize the scenarios through bricolage (Klag and Langley, 2013). Finally, the authors agreed on five scenario propositions on the basis that 'as few as four scenarios, even expressed as snapshots, may be useful' (Ram, 2020, p.15). For the assessment, we selected ten experts on issues related to HEI entrepreneurialism. The criteria for the selection of these experts included experience in academia; experience in practice; experience as a policy adviser; and publication impact (i.e., citations). Moreover, we attempted to provide an international perspective and gender balance by selecting five male and five female experts from eight different countries on four continents. Due to limited population and availability issues, we received a response from four highly qualified and internationally recognized expert informants (Table 1) who assessed the scenario propositions to (1) validate them and (2) derive possible implications. The experts conducted their assessment—individually and independently—between November and early December 2019 through a structured online questionnaire. First, we presented them with the five scenario propositions (Section 3.4.1). In due course, we asked them to assess each scenario individually and to challenge the propositions. Subsequently, the same experts derived implications for HEIs pursuing entrepreneurial pathways. The implication question borrowed concepts from scenario backcasting and roadmapping propositions (Hussain, Tapinos and Knight, 2017), while the assessment criteria used to validate the scenarios was also based on prior research (Amer, Daim and Jetter, 2013) and used a 5-point Likert-scale. Nevertheless, we did not employ the assessment scale as a quantitative measurement but rather as a guiding reference (Figure 3.1) to assist in analysing the experts' answers.

Expert	Country	Short Profile
Henry Etzkowitz (male)	USA	Originator of the 'Entrepreneurial University' , 'Third Mission' and 'Triple Helix' concepts. Professor Etzkowitz is currently a Visiting Lecturer at the Stanford University's Science, Technology and Society Program, a Visiting Professor at the University of London School of Management (Birkbeck College) and serves as the President of the Triple Helix Association and the International Triple Helix Institute.
Marcelo Amaral (male)	Brazil	Professor at the Fluminense Federal University in Rio de Janeiro. Professor Amaral is a specialist for project management oriented to technology innovation, certified by the International Association of Innovation Professionals. He serves as consultant to private and public institutions; leads, since 2008, the Triple Helix Research Group in Brazil and has published more than 50 academic works on the field.
Paul D. Hannon (male)	UK	Director of the Institute for Entrepreneurial Leadership at Swansea University and expert at the European program HEInnovate. Professor Hannon has shaped enterprise and entrepreneurship education, small business support and development in the UK and overseas during the past 40 years as a CEO, government adviser, educator and entrepreneur.
Val Livada (male)	Romania and USA	Senior lecturer at Massachusetts Institute of Technology's Sloan School and Adjunct lecturer at Boston University's Questrom School of Business. Professor Livada has over 35 years of experience as entrepreneur, technology/business consultant and startup board advisor with expertise in strategic planning, innovation, entrepreneurship, new business/product development and R&D management.

Table 3.1: Experts Profile

3.4. Results

3.4.1. Scenario propositions

The resulting scenario propositions are exploratory normative scenarios grounded in present trends, in which the preoccupations and interests of stakeholders are taken into consideration (Ducot and Lubben, 1980). The propositions thus reflect the expectations of entrepreneurial ecosystem stakeholders related to HEIs and encompass an HEI's three missions: teaching, research, and the third mission, which is related to economic and societal impact. Furthermore, three aspects driving the scenarios include the current and potential impact of

(a) internationalization, (b) digital transformation, and (c) collaborative networks and co-creation processes.

The five scenario propositions (Table 3.2) that emerged from the data collected during the workshop and visioning exercises include:

- **Worldwide Scenario:** Collaboration among international entrepreneurial universities leads them to form worldwide institutions;
- **Transdisciplinary Scenario:** Entrepreneurship evolves to become the enabler of transdisciplinary formats, integrating all disciplines;
- **Adaptive Learning Scenario:** Adaptive education evolves to become a central aspect in entrepreneurial universities, with the personalization of curricula and learning experiences supported by artificial intelligence tools;
- **Blended Scenario:** The flipped classroom pedagogical method (i.e., syllabus delivered online; professor assumes a coaching role) evolves to take a central role in entrepreneurial universities. Most content is available online, and international classrooms and international teamwork work in virtual reality environments;
- **Ecosystem Scenario:** Co-creation evolves to become the central process in entrepreneurial universities, enabling the agile co-development and co-financing of research, teaching, and service formats.

Scenario Name	Scenario Description (Story/Rationale Behind)	Citations Examples
1. WORLDWIDE SCENARIO	• Collaboration among international Entrepreneurial Universities evolve to form a worldwide organization; • This organization's values, vision, and mission are aligned with global sustainable development goals (SDGs); • Co-creation evolves to become the norm when (further)developing (new) concepts for HEIs teaching, researching, and transferring activities; • Students mobility is enabled in flexible ways; • International classrooms and international teamwork are common formats; • Empathy, collaboration, critical thinking, and intercultural communication are central aspects of the learning process;	'How we can create a big worldwide university or different ones that allow more exchange of students experts' '…we have these global challenges and why do we need all these single universities there and we find this or that university better because they give better grades, but this is the discussion… But isn't it more important that we co-create? So, I would be interested that in how I send my student to your university and they come back and have new ideas and challenge our professors. So, I have more an idea of how we can create a big worldwide university or different ones that allow more exchange of students experts etc.' 'Co-creation of international Universities' 'Other countries will have to come closer to the current state of western HEIs. Their role will be more one of guidance in this process (…) possible enablers of new forms of entrepreneurial acting and thinking, particularly in the process of co-creation.'

Scenario Name	Scenario Description (Story/Rationale Behind)	Citations Examples
2. TRANSDISCIPLINARY SCENARIO	• Entrepreneurship evolves to become the enabler of transdisciplinary teaching and research formats, integrating different academic disciplines; • Faculty and academic discipline silos are merged and the entrepreneurial university functions as an (eco)system with systems and structures in collaborative transdisciplinary 'beehives;' • Plurality becomes the norm, not the exception, with all fields contributing value to the whole; • Entrepreneurial Universities have a multitude of disciplines ranging from the arts, humanities to STEM, applied sciences, and to the vocations;	'Different subjects open for each other; more interaction and interchange of knowledge between STEM subjects, economics, but also arts, design, psychology, social aspects; understanding the consequences and impact in other dimensions getting inspired by other subjects and topics' '…2 years at university and then for 1-2 years to a vocational college and the vocational modules were about meeting industries needs and jobs and the university type modules were about societal integration and critical thinking and being able to take those into your vocational segment. So not divorced from your vocation, but related to it. So, you have this clear idea that the role of a university is not simply training you to do your job. Because that is dangerous!' 'One thing I've noticed here is that we have been talking about universities, but here in the global south we talk more and more about pluriversities… and the strength of pluralism and the pluriversal perspective rather than a universal perspective. So, you might be a collective, but you don't have to be the same to be equal and you don't have to be the same to contribute value' 'We need to have these BEEHIVES. We need to have an easy atmosphere to meet and to discuss your ideas and the university can be that place'
3. ADAPTIVE LEARNING SCENARIO	• Adaptive Education evolves to become a central aspect of entrepreneurial universities; • Artificial intelligence tools support this process; • Personalization of curricula and learning experiences; • Students are the central element and starting point of their higher education learning experience; • The arts and the applied sciences silos disappear;	'We are taught to be a good employee, follow the line and don't think too much out of the box. Especially within applied sciences. I imagine a world in which universities give their students all the instruments to make wise choices about their future. This means completely changing the actual structure of learning programs.' 'Switch from one to many education paths. To one to one, defining goals, and objectives based on personal behaviors and the aspirations of each student' 'The next step is adaptive education, where teachers can see the progress of students and follow'

Scenario Name	Scenario Description (Story/Rationale Behind)	Citations Examples
4. BLENDED SCENARIO	• The flipped classroom evolves to take a central role in entrepreneurial universities; • Entrepreneurial universities provide a combination of online and offline teaching formats that can be combined; • Most content is delivered online; • Coaching/Mentoring and action/experiential learning are central to the teaching process; • International classrooms and international teamwork are enabled by virtual reality;	'The traditional form of teaching will be more and more replaced by online and practical experience through cooperation with industry partners.' 'The challenge is…to recognize how we can hybridize… there are some things that only a human can teach you and can respond to. But there is this amazing technology that can help in other ways. If we can find ways to do both, with the MOOCS. Some of the work we have done, it is looking into the MOOCS [Massive Open Online Courses] and LOOCS [Local Open Online Courses]. So, the MOOCs and at the same time you have local open courses, so you have someone doing and facilitating in the local level and you have the benefit of this massive international community'
5. ECOSYSTEM SCENARIO	• Co-creation evolves to become the central process in entrepreneurial universities enabling agile co-development and co-financing of research, teaching, and service formats; • Entrepreneurial universities are key actors in innovation ecosystems together with government, industry, non-governmental and civil society organizations; • The entrepreneurial university resources are open to actors from the innovation ecosystem; • Actors from the innovation ecosystem actively contribute to all activities taking place in the entrepreneurial university in an open collaboration atmosphere;	'Theory enriched learning in, about, and for real world.' 'HEIs have to think of themselves as bridges of innovation and entrepreneurship allowing the connections between different fields of action and actors.' 'The funding of HEIs is very likely to be a major impact factor for the vision they are working on. Fundamental research, applied knowledge, corporate training are three pillars to take into account and fund. Preferably HEIs need to have partners-links outside of their competences and region.' 'Particularly in the western societies the role and objectives of education will have to be negotiated and developed through quadruple helix discussions to support the 'birth' of new talents, which can answer the global challenge needs.'

Table 3.2: Scenario propositions

3.4.2. Scenarios assessment

The five proposed scenarios are not mutually exclusive. This fact is a key aspect for when assessing its utilization potential. An expert informant pointed out 'the most likely scenario is a combination of the previous five…None will happen independently' (Expert_4), while Expert_2 believed that 'a combination of all the above scenarios is plausible in the short to medium term' rather than the long-term perspective initially set for the study. These views add a sense of urgency to the matter, explained by Expert_2: 'the higher education sector is poised for a highly disruptive period as has been witnessed across many other professional service areas globally... It's unlikely the number of HEIs as currently configured will/can survive, and we will see significantly different landscapes for post compulsory education, requiring different leaders, mindsets, values, services, outcomes, relationships'.

The scenarios most positively assessed by the experts were Scenario 4 (blended) and 2 (transdisciplinary), which were based on a 5-point Likert scale (Figure 3.2). The experts agreed that Scenario 4 (blended) was not only possible but is already a reality—at least in some contexts. For instance, in Brazil, in 2019, a greater number of higher education students were enrolled in 'hybrid' distance learning degrees than regular ones, a trend driven by private HEIs offering two-year technical higher education degrees, which are not equivalent to bachelor's degrees (Branco, 2020). This scenario is a likely pathway for HEIs in the short-term, a fact aligned with a sense of 'urgency' influenced by exogenous forces: 'Increases in global populations and rising demands for learning opportunities will need a resource-efficient solution' (Expert_2). Nevertheless, there are many challenges in pursuing the blended scenario, as 'new standards must be established for educational requirements' (Expert_4). Furthermore, there is a need for policymakers and HEIs to reflect on 'whether a preponderance of online [courses] creates a better educational environment if done on a mass

scale rather than through international seminars is another question. [It] depends upon implementation, whether to simply deliver content to larger numbers or facilitate genuine cross-cultural interaction' (Expert_3). After all, as pointed out by Expert_1, 'several rules need to be changed in HEIs, governments, and professional regulations to enable this scenario' to make it feasible. In this sense, 'this needs to be managed such that the emotive/conative and not only the cognitive aspects of learning are engaged in a holistic approach to human development. [This includes] continual breakthroughs and understandings in the scope of AI to develop humans at an intellectual level; more engagement in alternative methods of teaching/learning embedded in early teacher training opportunities; closer linkages/sponsorships between industry and education; success stories and role models' (Expert_2).

