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Bridging Academia and Enterprise: A Framework for Collaborative Success

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Abstract

University-enterprise collaboration (UEC) is an essential aspect of research and innovation involving cooperation between universities and industry or other organizations. UEC can lead to economic growth, job creation, and enhanced research outcomes. However, the complexity and diversity of UECs present challenges in developing a practical framework that can guide the development and implementation of such collaborations. The aim of this paper is to develop a UEC framework from the key concepts identified in the literature, which can be adapted to various disciplines/contexts. This research paper is part of an ERASMUS+ project, which aims to strengthen enterprise collaboration for resilient communities in Asia (SECRA). The current paper presents the findings of thematic analysis of existing UEC literature and the resultant conceptual framework. Thematic analysis of eligible literature ($N = 84$) unveiled four themes and thirty-two sub-themes important to UEC. The proposed UEC framework highlights the importance of several structural, cultural, relational, and material themes and their underpinning concepts for developing successful UECs. The findings can inform future research on UECs, guide UEC practice, and provide the foundations for developing successful UECs. However, further research is needed to test the feasibility and validity of the framework in real-world UEC collaborations and to explore the interactions between different themes, sub-themes, and underlying concepts.

Keywords University enterprise collaboration · University Industry partnership · Open innovation · Framework · Success · Barriers

Extended author information available on the last page of the article

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Introduction

University enterprise collaboration (UEC) can take many forms, including co-research, knowledge transfer, student internships and exchanges (Liyanage et al., 2018). UECs yield benefits to both university and enterprise stakeholders. Universities can provide enterprises with access to academic expertise (Liang et al., 2012) and possess research capabilities that enterprises can leverage to gain a competitive advantage in developing innovative solutions (Abdulai et al., 2020; Fischer et al., 2021; Li & Zhu, 2021; Li et al., 2022; Thomas & Paul, 2019). Academics have not only in-depth expertise in their field but also rigorous and analytical approaches to problem-solving and are free of commercial interests. As such, universities can offer enterprises objective and well-informed expertise and enable enterprises to develop innovative solutions (Kobayashi et al., 2017; Ma et al., 2022; Mdleleni, 2022; Mougin et al., 2021; Utami et al., 2018; Wiek et al., 2011). In addition, universities generate highly skilled graduates, which helps to diversify workforces (Kraft et al., 2019; Page et al., 2019) and provide a cost-effective solution to staffing needs (Galloway et al., 2014; P. Maertz Jr et al., 2014; Urquía-Grande & Perez Estebanez, 2020).

Access to enterprises allows universities to build strong connections and expose students and researchers to real-world practices and challenges (Ankrah & Al-Tabbaa, 2015; Dos Santos & Benneworth, 2019; Matthews et al., 2021; Miller et al., 2014; Universities Australia, 2019). In turn, this allows universities to acquire funding for research and development projects to enhance research capabilities and the production of high-quality academic outputs (Awasthy et al., 2020). Enterprises can also provide university students with opportunities to enhance their skills for their future careers and also provide career opportunities for graduates (Adamczyk et al., 2022; Castelló et al., 2023; Dos Santos & Benneworth, 2019; Kang & Girouard, 2022; Matthews et al., 2021; Universities Australia, 2019). In turn, this can benefit universities indirectly via increased graduate employability and the potential for specialised, hands-on placement opportunities for prospective students (Adeosun et al., 2022; Avvisati et al., 2013). On the other hand, UECs allow enterprises to leverage academic research and knowledge to gain a competitive edge in addressing complex challenges (Huang & Chen, 2017). As such, UECs are critical in driving innovation, fostering economic growth and providing students with valuable experiences and opportunities (Avvisati et al., 2013; Chow et al., 2020). UECs allow universities and enterprises to leverage each other's expertise and capabilities to achieve shared goals and reciprocal outcomes (Noble et al., 2017; Osorno-Hinojosa et al., 2022; Polese et al., 2021).