		ASSESSMENT CRITERIA			
		Consistent / Coherent	**Plausible**	**Relevant /Pertinent**	**Complete / Correct**
SCENARIOS	**MOST**	Blended	Transdisciplinary	Transdisciplinary	Blended
	↑	Transdisciplinary	Blended	Blended	Transdisciplinary
		Ecosystem	Ecosystem	Ecosystem	Ecosystem
		Worldwide	Adaptive Learning	Adaptive Learning	Adaptive Learning
	LEAST	Adaptive Learning	Worldwide	Worldwide	Worldwide

Figure 3.2: Scenario propositions assessment

Scenario number two (transdisciplinary) is a plausible possibility and is even already happening in some contexts, as it is similar to the reality at some applied sciences universities in Europe or in innovative and forward-thinking transdisciplinary centres at top-tier HEIs around the world. It seems to be a trend 'to encourage an entrepreneurial mindset through teaching programs' (Expert_3). However, whether HEIs could deliver the proposed scenario

remains moot because it is still ‘unclear if there is sufficient support to become the norm’ (Expert_3). Furthermore, the scenario’s feasibility might be ‘low due to the traditional structures of knowledge areas’ (Expert_1). Hence, the change required is not only institutional; the first step is to align policies and public funding schemes. An expert summarized the influencing forces of the transdisciplinary scenario: ‘There are challenges in normalizing these behaviours across the sector, particularly in removing silo mentalities and the dominance of professional bodies and gatekeepers…government and industry pressures in seeking effective and timely solutions to global and national wicked problems; the voices of the youth seeking greater focus on making an impact in the world; a shift in political emphasis and hence funding; new institutions forming that have an alternate mindset and approach to the purpose and value of education; new leaders driving new and existing institutions; changes to the methods for determining the rankings of universities; potential students voting with their feet and selecting places of study from a different perspective and set of values; increasing pressures from climate change, security, and other SDGs’ [Sustainable Development Goals] (Expert_2).

Scenario 5 (ecosystem) was neutrally assessed. It reflects a welcome trend, as ‘the innovation ecosystem requires a close collaboration between research centres, start-ups, and industry… [and] the realization that the above relationships are desperately needed’ (Expert_4). Moreover, ‘many institutions are already engaged with their ecosystems and realize the value to their future. Clearly, some do this more effectively than others’ (Expert_2). The key aspect is how to implement this scenario, as there are many possible formats. Expert_1 suggested that ‘the creation of new, small and more flexible organizations or units can enable this scenario’, i.e., independently run entrepreneurship centres. Another expert pointed to ‘co-ventures in campus developments; the sharing of industry/employer assets as places for

learning; genuine joint degrees; and the shared risks and rewards across a diversity of projects' (Expert_2). Nonetheless, Expert_1 stated that 'it is difficult to think about how this scenario will work on a massive scale. The management in the HEIs will be more complex, and the results/impacts of this change are not clear'.

Based on the assessment criteria applied, the experts did not perceive the remaining scenarios to be as promising as the previous ones. They considered Scenario 3 (adaptive learning) to be inconsistent though possibly as relevant to HEIs' entrepreneurial pathways as Scenario 5 (ecosystem), because 'this type of educational reform must happen, but it has been fought by the establishment for centuries and it will occur very slowly' (Expert_4). One expert summarized the needs, challenges, and opportunities associated with this scenario: 'Learning opportunities will need to become more highly adaptive, with the focus shifting more toward the individuals' learning journey in the context of their emerging life and not considering education as a life phase between childhood and work. It's already happening in places. Also, learning is not solely the domain of education institutions. Changes to modes of learning, modes of assessment; further development of 'bundles' of learning which accumulate into a broad view of an individual's capacities and capabilities; increasing use of AI to deliver and assess; broader recognition and acceptance by employers/society of a wider range of awards/outcomes; increasing emphasis on the know-how/know-who than the know-what' (Expert_2).

The scenario assessed as being the least complete was the worldwide scenario. Comments from the experts included 'vague' (Expert_3) and 'the idea of an international organization seems strange' (Expert_1) with a multitude of pathways, i.e., 'collaboration among equal partners, [a] formal merger, or takeover' (Expert_3). In this sense, 'a more likely scenario is that such schools will be merged with universities to form larger entities locally. This is the

current trend and it would take a large unknown force to move in another direction' (Expert_3). An example is Aarhus University (Denmark), formed out of a merger of two HEIs and two research centres, a process that enabled it to become an entrepreneurial university (Pinheiro and Stensaker, 2014). Furthermore, the implementation of a worldwide HEI could lead to an elitist institution, as it is 'not clear how international mobility will be subsidized if it is to reach-down to lower economic levels' (Expert_3), although the experts recognized that digitization could enable this scenario. Nevertheless, Expert_2 'could foresee an increase in existing global alliances with ever stronger relationships,' since 'there is a clear and growing interest in universities to connect and collaborate'. In some contexts, this scenario could be more feasible, as it 'could make sense in Europe' (Expert_1), where 'existing EU programs for student mobility could be moved in the desired direction' (Expert_3).

Overall, experts agreed that there are few potential losses in HEIs pursing entrepreneurial pathways to address stakeholders' expectations, as 'the greatest risk is in not developing a more entrepreneurial and value-creation mindset' (Expert_2), since it might reduce 'the actual viability of institutions. Those that are slow to adapt will be at best marginalized or at worst eliminated' (Expert_4), which lets the 'traditional, comfortable culture that has existed for a very long time' prevail (Expert_4). However, when exploring and exploiting opportunities, HEIs must be mindful not to let 'energy dissipate in inconsequential projects' (Expert_3). Hence, an effective implementation strategy is crucial. Independently of the pathway(s) chosen, HEIs have the opportunity to 'increase centrality as [an] engine of post-industrial knowledge-based society' (Expert_3). Furthermore, 'the idea of continuous learning and the increase of access in developing countries creates a big market. Working as an entrepreneurial university, the HEI will gain more proximity to the real problems and deliver better results to society' (Expert_1).

3.5. Discussion

According to Audretsch (2014, p.320), 'perhaps it is the ability of the university to both adhere to its traditional strengths as well as adapt to the needs and concerns of society that has made it one of the most resilient institutions in society.' Nevertheless, in this study, we seek to reflect on how HEIs, regardless of their current level of entrepreneurialism, should evolve in the long-term to address the preoccupations and interests of entrepreneurial ecosystem stakeholders. The results of this study demonstrate that, to live up to future expectations, HEI management needs to find innovative ways to produce human, knowledge, and entrepreneurial capital concomitantly and efficiently. In this sense, HEIs need to develop new approaches to knowledge generation through decentralized, inter-, and transdisciplinary formats that include external EE stakeholders. This shift in purpose could be essential to resolving urgent problems and challenges (societal, economic, and technological). Teaching formats and research results should be integrated through real-time innovation processes (Weber, Sailer and Katzy, 2015; Stolze, Sailer and Gillig, 2018) into the real world, making sure stakeholders' perspectives remain in focus to produce value and advance knowledge societies. If such an approach is to succeed, HEIs must re-structure, starting with a mindset change that moves away from an administrative way of thinking towards an entrepreneurial mindset, sensing and seizing opportunities effectively while demonstrating an ability to act quickly and precisely to agilely develop novel concepts within teaching and research activities as well as those addressing the third mission. In this process, they should take into account the potential impact of internationalization, digital transformation, and EE collaboration strategies.

In this sense, transdisciplinary-learning and blended environments in HEIs should not depend on faculties; instead, stakeholders in EEs should be involved in co-creation to tackle challenges that arise in particular fields of society and/or have an impact on specific regional areas.

Permeable boundaries among HEIs and their stakeholders (Spigel, 2017; Etzkowitz et al., 2019) benefit from fluid (infra)structures, which ease their implementation (Teece, 2018). For instance, re-thinking the HEI as a multiple hybrid organization (Kleimann, 2019) provides flexible architecture and open access points for all stakeholders to connect and communicate more effectively within HEIs or at science and technology parks (e. g., living labs and creative spaces).

So, what are the opportunities and risks for HEIs in pursuing entrepreneurial pathways? Scholars have already raised concerns about HEIs' ability to follow entrepreneurial pathways. Stensaker and Benner (2013) pointed out that HEIs could be 'doomed to be entrepreneurial', meaning that pursuing entrepreneurial pathways is a path without return. Ylinenpää (2013) indicated HEIs could 'get stuck in the middle', marginalized by epitomes. Assuming a HEI successfully becomes entrepreneurial, it would still face the risk of a paradox of success, as exemplified by Stanford University, which oversaw the potential of academic entrepreneurship by initially only focusing on research output (Etzkowitz, 2013c; Etzkowitz et al., 2019). These risks, however, should not justify inertia to not make strategic choices.

Our findings demonstrate that EE stakeholder expectations of HEIs illustrate the opportunities for HEIs to explore, as the normative explorative scenarios are grounded in present trends (Ducot and Lubben, 1980). Hence, our findings confirm and exemplify the critical role of history in scenario thinking development (Bradfield, Derbyshire and Wright, 2016). The five proposed scenarios here are not mutually exclusive and do not represent the broad spectrum of possible scenarios that HEIs might face in the future. Instead, they provide valuable and novel insights and foresights to inform strategic decision-making. Expert informants in this paper believe that a combination of these scenarios is plausible and that it might even come to pass in the short- to medium-term, rather than the long-term. This fact adds a sense of

urgency for HEIs to proactively manage this endless transition toward entrepreneurialism (Etzkowitz and Leydesdorff, 2000), acknowledging the influence of exogenous and endogenous forces to 'ignite, sensitize, consolidate and institutionalize' an entrepreneurial culture following a nonlinear iterative process to transform themselves (Stolze, 2021). This process is assumed to 'fully mediate the transformation capability–organizational change relationship' inside HEIs (Zhang, Wang and O'Kane, 2019, p.13).

Moreover, is it important to point out that our data collection occurred before the emergence of the Covid-19 pandemic, an unexpected exogenous force that affected HEIs' ability to deliver teaching, research, and transfer activities. The push towards digital formats during the pandemic certainly anticipates the consolidation of the blended scenario forecasted in this study. Nevertheless, the long-lasting effects of the pandemic on HEIs' entrepreneurial pathways is a new research agenda priority. Further interesting limitations of this study open up avenues for future research, as our findings remain contextual, since entrepreneurial ecosystem stakeholders and expert informants are partisan in the field of higher education entrepreneurialism. Future research would benefit from the inclusion of different sets of stakeholders. Furthermore, subsequent studies might analyse HEIs' change management processes, testing the desirability, feasibility, viability, and sustainability of different advancement implementation strategies through quantitative and longitudinal approaches.

3.6. Conclusion

This research addressed entrepreneurial ecosystem stakeholders' preoccupations and interests regarding HEIs' roles in the future and assessed the opportunities and risks associated with HEIs pursuing these entrepreneurial pathways. The five scenarios proposed in this study provide valuable insights and foresights for HEIs to prepare for a number of plausible

futures (Varum and Melo, 2010). It supports framing decision-making agendas (Volkery and Ribeiro, 2009), enabling the generation of strategies to mitigate risks and seize opportunities (Varum and Melo, 2010) by identifying key international trends and their drivers. In practice, our study findings are ready for utilization, i.e., to support the analysis of opportunities and threats during strategic planning activities. However, independently of the strategic choices made, the adopted implementation strategies are key to success, as each institution must develop its own entrepreneurial pathway based on its individual context.

In conclusion, our study contributes to theory on foresight studies by exemplifying the application of scenario planning in an international context while also promoting 'social capital' among the study's participants (Lang and Ramírez, 2017). At the same time, it makes a clear contribution to scholars' understanding of the entrepreneurial pathway for HEIs by offering a systematically developed—and much needed—foresight perspective.

4. Advancing HEIs' third-mission through dynamic capabilities: the role of leadership and agreement on vision and goals

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Higher education institutions (HEIs), once considered among society's most resilient institutions, are facing challenges due to changes in governments' and society's expectations of them. Within the sector, there is a global call for new models and practices, requiring HEIs to develop the management capabilities once reserved for businesses. In this sense, they will pave entrepreneurial pathways and contribute to economic, technological and societal developments in their regions, thus adding a third mission (engaging socio-economic needs and market demands) to the traditional two (education and research) and transforming themselves into more entrepreneurial institutions. Dynamic capabilities enable transformation processes by allowing the dynamic sensing and seizing of opportunities and risks and the promotion of iterative change and reconfiguration. Scholars have called on HEIs to develop such dynamic capabilities in order to transform themselves and better respond to their sector's challenges. Nevertheless, the understanding of how dynamic capabilities might advance HEIs' third mission is still an underexplored concept, and in this paper, we propose mechanisms that promise to transform dynamic capabilities into third mission advancement. We have developed numerous theoretically grounded hypotheses and tested them with a partial least squares structural equation model into which we funnelled data collected from key decision-makers at German HEIs. The results suggest that dynamic capabilities do indeed influence third mission advancement; however, this relationship is mediated by the role of leadership and organisational agreement on vision and goals.

4.1. Introduction

Even though higher education institutions (HEIs) may be among the most resilient and enduring institutions (Maassen and Stensaker 2011; Audretsch 2014), governments' and society's expectations of their contributions have evolved beyond the traditional roles of teaching and research. Now, HEIs have been given a third mission: to actively contribute to

economic, technological and social advancements by producing human, social and entrepreneurial capital (Etzkowitz and Leydesdorff 1998; Etzkowitz et al. 2000; Guerrero, Cunningham and Urbano 2015). Higher education reforms have resulted in structural institutional changes (Maassen and Stensaker 2011) in which HEIs must demonstrate the ability to transform and evolve. Institutions that incorporate the third mission in this process are considered entrepreneurial (Etzkowitz 2004; Guerrero and Urbano 2012). Within this scenario, HEIs' traditional management practices are no longer suitable (Teece 2018), and they therefore require new models for producing strategic advancements.

Dynamic capabilities (DCs) are an essential concept in strategic management practices. They refer to an organisation's ability to sense and seize opportunities to reconfigure and transform itself and are especially key in rapidly changing sectors. Thus, DCs enable value creation and the development of competitive advantages (Teece, Pisano and Shuen 1997; Wilden et al. 2013).

Previous research has pointed out that modern HEIs can be characterised as organisations that blend managerial practices and collegial professional values (Seeber et al. 2015), and the ideal of HEIs becoming more entrepreneurial is to be studied as a complex and multifaceted phenomenon (Kaša et al. 2019). Regarding DCs in higher education, studies have shown that they create value in universities' technology transfer processes (Yuan et al. 2018), which is a key third mission activity. Overall, DCs provide HEI leaders with guidance in generating organisational adaptation (Leih and Teece 2016). These adaptions transpire via long iterative processes that are constantly influenced by exogenous and endogenous forces. Hence, such adaption processes require that DCs enable HEIs to develop new projects as experiments that sensitise stakeholders to the third mission so that it can be institutionalised later (Stolze 2020).

Nevertheless, how DCs can support the strategic advancement of different types of organisations still requires further research (Vogel and Güttel 2013). In this context, scholars' comprehensive understanding of how DCs facilitate HEIs' third mission advancement is an important but underexplored aspect. Against this background, this study addresses the following research question: how can DCs be translated into HEIs' strategic third mission advancements?

We answered this question using a research model that explored how third mission advancements in German HEIs occur by employing DCs through two routes: (1) leadership and (2) the establishment of a vision and goals. We took this approach because prior research suggested that developing strong DCs might require entrepreneurial leadership (Schoemaker, Heaton and Teece 2018) and an entrepreneurial vision (Wakkee et al. 2019).

We tested our theoretical model from explanatory and predictive perspectives using survey data from German academics who drive their institution's third mission initiatives. The resulting measurement and structural models presented satisfactory outputs. We concluded that DCs alone have limited explanatory power in third mission advancement. A change-embracing leadership that effectively establishes a vision and goals through collaborative means mediates third mission advancements. Given this, our study's contributions are threefold: (1) it further explains the relationship between DCs and HEIs' third mission; (2) it identifies two mechanisms for effectively transforming DCs into third mission advancement; and (3) it offers managerial insights HEI decision-makers can draw on to advance their institution's third mission.

This article is structured as follows: first, we provide a theoretical foundation for our conceptual model and hypotheses. Then, we contextualise our research setting and explain

our procedures before presenting and assessing the measurement and structural models' results. After, we discuss this study's implications and limitations; we then propose possible research venues and render a conclusion.

4.2. Theoretical framework and research model

4.2.1. HEIs' governance and third mission

In the last three decades, many countries have reformed their higher educational systems, changing HEIs' autonomy, public financing, mission and accountability. In Europe, for example, European Union directives and national government initiatives concomitantly affect HEIs (Curaj, Deca and Pricopie 2018). Governments' and societies' expectations of HEIs have come to include more than teaching and research. Now, they are expected to be catalysts for regional economic, social and cultural development with the ultimate purpose of ensuring societies thrive' in their entrepreneurial endeavours (Audretsch 2014). Thus, governments developed funding programmes to promote HEIs' entrepreneurialism. Take, for instance, the British Science Enterprise Challenge, Dutch centres of excellence, the German EXIST or the Austrian A+B schemes (Mcgowan, Sijde and Kirby 2008).

HEIs' third mission can be seen as a second academic revolution (Etzkowitz 2003) in which enterprise is added to the traditional missions of teaching and research. Enterprising endeavours produce entrepreneurial capital and positively impact regional economies (Guerrero, Cunningham and Urbano 2015). HEIs that effectively incorporate the third mission are seen as entrepreneurial universities – a new paradigm introduced by Etzkowitz (1983) and based on strategic developments at Stanford and the Massachusetts Institute of Technology (MIT). Initially considered institutional anomalies because they deviated from the research university model (Etzkowitz 2004), these institutions now epitomise the entrepreneurial

university ideal, inspiring HEIs around the world to emulate their achievements and attempt to build their own silicon valleys (Andersson et al. 2004; Etzkowitz 2019).

Managing HEIs' advancement towards the third mission is more complex than one might think. In comparison to the average firm, an HEI has a broader range of stakeholders and a wave of heated and impactful political influences (Teece 2018). HEI governance and leadership style play a key role in the success (or failure) of strategically advancing the third mission (Garcia et al. 2012). For instance, the case of the University of Bari in Italy demonstrates that the third mission is mainly enabled by 'an open model of governance with internal and external stakeholder involvement' (Lombardi et al. 2019, 3394).

In this sense, governments have pushed HEIs to make changes in their governance structure so they can be 'more effective, efficient and responsive to societal needs' (Capano and Pritoni 2020, 2), providing the necessary support for entrepreneurship and related education (Guerrero, Toledano and Urbano 2011). Thus, propositions to transform HEIs into entrepreneurial universities include governance and leadership as key drivers, which was reflected in Clark's (1998) strengthened steering core proposition and Nelles and Vorley's (2011) entrepreneurial blueprint.

4.2.2. HEIs' leadership and visioning

In HEIs, leadership must incorporate a collegiality ethos into management approaches, as this is critical in order for change management processes to 'create vision, communicate policy and deploy strategy' (Davies, Hides and Casey 2001, 1026). When proper leadership is missing, an institution is seen as hindering its own development and performance, as in the case of some African HEIs (Muriisa 2014). Furthermore, Ekman, Lindgren and Packendorff (2018, 218)

found that the 'relationship between government and universities implies a 'black-boxing' of academic leadership' of which we still know little about.

HEIs' presidents, provosts and chancellors shape their institution's developmental path (Eddy and Vanderlinden 2006). The strong leadership provided by these individuals support HEIs' transformation into more entrepreneurial universities (Yokoyama 2006; Wakkee et al. 2019). Cases illustrating advances in HEIs' third mission have highlighted the key roles chief executives play, including at Stanford (Etzkowitz 2003; Leih and Teece 2016), MIT (O'Shea et al. 2007) and Garfield State (Mcclure 2016) in the United States; further cases have been made of the Chalmers Institute of Technology in Sweden (Jacob, Lundqvist and Hellsmark 2003; Berggren 2011) and the University of Itajubá in Brazil (Almeida 2008). Hence, HEIs' senior management support is essential, as these people hold 'sufficient managerial authority to be able to make decisions in the process of consultation and to convince sophisticated individuals that the transition would have a beneficial effect' (Mcroy and Gibbs 2009, 697). In order to promote transformative organisational change, HEIs' leaders must obtain support from the broader academic community (van Ameijde et al. 2009) and include external stakeholders (Etzkowitz and Leydesdorff 1998) in an environment of co-creation (Mader, Scott and Razak 2013).

In this context, clear communication between HEIs' leaders and its scholars and staff is essential, as it influences the organisational climate and the 'faculty's intellectual leadership behaviours' (Uslu and Arslan 2018, 408). Effective communication is fundamental in empowering individuals and managing the internal politics related to, for instance, the distribution of funds for third mission initiatives (Garcia et al. 2012). A key element of this communication is institutional vision, as HEIs must re-envision themselves to produce change (Hamington and Ramaley 2018), set goals and establish an entrepreneurial vision to enable

their transformation into more entrepreneurial entities (Wakkee et al. 2019). Thus, public institutions should focus on developing a shared vision and its implementation (Volcker 2014). Additionally, clearly defined goals have been identified as enablers of the emergence of effective distributed leadership in HEIs (van Ameijde et al. 2009).