Although several attempts have been made to develop UEC frameworks, existing frameworks have faced multiple criticisms and have yet to be universally accepted. First, existing frameworks have been criticised for lacking robust theoretical foundations (Shinn, 2003). Second, existing frameworks are often developed within specific universities, focusing primarily on academic perspectives to guide internal policies and procedures (Hénard et al., 2012; Sjöö & Hellström, 2019). Therefore, existing frameworks may not adequately consider the perspectives and requirements

of external stakeholders and, thus, the real-world applicability of the framework. Third, although not specific to UEC frameworks, broader literature regarding framework implementation has highlighted the limiting effect of intricate frameworks (e.g. Casper & Kettler, 2001; Hidalgo, 2019; Yusof & Aspinwall, 2000). Finally, some frameworks have a narrow focus. As such, they have limited applicability since they cater only to specific disciplines. For instance, a framework focusing on hospitality internships may not be suitable for enterprises focused on technology co-research UECs (e.g. Li, L. & Li, 2013; Nama & Kurniawan, 2017). That said, this does not imply that specialised frameworks lack relevance. Instead, it emphasises the necessity of amalgamating established literature to identify the fundamental concepts that underpin successful UECs. As such, it is necessary to address the limitations discussed to develop a UEC framework that facilitates successful UECs. Therefore, this paper aims to develop a conceptual UEC framework based on the fundamental concepts identified in the literature that can be applied to various types of UECs and adapted to various disciplines/contexts.

Methods

The paper is part of an ERASMUS + EU funded project titled “SECRA–Strengthening University-Enterprise Collaboration for Resilient Communities in Asia”. During phase one of this research, a systematic literature review was conducted initially to assimilate existing literature concerning UEC (Tucker et al., 2023b). In phase two of this research, documentary reviews were conducted in three Asian partner countries (Sri Lanka, Thailand and the Philippines) to identify barriers and enablers of UEC (Tucker et al., 2023a). The present paper aimed to assimilate the findings from both stage one and stage two of the project using thematic analysis (Braun & Clarke, 2006) to derive a conceptual framework to guide the development of successful UECs.

The first stage of the thematic analysis involved data familiarisation. The researchers explored the data obtained in stages one and two of the SECRA project to familiarise themselves with the content within UEC literature. The second stage involved generating initial codes (discernible patterns of meaning) (Braun & Clarke, 2006). These initial codes categorised meaningful elements within the identified literature, thus laying the foundation for subsequent analytical stages (Braun & Clarke, 2006). The third stage of the thematic analysis involved theme identification, in which codes were then grouped under broader umbrella themes (Braun & Clarke, 2006). This phase necessitates grouping interrelated codes into overarching themes (Braun & Clarke, 2006). The fourth stage of the thematic analysis involved reviewing themes (Braun & Clarke, 2006). Through an iterative process, the researchers refined and scrutinised the identified themes to ascertain their validity. This approach subsequently minimised individual researcher bias and ensured methodological rigour, thus enhancing the credibility of the findings. In the fifth stage, *defining and naming themes*, the researchers formulated explicit definitions for individual themes (Braun & Clarke, 2006), coupled with the categorisation that encapsulates

each thematic construct (i.e., *structure* referring to the systems, policies, procedures and organisational arrangements that determine decision-making and operations within an organisation). Themes are often utilised to create a conceptual framework or theoretical model that elucidates the relationships between concepts and clarifies how different variables or elements interact and influence each other within a given context (Braun & Clarke, 2006; Fereday & Muir-Cochrane, 2006; Naeem et al., 2023).

The research team then undertook a *conceptual mapping* process to identify and organise identified themes, concepts and their relationships to develop a visual representation of a complex idea or theory (Ligita et al., 2022; Rosas & Camphausen, 2007; Rosas & Ridings, 2017; Starov et al., 2014; Stockwell et al., 2009). Concept mapping integrates qualitative methods to enable a group of people to articulate and depict a coherent conceptual framework of any topic of interest (Trochim & McLinden, 2017). In this case, the themes, sub-themes and individual concepts were grouped and mapped onto a visual diagram. UEC is a broad and diverse area that covers a wide range of topics, disciplines and contexts. The breadth of UEC literature provides a rich literature base upon which a theoretical framework could be developed. However, it is currently noted that the UEC literature is scattered and is lacking cohesion (Awasthy et al., 2020). As such, conceptual mapping is a powerful tool for exploring the complexities of UEC and assimilating a broad literature base into a coherent, visual narrative (Trochim, 1989).