According to Battilana, Leca and Boxenbaum (2009), developing a vision in an institutional context requires mobilising allies and motivating stakeholders to achieve and sustain it. HEIs' strategic planning activities rely on a vision, and the process of its development must be participative (Özdem 2011). However, the actual role and effect of a vision on HEIs' performance is not yet well researched (Kantabutra 2010), which leaves a gap in the understanding of its effect on strategic advancement.

4.2.3. Dynamic capabilities and their role in HEIs

DCs are a conceptual proposition introduced by Teece, Pisano and Shuen (1990) and refer to an organisation's ability to sense and seize opportunities and threats in order to strategically promote change. Sensing means monitoring and identifying signs of possible change, even if weak, in the organisation's meso and macro environments. Effectively sensing threats enables an organisation to mitigate the associated risks. Meanwhile, effectively sensing opportunities enables an organization to seize them through timely innovations that increase its competitive advantage. However, in volatile environments, sensing and seizing are not enough to produce effective responses, requiring organisations to reconfigure and constantly adapt to change. To develop strong DCs, organisations need entrepreneurial leadership, as this process requires more experimentation than detailed planning (Schoemaker, Heaton and Teece 2018), i.e., it requires more entrepreneurialism and less management.

The concept of DCs borrows and combines elements from strategic management, evolutionary economics and behavioural theory (Vogel and Güttel 2013) to explain how organisations leverage their capabilities to respond to swift environmental changes and create new competitive advantages (Teece, Pisano and Shuen 1997). Since the 1990s, the concept has gained momentum among researchers but still remains a novel proposition requiring a stronger foundation of empirical studies to reveal how it can support the strategic advancement of different types of organisations (Vogel and Güttel 2013).

In the context of HEIs, strong DCs are able to create value for different stakeholder groups while at the same time protecting the academic ethos (Siegel and Leih 2018; Teece 2018). For instance, Stanford's successful strategic advancements towards the third mission and recognition as epitomising the entrepreneurial university model has been attributed to its superior dynamic capabilities (Leih and Teece 2016) in comparison to other institutions. Furthermore, Leih and Teece (2016) also proposed that campus leaders' DCs positively influence work commitment, ultimately contributing to university performance. Here, the question remains as to what extent and how DCs contribute to HEIs' third mission advancement.

4.2.4. Research model and hypotheses

Our proposed research model (Figure 4.1) illustrates our hypotheses and allowed us to investigate to what extent leadership and agreement on vision and goals provide effective routes that enable DCs to assist third mission strategic advancement. We assumed that leadership and agreement on visions and goals mediate DCs impact on third mission advancement, theorising that an HEI with strong DCs can provide the necessary leadership to

reach agreements on vision and goals, enabling greater flexibility and a multitude of entrepreneurial pathways to the advancement of its third mission.

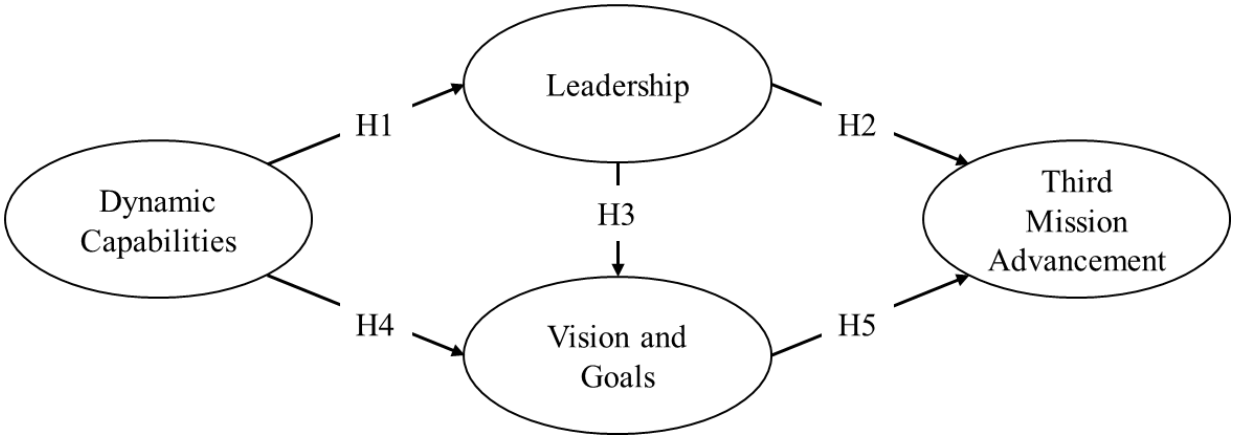

Figure 4.1: Conceptual Model

Based on the theory reviewed, we conceptualised two routes composed of five hypotheses (Figure 4.1). The first hypothesis stated that DCs are positively associated with the leadership of an HEI's governing body (H1). This hypothesis built on three facts: first, leadership is required to incorporate an ethos of collegiality into management practices (Davies, Hides and Casey 2001); second, entrepreneurial leadership is required to develop strong DCs (Schoemaker, Heaton and Teece 2018); and third, DCs produce value for different stakeholders while protecting an academic ethos (Siegel and Leih 2018; Teece 2018).

Additionally, strong leadership supports HEIs' transformation into more entrepreneurial universities (Yokoyama 2006; Wakkee et al. 2019), and many institutional cases across the world illustrate this in the literature (e.g., Stanford, MIT, Itajubá and Chalmers). These leaders' management styles influence the success or failure of third mission strategic advancement (Garcia et al. 2012). This happens because top managers have the authority to convince internal and external stakeholders to produce institutional change (Mcroy and Gibbs 2009).

Hence, we assumed that the leadership provided by an HEI's governing body is positively associated with third mission advancement (H2).

Moreover, due to the convincing power of leaders over 'sophisticated individuals' (Mcroy and Gibbs 2009, p.697) who are part of different stakeholder groups, we also theorised that the leadership provided by an HEI's governing body is positively associated with agreement on its vision and goals (H3). This is so for two reasons: first, in institutional contexts, the development of a new vision, achieving it and sustaining it require motivating all stakeholder groups and mobilising allies (Özdem 2011); second, clearly defined goals enable effective distributed leadership in HEIs (Garcia et al. 2012).

The formulation of a vision through participatory processes is fundamental to HEIs' strategic planning (Özdem 2011). Given this and the fact that DCs are an essential concept in strategic management practices designed to produce change, our fourth hypothesis stated that an HEI's DCs are positively associated with organisational agreement on vision and goals (H4). Moreover, on the grounds that to produce change and transformation HEIs need to first re-envision themselves (Hamington and Ramaley 2018) and that entrepreneurial visioning and goal setting enable their transformation into more entrepreneurial institutions (Wakkee et al. 2019), our fifth hypothesis was that agreement on vision and goals is positively associated with third mission advancement (H5).

4.3. Methods

4.3.1. Sample and data collection

We conducted a survey with key respondents from German HEIs to test our hypotheses using a structured online questionnaire. For the purpose of this survey, key respondents were defined as academics (professors, project managers or associate researchers) who were

among the key people driving the third mission in their institutions. Specifically, we contacted the individual responsible for their institution's successful application to EXIST-Potentiale conceptual and/or final phases (GFMEAE 2020), a recent federal government scheme aimed at progressing German HEIs' third mission. The two-phased application process unfolded in 2019 and required HEIs to strategically conceptualise (concept phase) and pilot (final phase) third-mission-related initiatives that successful applicants were to implement in the final phase. This scheme had three modules: (1) Potentiale Heben ('Increase Potential') targeted small- and medium-sized institutions that needed to further develop their third mission initiatives; (2) Regional Vernetzen ('Connect Regionally') targeted HEIs that aimed to further develop their regional entrepreneurial ecosystem; (3) and International Überzeugen ('Promote Internationally') focused on entrepreneurial universities that aimed to further internationalise their third mission.

The above context provided us with an up-to-date, qualified mailing list of key respondents who recently managed a large, institutional and strategic third mission planning process. The procedure allowed us to approach a diverse group of HEIs rather than focus on institutions already recognised as entrepreneurial universities (see appendix). This unique research setting was especially relevant to our study, as we aim to explain third mission advancements in HEIs, regardless of their current developmental stages.

In total, 201 distinct institutions were approved in the first conceptual phase and/or in the final phase of EXIST-Potentiale. From those, we contacted 194 HEIs, excluding seven medical schools / university hospitals. First, we conducted a pilot study at our own HEIs to pre-test the questionnaire. We implemented small changes regarding instructions and clarifications of the constructs. In April 2020, we electronically collected the data by sending all 194 respondents personalised invitations and up to two reminder e-mails to complete the online form. We

obtained a 23% valid response rate (45 individuals) after excluding 28 incomplete questionnaires – a response-rate considered adequate for organisational studies with key respondents (Baruch and Holtom 2008). A characterisation of the sample, including HEI profiles, is available in appendix.

4.3.2. Measures

This confirmatory study's measures for further developing a theory on the effect of DCs on HEIs' third mission was built on validated scales available in the literature. We adapted these to the context of HEIs based on the theoretical foundation available, and we operationalised all independent constructs into a 7-point Likert scale (1 = 'strongly disagree' to 7 = 'strongly agree'). The dependent construct Third Mission Advancement was operationalised via two distinct semantic 5-point Likert-scales as a procedural remedy to mitigate common method bias (Podsakoff et al. 2003). The questionnaire was organised per construct and in blocks, offering the constructs' descriptions to participants before the indicators they had to rate.

DCs: As reflective constructs in explorative models are allowed redundancy, 14 indicators were adapted from Wilden et al. (2013) and Kump et al. (2018) borrowing concepts from two qualitative study on HEIs' DCs (Leih and Teece 2016; Teece 2018). During the calculation of the measurement model, we excluded five indicators due to redundancy, below-threshold reliability and/or discriminant validity (Hair, Ringle and Sarstedt 2011). The nine remaining indicators loaded above 0.70 and are described in Table 4.1 ($\alpha = 0.912$).

Leadership: This construct was presented to the study's participants in the following manner: 'With the following items, we would like to assess how engaged your HEI's senior leaders are in third-mission-related initiatives and future planning. Please consider your HEI's president, vice-presidents and board(s) of governors as senior leadership (i.e., Senate; Hochschulräte).'

Drawing on validated scales measuring leadership (Ahire, Golhar and Waller 1996; Min and Mentzer 2004; Peng, Schroeder and Shah 2008; Oliveira and Roth 2012), we conceptualised 19 indicators, and following the same assessment procedure conducted for the DC measures, we excluded eight items. All remaining indicators (Table 4.1) loaded above 0.70 ($\alpha = 0.943$).

Agreement on Vision and Goals: The four applied indicators were borrowed from Min and Mentzer's (2004) validated scale. These were operationalised by adapting them to the context of this study (Table 4.1), and they were satisfactorily loaded above 0.70 ($\alpha = 0.847$).

Third Mission Strategic Advancement: Previous to exploring this construct, we presented participants with an explanation of the third mission concept: 'When answering this question and the remainder of the questionnaire, please take into consideration that higher education institutions' (HEIs) third mission refers to an additional function of HEIs in the context of knowledge societies. For the purposes of this study, it includes a wide range of initiatives that aim to positively impact the development of HEIs' regional ecosystems in economic, technological and societal terms.' The lack of a suitable validated scale to assess this construct led us to conceptualise two semantic scales. First, regardless of a HEI's stage of third mission development, we proposed a 5-point Likert scale. Our proposition discerned change strategy conceptualisation and implementation (Herrmann and Nadkarni 2014; Heyden et al. 2017) and was derived from a recent action framework proposed to make HEIs more entrepreneurial (Stolze 2020). The first indicator loaded at 0.901 and its five Likert points read: (1) 'My HEI has not yet started to develop nor implement third-mission-related initiatives'; (2) 'My HEI has started to develop third-mission-related initiatives but has not implemented them yet'; (3) 'My HEI started to implement third-mission-related initiatives'; (4) 'My HEI is currently consolidating third-mission-related initiatives'; and (5) 'My HEI has already institutionalised its third-mission-related initiatives.' The second indicator took into consideration the intensifying

competition in the higher education sector (Brankovic 2018; Klofsten et al. 2019) to asses competitive performance and borrowed from Mikalef and Pateli (2017). This indicator rated HEIs' third mission performance in comparison to other German HEIs as: (1) 'Insignificant'; (2) 'Below average'; (3) 'Average'; (4) 'Above average'; or (5) 'We are one of the leading HEIs in the country.' This indicator loaded at 0.931, and this novel construct conceptualisation proved to be a reliable proposition (α = 0809).

Common Method Bias Control: Self-report questionnaires are a well-known problem in organisational research, and the challenges they introduce need to be adequately addressed (Podsakoff and Organ 1986). Therefore, we employed the procedural remedy of having different response formats (Podsakoff et al. 2003). The dependent construct (Third Mission Advancement) was measured via two distinct semantic 5-point Likert scales, while the independent variables were measured with a standard 7-point agreement Likert scale. Moreover, we structured the questionnaire in blocks, one per construct, and provided adequate descriptions.

4.4. Results

4.4.1. Measurement model assessment

We employed the variance-based structure equation modelling technique partial least squares path modelling (PLS-SEM) to assess our measures and test our hypothesised model with support from the software SmartPLS3 (Ringle, Wende and Becker 2015). PLS-SEM is considered a robust yet flexible technique suitable in diverse situations (Hair, Ringle and Sarstedt 2011; Hair et al. 2012), and it is widely employed in management research and increasingly in higher education studies (Ghasemy et al. 2020). It is a particularly suitable technique in estimations of complex causal predictive models with more parameters than

observations or when observations are restricted by small populations, as it computes measurement and structural model relationships separately instead of simultaneously (Hair et al. 2019). Given that our sample was technically small but could not be reasonably extended because of the limited overall population of German HEIs, PLS-SEM was an appropriate approach. In order to provide concise and precise reporting, we followed state-of-the-art procedural guidelines offered by Hair et al. (2019) and Ghasemy et al. (2020).

First, we examined the indicators' factor loading. All indicators loaded above 0.70 (Table 1). A recent recommendation suggested a threshold of 0.708 for loadings – up from the widely applied 0.60 threshold – meaning the construct explained more than 50% of its indicator's variance (Hair et al. 2019). Only one indicator (DC_6) loaded slightly below this more conservative threshold at 0.703.

Next, we assessed the constructs' internal consistency reliability via three distinct methods recommended by Hair et al. (2019): (1) composite reliability, which provides the highest results, as items are weighted; (2) Cronbach's alpha, a more conservative unweighted measure; and (3) rho_A, an intermediate measure proposed as a more precise construct reliability measure (Dijkstra and Henseler 2015). All our constructs presented good reliability based on these measurements, since they were far above the satisfactory threshold of 0.70 (Table 4.1).

Next, we assessed convergent validity and discriminant validity. First, on the construct level, we checked for average variance extracted (AVE), which has a threshold of 0.50. All our constructs presented good convergent validity (Table 4.1). To verify discriminant validity, we checked the traditional Fornell-Larcker criterion (Table 4.2) and the novel Heterotrait-Monotrait ratio (Table 4.3); the latter is considered a reliable and more precise measurement

in PLS-SEM (Franke and Sarstedt 2019). All constructs were empirically distinct from each other, since their shared variance was lower than their AVE (Fornell and Larcker 1981), and all had heterotrait-monotrait ratios below the maximum of 0.85 (Henseler, Ringle and Sarstedt 2015; Franke and Sarstedt 2019). On the item level, we checked their factor loadings versus cross-loadings to assess discriminant validity (see appendix). All items loaded the highest on their respective constructs, confirming the indicators' discriminant validity.

Constructs	Factor Loading	t-value*
DCs (Cronbach's α = 0.912; rho_A = 0.925; CR = 0.927; AVE = 0.586)		
DC_1: 'At my HEI, members participate in activities in the regional ecosystem.'	0.731	6.229
DC_2: 'At my HEI, we systematically monitor developments in the higher education sector in Germany.'	0.831	8.616
DC_3: 'At my HEI, we systematically monitor developments in the higher education sector abroad.'	0.708	5.240
DC_4: 'My HEI benchmarks the third mission initiatives of other German HEIs.'	0.743	13.211
DC_5: 'My HEI monitors the performance information of third mission initiatives.'	0.816	18.401
DC_6: 'My HEI invests to develop projects that solves regional ecosystem stakeholders' problems.'	0.703	5.608
DC_7: 'My HEI adopts best practices for third mission initiatives.'	0.856	21.672
DC_8: 'At my HEI, we listen to the needs of regional ecosystem stakeholders and develop new projects accordingly.'	0.732	5.272
DC_9: 'At my HEI, we frequently change or adapt practices and processes based on feedback from internal and external stakeholders.'	0.755	6.169
Leadership (Cronbach's α = 0.943; rho_A = 0.944; CR = 0.951; AVE = 0.637)		
L_1: 'My HEI's senior leaders communicate and reinforce the institution's entrepreneurial values.'	0.790	7.531
L_2: 'My HEI's senior leaders provide personal leadership for third-mission-related projects.'	0.768	6.399

Constructs	Factor Loading	t-value*
L_3: 'My HEI's senior leaders create and communicate a vision focused on the third mission.'	0.808	9.209
L_4: 'My HEI's senior leaders are personally involved in improvement of third-mission-related activities.'	0.837	8.415
L_5: 'My HEI's senior leaders participate in the third-mission-related activities.'	0.818	11.334
L_6: 'My HEI's senior leaders consider the improvement of third-mission-related activities a way to strategically advance the HEI.'	0.753	10.243
L_7: 'My HEI's senior leaders view the third mission as being as important as the teaching and research missions.'	0.807	12.910
L_8: 'My HEI's senior leaders allocate adequate resources to efforts related to the third mission.'	0.790	17.329
L_9: 'My HEI's senior leaders repeatedly tell professors and staff that its advancement depends in it adapting to regional ecosystem stakeholder demands.'	0.791	11.463
L_10: 'My HEI's senior leaders repeatedly tell professors and staff that building, maintaining and enhancing relationships with regional ecosystem stakeholders is critical to its advancement.'	0.793	12.104
L_11: 'My HEI's senior leaders repeatedly tell professors and staff that collaborating and co-creating with regional ecosystem stakeholders is critical to its advancement.'	0.821	15.176
Vision and Goals (Cronbach's α = 0.847; rho_A = 0.854; CR = 0.898; AVE = 0.688)		
VG_1: 'My HEI has common goals related to the third mission.'	0.844	15.207
VG_2: 'My HEI is actively involved in standardising third-mission-related practices and operations.'	0.779	8.451
VG_3: 'My HEI clearly cooperatively defines third-mission-related roles and responsibilities with internal stakeholders.'	0.909	34.763
VG_4: 'At my HEI, we all know which members are responsible for which third mission activities.'	0.778	6.679
Third Mission Advancement (Cronbach's α = 0.809; rho_A = 0.827; CR = 0.912; AVE = 0.839)		

Constructs	Factor Loading	t-value*
TMA_1: Description that best fits the HEI's third mission development status: (1) 'My HEI has not yet started to develop or implement third-mission-related initiatives'; (2) 'My HEI has started to develop third-mission-related initiatives but has not implemented them yet'; (3) 'My HEI started to implement third-mission-related initiatives'; (4) 'My HEI is currently consolidating third-mission-related initiatives'; (5) 'My HEI has already institutionalised its third-mission-related initiatives.'	0.901	24.232
TMA_2: HEI third-mission performance in comparison to other German HEIs is: (1) 'Insignificant'; (2) 'Below average'; (3) 'Average'; (4) 'Above average'; (5) 'We are one of the leading HEIs in the country.'	0.931	33.651

*Significance level: 0.05

Table 4.1: Constructs' Validity and Reliability and Indicators' Factor Loading and Significance

	Third Mission Advancement	DCs	Leadership	Vision and Goals
Third Mission Advancement	0.916			
DCs	0.559	0.766		
Leadership	0.653	0.679	0.798	
Vision and Goals	0.669	0.735	0.662	0.829

Table 4.2: Constructs' Fornell-Larcker Criteria

	Third Mission Advancement	DCs	Leadership	Vision and Goals
Third Mission Advancement				
DCs	0.617			
Leadership	0.733	0.704		
Vision and Goals	0.808	0.790	0.729	

Table 4.3: Constructs Heterotrait-Monotrait Ratios

Last, we examined collinearity to assure it did not result in biased regression results (Hair et al. 2019), a check recommended in PLS-SEM studies (Kock 2015). The accepted threshold for this check is a variance inflation factor of 3.3. However, as PLS-SEM algorithms effectively

reduce model-wide collinearity, a higher threshold (5 or even 10) may also be acceptable (Kock and Lynn 2012). Our model's constructs did not present collinearity issues (Table 4.4).

	Third Mission Advancement	DCs	Leadership	Vision and Goals
Third Mission Advancement				
DCs	2.540		1.000	1.855
Leadership	2.078			1.855
Vision and Goals	2.440			

Table 4.4: Constructs Collinearity Statistics (Variance Inflation Factor)

4.4.2. Structural model assessment

Before assessing our structural model, we produced a direct model without mediation (Figure 4.2) to first establish a benchmark for comparing results in order to complement our assessment of how DCs affect third mission advancement. The direct model proved to be valid, though it demonstrated lower explanatory power in comparison to our mediated model (Figure 4.3), as its R^2 was 0.343 vs. 526. Nevertheless, it offered a very similar out-of-sample prediction power (Q^2predict = 0.293 vs. 295 in Figures 4.2 and 4.3).

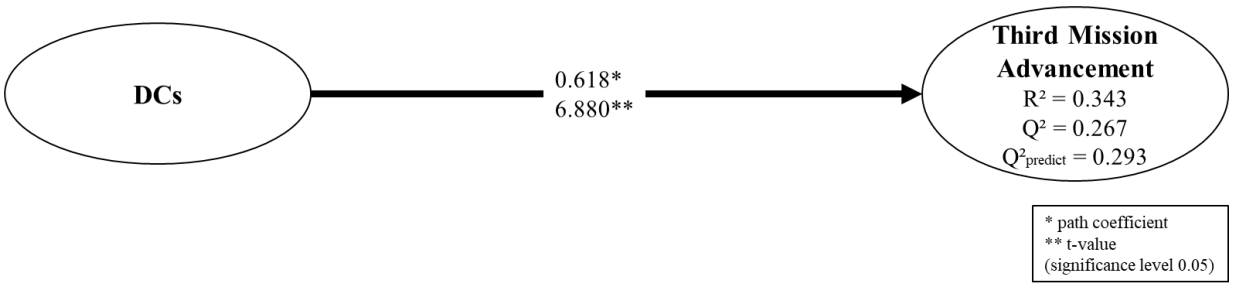

Figure 4.2: Direct Model without Mediation

In order to assess our proposed structural model (Figure 4.3), we first verified the coefficient of determination (R^2), which expresses association level but not causation (Shmueli 2010), thus measuring the model's explanatory power. According to methodological guidelines (Hair,

Ringle and Sarstedt 2011), our proposed model presented moderate explanatory power with R^2 of 0.461 (Leadership), 0.526 (Third Mission Advancement) and 0.590 (Vision and Goals).

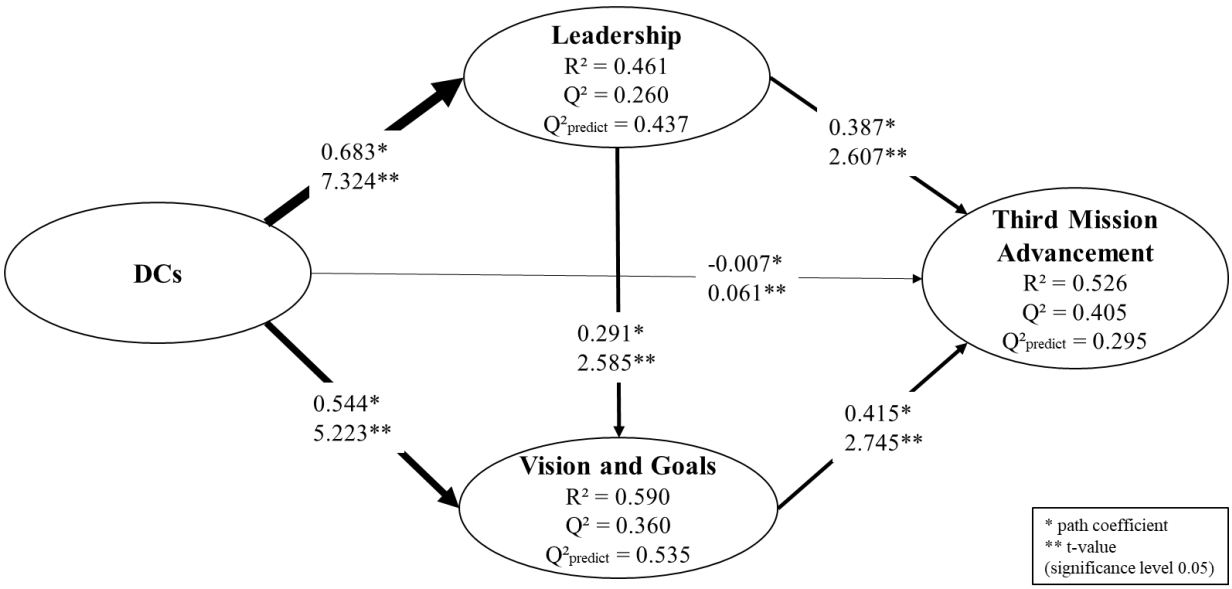

Figure 4.3: Proposed Model with Mediation

Next, we employed a blindfolding procedure to calculate the Q^2 value, which combines in-sample explanatory power with out-of-sample prediction elements. Even though researchers routinely use this metric to assess a model's predictive accuracy, recent methodological guidelines argued that it is imprecise because it is not an out-of-sample-only measurement (Shmueli et al. 2019). Therefore, in addition to reporting the Q^2 value (Figure 4.3), we calculated a recently developed prediction power measurement, namely PLS Predict (Q^2predict). With recommended setting (10 subsets; 10 repetitions), we observed (see Appendix) that all indicators used to measure Third Mission Advancement and Vision and Goals presented via PLS were lower than what was obtained via a linear regression model, which is considered a 'naïve' benchmark (Shmueli et al. 2019, 2326). Therefore, the model had a high predictive power for these constructs. A medium predictive power was observed for leadership, as one of its indicators (L_11) had a slightly lower root mean square error caused by linear regression (Hair et al. 2019; Shmueli et al. 2019).

After confirming the explanation and prediction powers of our structural model, we assessed its paths significance by calculating their coefficients and t-values (Figure 4.3). We ran the recommended two-tailed complete bootstrapping with 5,000 subsamples at a significance level of 0.05 using the bias-corrected and accelerated bootstrap confidence interval method. This was the preferred procedure because confidence intervals could be adjusted for data 'skewness' (Hair et al. 2019, 6).

The size of path coefficients were aligned with the observed effect size (f^2), making the reporting of the latter redundant (Hair et al. 2019). Based on the resulting t-values, all but one path (from DCs directly to third mission advancement) were relevant, with arrows' widths illustrating their relative relevance (Figure 4.3). Moreover, to assess the mediating effect of Leadership and Vision and Goals, we checked for the specific indirect effect of DCs on Third Mission Advancement (Nitzl, Roldan and Cepeda 2016). The results showed that the mediated paths were relevant (Table 4.5).

	Original Sample	Sample Mean	STDE	T-Value	P-Value
DCs -> Leadership -> Third Mission Advancement	0.257	0.261	0.112	2.293	0.022
DCs -> Vision and Goals -> Third Mission Advancement	0.226	0.224	0.098	2.302	0.021
DCs -> Leadership -> Vision and Goals	0.205	0.202	0.091	2.252	0.024

Table 4.5: Path-Specific Indirect Effects

When compared to the results of the direct model (Figure 4.2), the assessment of the mediated structural model confirmed that both theorised routes are valid and offer superior explanations to the relationship between DCs and third mission strategic advancement. Specifically, HEIs' DCs are indeed positively associated with the leadership of its governing

body (H1) and with agreement on vision and goals (H4), while the leadership provided by an HEI's governing body is positively associated with organisational agreement on vision and goals (H3). Additionally, leadership provided by an HEI's governing body and agreement on vision and goals are positively associated with an HEI's third mission advancement (H2 and H5, respectively).

4.5. Discussion

In this study, we examined how DCs facilitate third mission advancements in HEIs and assessed to what extent leadership and agreement on vision and goals provide effective routes that enable DCs to assist third mission advancements. We tested our hypotheses through a PLS-SEM analysis, as this method is particularly useful in predicting and identifying an outcome's drivers (Hair, Ringle and Sarstedt 2011; Hair et al. 2019). We surveyed key respondents from 45 German HEIs in different stages of pursuing entrepreneurial pathways. This was a key setting, as prior empirical research generally analysed successful cases retrospectively, potentially leading to biases and contextual findings (Battilana, Leca and Boxenbaum 2009).

We measured third mission advancement based on the perceived development stage and national competitive performance. Our results confirm that DCs play in important role in facilitating such advancements in HEIs. Specifically, German HEIs' ability to sense opportunities by benchmarking other German HEIs and monitoring their third mission initiatives are key capabilities. Sensing by benchmarking leads HEIs to adopt best practices in order to transform themselves into more entrepreneurial institutions. This strategy might be the result of a relatively late start to introducing third mission initiatives. However, there are dramatic limitations to emulation strategies due to differences in environmental context,

resources and internal capabilities (Etzkowitz and Zhou 2008; Philpott et al. 2011; Stensaker and Benner 2013).

Teece (2018, p.1) argued that HEIs require 'institutional introspection, cultural change and the development of effective processes for diagnosing problems and reaching decisions. Strong dynamic capabilities can help a university confront the uncertainty surrounding new technologies and prioritize resource allocation to favour the future.' Our empirical analysis confirm his essay's argumentation and builds on it by demonstrating the mediating role of leadership and agreement on vision and goals.

We also found that third-mission-related roles and responsibilities must be defined cooperatively among internal stakeholders in order to achieve an agreement on goals and develop a vision. For this to succeed, HEIs' presidents and governing bodies must provide the necessary leadership by allocating adequate resources to efforts related to the third mission and telling professors and staff that they should build, maintain and enhance relationships with regional ecosystem stakeholders, as collaborating and co-creating with them is critical to HEIs' advancement. In this sense, leaders must take into account 'entrepreneurial ecosystem stakeholders' preoccupations and interests' regarding HEIs' future roles and produce normative scenarios driven by internationalisation, digital transformation, collaborative networks and co-creation processes (Stolze and Sailer, 2020).

Nevertheless, our findings indicate that a prerequisite for this strategic change process is that HEI leaders consider the third mission as being as important as the teaching and research missions. Middlehurst (2013, p. 276) questioned if HEIs' leaders are 'fit for the future', as institutional governance 'is messy and contested territory where the boundaries between levels are blurred and where power and authority between different actors in the system are

in flux.' Thus, there should be a policy call for HEI leaders' professional development to provide them with the necessary business skills and relationship management competences (Tran and Nghia 2020).

In light of this study's results and discussion, its contributions are threefold. First, it further explains the relationship between DCs and HEIs' third mission. It empirically confirms the relevance of DCs in advancing HEIs' third mission by demonstrating that they are in fact influenced by the mediating role of leadership and agreement on vision and goals. Its second contribution is the identification and confirmation of two mechanisms through which DCs can be employed to enhance and predict third mission advancement. These two contributions were achieved following state-of-the-art application and reporting recommendations for PLS-SEM studies (Hair et al. 2019; Ghasemy et al. 2020), offering novice scholars a didactic example of the method's use in higher education studies. Finally, our discussion offers managerial insights into how HEI decision-makers advance their institutions' third mission, as it further elaborates and exploits the critical role of governance as a key entrepreneurial pathway.

Some limitations of this study open interesting avenues for future research. First, our sample concentrates on German HEIs and hence includes the contextual singularities of that country's higher education system. Even though our sample included institutions of different sizes and profiles (see appendix) and from 11 (out of 16) federal states, contextual bias cannot be ruled out. Therefore, our results may not be transferable to other contexts, and thus, we call for replication studies to test the developed research model in other countries, as there is significant potential for publishing replication studies (Block and Kuckertz, 2018) as it enables for instance cross-country comparisons. Furthermore, our self-report measures might have been influenced by social desirability bias, and future studies might therefore opt to combine these with secondary data sources on key performance indicators associated with HEIs' third

mission. In this sense, the open publication of survey data is great relevance (Arz and Kuckertz, 2019). Specifically, studies with larger samples might apply such indicators as moderators to produce novel insights that improve our understanding of the phenomenon and raise new implications that support HEIs' strategy and management practices.

4.6. Conclusion

This study's findings illustrate the central role of HEI leaders in the process of producing and leveraging DCs for envisioning and advancing their institutions' third mission. It might also pave the way for a more open discussion on the policy and institutional levels about the necessary governance structures, management practices and entrepreneurial mindsets required to lead HEIs into the 21st century.

5. Discussion and Conclusion

This dissertation comprises three studies that shed light on strategic advancements for the development of HEIs' third mission. Combined, they contribute to answer the overarching research question of how can HEIs become more entrepreneurial and strategically advance their third mission.

In this final chapter, a summary of the results and contributions of each study leads to the proposal of a conceptual framework for third mission advancement at HEIs and a succinct explanation of this dissertation's contributions to theory and practice. Finally, promising research avenues are presented to deepen the understanding of HEIs' strategic advancements towards institutionalising the third mission, leading to the conclusion of this dissertation.

5.1. Summary of Results and Contributions

According to Audretsch (2014, p. 320), 'perhaps it is the ability of the university to both adhere to its traditional strengths as well as adapt to the needs and concerns of society that has made it one of the most resilient institutions in society'. Nevertheless, to live up to future expectations, HEIs' leaders need to make strategic choices that enable the exploration of innovative ways to produce human, knowledge, and entrepreneurial capital concomitantly and efficiently.

Making the right strategic choices by paving entrepreneurial pathways that lead to advancing HEIs' third mission is a complex and multi-faceted topic. To answer the overarching question proposed for this study–how can HEIs become more entrepreneurial and strategically advance their third mission–three separate studies were conducted, employing different research methods and contexts. First, chapter two presented a systematic literature review containing an overview of the topic's state of current research. It presented a synthesis of transformation

cases, proposing three core entrepreneurial pathway propositions, steered through an iterative action-framework. Next, chapter three brought a foresight perspective to the current discussion by addressing the expectations of entrepreneurial ecosystem's stakeholders towards entrepreneurial HEIs in the long term. Finally, chapter 4 identified two mechanisms through which dynamic capabilities may translate into third mission strategic advancement, namely leadership and agreement on vision and goals.

Study 1 confirmed through the synthesis of 36 cases published in peer-reviewed journals that the transition of HEIs towards an entrepreneurial mode is 'endless' and based on 'nonlinear innovation models', as conceptualised by Etzkowitz and Leydesdorff (2000). Its key contribution refers to the identification of three core entrepreneurial pathways, namely education, ecosystem, and governance. The need to identify core pathways that might apply to different institutional contexts was one of the key research avenues suggested by leading scholars researching the phenomenon of entrepreneurialism in HEIs (Klofsten *et al.*, 2019). Furthermore, the first study contributes to practice by providing HEI leaders an action-framework that may serve as a strategic management tool. It explains the meta-level innovation process that enables organisational change by its mediation role between 'transformation capability' and 'organisational change' in HEIs (Zhang, Wang and O'Kane, 2019). The action-framework demonstrates how the transformation process of HEIs' is composed of a series of pilot experiments following an iterative, non-linear path, constantly influenced by exogenous and endogenous forces. This is a novel proposition which extends the initial conceptualisation of Etzkowitz and Leydesdorff (2000) by combining their triple-helix model with the need to develop dynamic capabilities (Siegel and Leih, 2018; Teece, 2018).

It is important to recall that in meta-ethnography synthesised interpretations are 'metaphors' or 'characterizations of the juxtaposition of the author's perspective with the perspectives of those studied' (Thorne et al., 2004, p.1347). In this sense, this meta-ethnographic study might not fulfill all of the requirements for an audit trail, since the empirical evidence reviewed, which is based on the analysis of case-studies, is combined with the author's own expert practitioner insights (France et al., 2014). However, to mitigate these limitations, up-to-date guidelines for methodological rigor and for reporting were followed to improve confidence in the outcomes (Doyle, 2003; Lewin et al., 2018; Noyes et al., 2018; France et al., 2019).

Study 2 contributed to theory and to answering the overarching question of this dissertation, by adding a foresight perspective to the discussion. It confirmed and exemplified the critical role of history in scenario thinking development (Bradfield, Derbyshire and Wright, 2016), as it produced normative explorative scenarios grounded on present trends (Ducot and Lubben, 1980). The five proposed scenarios in this study–transdisciplinary, blended, adaptive learning, ecosystem, and worldwide – are not mutually exclusive and do not represent the broad spectrum of possible scenarios that HEIs might face in the future. These, nevertheless, provided valuable and novel insights and foresights to inform HEI leaders about the process of establishing a new vision developing entrepreneurial pathways, thus also contributing to practice.

The expert informants consulted to assess the scenario propositions believe that a combination of all five scenarios is plausible, and might even occur in the short to medium term, rather than the long-term aim of this foresight study. This fact adds a sense of urgency for HEIs to proactively manage this endless transition toward entrepreneurialism (Etzkowitz and Leydesdorff, 2000), acknowledging the influence of exogenous and endogenous forces to 'ignite, sensitize, consolidate and institutionalize' an entrepreneurial culture, following a non-

linear iterative process to transform themselves (Stolze, 2020). Furthermore, it is important to highlight that this study was conducted just before the pandemic outbreak of 2020. The impact the pandemic caused on HEIs, which had to accelerate the implementation of online resources for teaching, research and transfer, is yet to be studied in-depth. Nevertheless, it is fair to assume that the blended scenario proposition has increased in relevance due this exogenous unexpected force.

Study 3 confirmed the relevance of adding a foresight perspective to this discussion, as agreement on vision and goals is a mechanism that together with leadership, enables dynamic capabilities (DCs) to be translated into third mission advancements. Teece (2018, p.1) argued that strong dynamic capabilities assist HEIs confronting uncertainties to allocate resources that favour the future. Study 3 confirms and extends this theory by demonstrating the mediating role of leadership and agreement on vision and goals.

Hence, study 3 contributes to the theory on HEI's entrepreneurial pathways by explaining the relationship between DCs and HEIs' third mission. It also empirically confirmed the relevance of DCs in advancing HEIs' third mission and extended current theory by demonstrating the mediating role of leadership and agreement on vision and goals. In this sense, it offers managerial insights into how HEIs' decision-makers might advance their institutions' third mission and exploit the critical role of governance as a core entrepreneurial pathway, as identified in the first study.

Moreover, the study answered a recent call for more PLS-SEM studies in higher education research (Ghasemy et al., 2020) to improve methodological rigor. By following state-of-the-art application and reporting recommendations for PLS-SEM studies (Hair et al. 2019; Ghasemy et al. 2020), study 3 serves as a didactic example for novice scholars in the field.

Combined, the contributions of the three studies lead to the proposition of a model that empirically explains the underlying process for HEIs' to advance their third mission through entrepreneurial pathways (Figure 5.1).

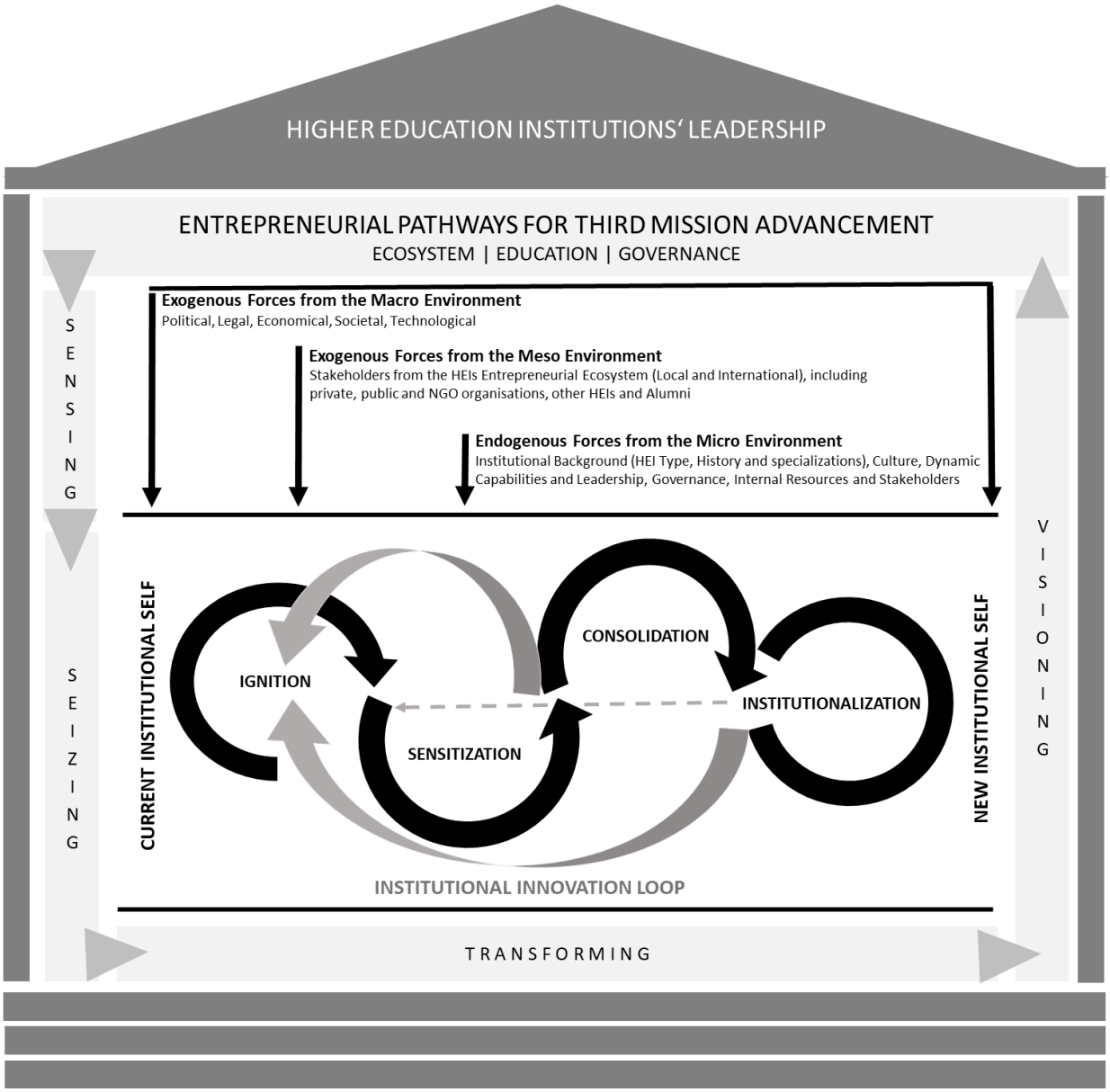

Figure 5.1: HEIs' third mission advancement model

An entrepreneurial HEI possesses a leadership team (boards, president and vice-presidents) that makes the strategic choices necessary to advance their third mission. However, in other contexts, boards are seen as contributing to organisational inertia in public enterprises and might actually become a barrier for entrepreneurialism (Tremml, 2020). The same applies to HEIs with regard to third mission advancement, as leadership offered by such boards is a mediating mechanism that translates dynamic capabilities into third mission advancement.

Even though practitioners and academic literature have emphasised the iterative non-linear characteristic of the entrepreneurial process through concepts such as effectuation (Sarasvathy, 2001) and lean startup (Ries, 2011), opportunity recognition and exploitation remain valid and proved concepts to explain the entrepreneurial process (Kuckertz *et al.*, 2017). In this sense, dynamic capabilities that enable the sensing and seizing of opportunities are required to generate the transformation necessary for HEIs to become more entrepreneurial. The exogenous and endogenous forces constantly influencing HEIs must be timely acknowledged to enable the seizing of opportunities, by igniting pilot projects that lead to the further development, consolidation, and institutionalisation of embracing an entrepreneurial culture.

Furthermore, the processes of recognising and exploiting opportunities must be accompanied by the envisioning of the desired new institutional self. Hence, foresight is a fundamental element in the transformation process for HEIs to become more entrepreneurial. A key aspect of envisioning future entrepreneurial pathways that advance the third mission of HEIs is the fact that such processes should be inclusive, for instance, through co-creation with internal and external stakeholders.

There are three core entrepreneurial pathways related to either governance, ecosystem or education initiatives. As entrepreneurship education is already established in higher education (Kuckertz, 2013), it is now necessary that the third mission of universities as a whole is institutionalised as a key pillar of higher education in the twenty-first century. For that, it must be acknowledged that entrepreneurial transformations require changes in HEIs' governance structures and on their roles within its ecosystem. For instance, in Germany (context of study 3), studies have shown that sensitising society through media is not enough to create a failure-friendly culture. Entrepreneurship education that acknowledges the regional differences is needed (Kuckertz, Berger and Prochotta, 2020). This regional differentiation is also necessary due to the differences in regional entrepreneurial ecosystems across Germany. In some areas, such as Stuttgart, universities do not dominate the local entrepreneurial ecosystem and networking is not optimal (Kuckertz, 2017).

Hence, to become more entrepreneurial and advance their third mission, HEIs must envision their future selves while sensing and seizing opportunities that produce transformation in all three core entrepreneurial pathways: education, governance, and ecosystem. To produce such a transformation, HEIs must acknowledge the exogenous and endogenous forces constantly influencing them in a timely manner to galvanise experiments that lead to the sensitisation, consolidation, and institutionalisation of these initiatives. Together, these shall enable the emergence of a more entrepreneurial new institutional self.

5.2. Directions for Future Research

The starting point of this dissertation was the identification of HEIs' entrepreneurial pathways as one of five key research agenda topics within the framework of entrepreneurial universities (Klofsten *et al.*, 2019). The research gaps in the understanding of entrepreneurial pathways

motivated this dissertation's overarching question of how can HEIs become more entrepreneurial and strategically advance their third mission.

The contributions made by this dissertation, summarized on chapter 5.1, observing the limitations of the three studies, open new research avenues for future studies. Beyond the specific research agendas already proposed by the three studies (chapters 2, 3 and 4), directions for future research also emerge from the dissertation in total. Three avenues for future research encompass this agenda: towards HEIs entrepreneurial leadership research, towards HEIs foresight research, and towards longitudinal research of HEIs entrepreneurial pathways.

Towards HEIs entrepreneurial leadership research

Governance is a core entrepreneurial pathway identified in Study 1, while leadership is a key mechanism to translate dynamic capabilities into third mission strategic advancements, as per study 3. Nevertheless, scholars have questioned if HEIs' leaders are ready for future challenges, as institutional governance 'is messy and contested territory where the boundaries between levels are blurred' (Middlehurst 2013, p. 276). In this sense, the influence of different leadership styles in HEIs and specifically entrepreneurial leadership remains an underexplored topic at the intersection of HEIs governance and third mission research. Moreover, there is an underexplored research opportunity related to the application of action-research and interventionist approaches that enable scholars to understand the pre-requisites, drivers, and outcomes of academics' transition to leadership roles inside their institutions.

Towards HEIs foresight research

Foresight research has increased in relevance within the management field; however, its application in higher education studies is still incipient. Studies two and three demonstrate the relavance of foresight and visioning for HEIs on the strategic advancement of their third-mission. These studies demonstrated that third-mission-related roles and responsibilities must be defined cooperatively among internal stakeholders to achieve agreement on goals and develop a vision. Furthermore, visioning exercises benefits from relationships with regional ecosystem stakeholders, as collaborating and co-creating a third mission vision with them is critical to HEIs' advancement towards entrepreneurialism.

Therefore, there is an underexplored opportunity for the development of foresight and visioning studies in higher education. In the context of strategic advancing HEIs' third mission, the role of vision and the establishment of entrepreneurial vision remains an underexplored topic in the higher education context.

Towards longitudinal research of HEIs' entrepreneurial pathways

This dissertation has emphasised throughout its three studies that the entrepreneurial university model and the strategic advancement of HEIs' third mission has occurred under the influence of epitomes, such as the Massaschussetts Institutite of Technology and Stanford Univerty, and through the dissemination of success cases in academic and practice-oriented literature. Nevertheless, there are dramatic limitations to emulation strategies due to differences in environmental context, resources, and international capabilities (Etzkowitz and Zhou 2008; Philpott et al. 2011; Stensaker and Benner 2013).

Therefore, as an increasing number of HEIs adopt different entrepreneurial pathways, the need to understand this novel research topic grows. HEI leaders strategic choices that enable

the development of a third mission is a recent phenomenon and overall is an underexplored research avenue. In this sense, additional longitudinal studies that enable the understanding of contextual singularities in different national higher education systems are necessary. Furthermore, longitudinal studies might demonstrate the implications of HEIs' change management process, testing the desirability, feasibility, viability, and sustainability of different third mission implementation strategies.

5.3. Conclusion

In conclusion, this dissertation sheds light on the development and envisioning of entrepreneurial pathways that enable HEIs to advance their third mission. By identifying three core entrepreneurial pathways, proposing an action-framework and envisioning five future scenarios, it explains the underlying transformation process and provides insights for strategic visioning. At the same time, by identifying mechanisms through which dynamic capabilities translate into third mission advancement, it augments the understanding of the transformation process by highlighting the relevance of governance as a core entrepreneurial pathway. Combined, these outcomes lead to the proposal of a model to explain the entrepreneurial pathways necessary to advance HEIs' third mission.

Hence, this dissertation offers the first steps towards scholars' understanding of HEIs entrepreneurial pathways by adequately answering how HEIs can become more entrepreneurial and strategically advance their third mission. This study thus contributes to the existing academic literature by improving the research on entrepreneurial pathways for HEIs, and by providing HEIs leaders and policymakers with insights and foresights for advancing HEIs' third mission and collectively developing more entrepreneurial higher education systems.

Appendix

STUDY 3 | SAMPLE PROFILE (n = 45)		%
Institution Type	Research University	17,8%
	Technical University	11,1%
	(Technical) University of Applied Sciences	64,4%
	College of Arts/Music	2,2%
	Other	4,4%
Institution Holder	Public	95,6%
	Private	4,4%
Location (Federal State in Germany)	Baden-Württemberg	26,7%
	Bavaria	22,2%
	North Rhine-Westphalia	11,1%
	Saxony	8,8%
	Hessen	6,7%
	Lower Saxony	6,7%
	Brandenburg	4,4%
	Rhineland-Palatinate	4,4%
	Saxony-Anhalt	4,4%
	Schleswig-Holstein	2,2%
	Hamburg	2,2%
Institution Size **(based on number of enrolled students)**	Less than 5.000	33,3%
	5.000 – 9.999	31,1%
	10.000 – 14.999	13,3%
	15.000 – 19.999	13,3%
	20.000 – 39.999	6,7%
	40.000 or more	4,4%
The HEI possess a/an…	Institute or Department for Entrepreneurship	28,8%
	Entrepreneurship Center	73,3%

STUDY 3 | SAMPLE PROFILE (n = 45)		%
	Office for Technology Transfer and/or Industry Relations	75,6%
	Vice-president for Entrepreneurship, Business, Industry Relations or Third-Mission	53,3%
	Office for HEIs Strategic Advancement (*Hochschulentwicklung*) or equivalent	35,6%
	Startup Acceleration Program	22,2%
	Startup Incubation Program	48,9%
	Maker Space	40,0%
	Living Lab	20,0%
	Competition/Award for Startup/Business Ideas	37,8%
	Seed or Venture Capital (fund, program)	6,7%
	Alumni Association	57,8%
Number of Entrepreneurship/Innovation Professors	Zero	13,3%
	Only one	15,5%
	2 - 5	51,1%
	6 - 9	8,8%
	10 or more	4,4%
	No Answer	6,7%
Approximated number of students trained in Entrepreneurship per Semester	Less than 100	15,6%
	100 - 499	35,6%
	500 – 999	13,3%
	1000 – 1999	2,2%
	2000 or more	4,4%
	No Answer	28,9%
Approximated total number of startups already graduated from incubation program (spin-offs)	Zero	8,9%
	1-9	28,9%
	10– 49	40,0%

STUDY 3 | SAMPLE PROFILE (n = 45)		%
	50 – 99	6,7%
	100 or more	8,9%
	No Answer	26,7%
Approximated number of active partners from the regional ecosystem (third-mission activities)	Less than 10	13,3%
	10-49	31,1%
	50-99	26,7%
	100 or more	8,9%
	No Answer	20,0%

STUDY 3 | Discriminant Validity: Indicators loading and cross-loading

	3rdMission Advancement	Dynamic Capabilities	Leadership	Vision & Goals
TM1_1	0.901	0.486	0.503	0.592
TMA_2	0.931	0.535	0.680	0.631
L_1	0.513	0.519	0.790	0.468
L_2	0.425	0.489	0.768	0.471
L_3	0.452	0.426	0.808	0.501
L_4	0.514	0.557	0.837	0.507
L_5	0.590	0.619	0.818	0.609
L_6	0.586	0.536	0.753	0.610
L_7	0.495	0.506	0.807	0.505
L_8	0.541	0.594	0.790	0.551
L_9	0.542	0.589	0.791	0.494
L_10	0.507	0.524	0.793	0.514
L_11	0.526	0.559	0.821	0.546
DC_1	0.489	0.731	0.601	0.572
DC_2	0.451	0.831	0.589	0.554
DC_3	0.354	0.708	0.307	0.317
DC_4	0.585	0.743	0.512	0.550
DC_5	0.615	0.816	0.572	0.682
DC_6	0.224	0.703	0.379	0.405
DC_7	0.446	0.856	0.629	0.759
DC_8	0.202	0.732	0.503	0.480
DC_9	0.305	0.755	0.448	0.567
VG_1	0.637	0.561	0.582	0.844
VG_2	0.564	0.384	0.431	0.779
VG_3	0.512	0.693	0.587	0.909
VG_4	0.508	0.754	0.574	0.778

STUDY 3 | Discriminant Validity: Indicators loading and cross-loading

	3rdMission Advancement	Dynamic Capabilities	Leadership	Vision & Goals

STUDY 3 | Structure Model Predictive Power

	RMSE (PLS Analysis)	RMSE (Linear Regression)
TM1_1	1.040	1.221
TMA_2	0.845	0.903
L_1	1.388	1.476
L_2	1.352	1.531
L_3	1.405	1.644
L_4	1.273	1.522
L_5	1.403	1.635
L_6	1.107	1.302
L_7	1.365	1.552
L_8	1.102	1.327
L_9	1.501	1.785
L_10	1.273	1.497
L_11	1.432	1.416
VG_1	1.269	1.398
VG_2	1.479	1.554
VG_3	1.227	1.291
VG_4	1.180	1.351

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