Results

The analytical approach adopted in the present paper involved a thematic analysis of the findings from the literature identified in stage one and two of the SECRA project, followed by conceptual mapping to synthesise and visualise the relationships among the identified themes. The literature review conducted in stage one of the SECRA project identified eighty-one publications related to UEC (Tucker et al., 2023b), whilst the country reports conducted in stage two identified one-hundred and thirty-nine literature sources (Tucker et al., 2023a). Although the country report literature contributed to the development of this framework, the decision was taken to exclude country-specific literature as it lacks the necessary level of generalisability to contribute meaningfully to this framework. As such, one hundred and thirty-six literature sources were excluded from the current analysis. The thematic analysis of the identified literature from the previous two stages of the SECRA project, forms the basis of the current paper.

For each literature source a standardised framework was applied to summarise the main objective (e.g. UEC model, theory, framework, literature review), the main findings from the paper (e.g. strategies for UEC success, barriers to successful UECs) and drew conclusions concerning the contributions of the paper to the broader understanding of the elements involved in successful UECs. The analysis revealed four themes and twenty-nine sub-themes related to UEC.

After identifying the themes, sub-themes and their underpinning concepts, a concept mapping exercise was conducted to develop a conceptual framework for UEC.

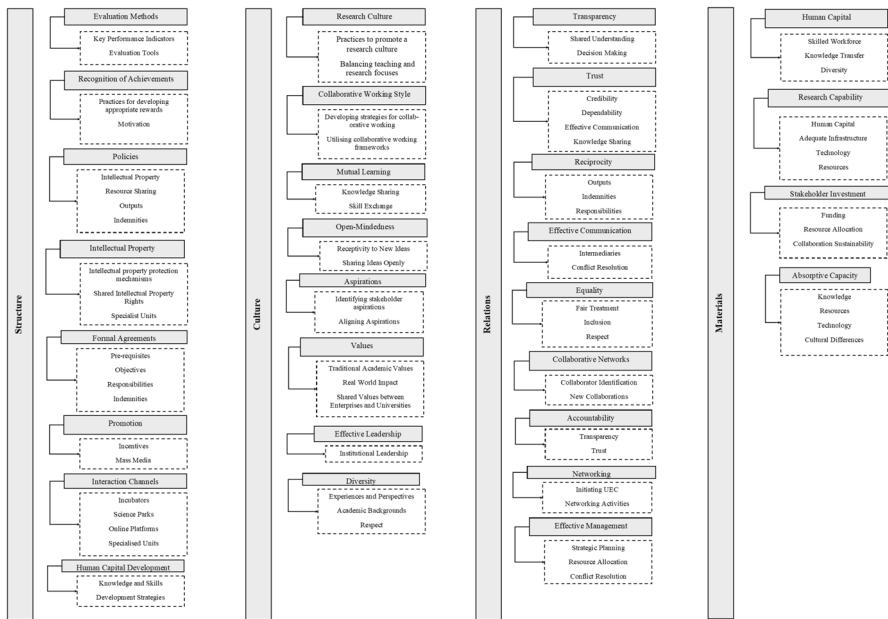


Fig. 1 Conceptual UEC framework

The concept mapping exercise allowed a concise framework to be visually represented that could be used to guide future research, policy development and practical applications related to UEC. It also allowed for a more comprehensive understanding of UEC by identifying the key elements/concepts and relationships between them (see Fig. 1).

Discussion

This paper aimed to develop a conceptual UEC framework based on the fundamental concepts identified in the literature that can be applied to various types of UECs and adapted to various disciplines/contexts. It is hypothesised that developing a conceptual UEC framework derived from the critical concepts presented in UEC literature will demonstrate adaptability across diverse disciplinary and contextual settings. The thematic analysis results suggest that successful UEC initiatives require attention to several key themes, including structure, culture, relations and materials. The themes identified reflect the underpinning concepts that contribute towards successful UECs thus highlighting the importance of developing a comprehensive framework that captures the diverse range of factors that should be considered within UECs. The broader themes and their subthemes provided the foundation for the conceptual framework. The discussion evaluates the core concepts underpinning each theme. However, it is pertinent to note that themes and subthemes within

the framework are not mutually exclusive. Attention will be drawn to interrelated themes and subthemes throughout the discussion.

Theme 1: Structure

The *structure* theme refers to the systems, policies, procedures and organisational arrangements that determine decision-making and operations within a UEC. This theme was characterised by the following eight sub-themes: evaluation methods, recognition of achievements, policies, intellectual property, formal agreements, promotion, interaction channels and human capital development. Each sub-theme encompassed several concepts identified during the thematic analysis (see Table 1).

Evaluation Methods

In UECs, *evaluation methods* are systematic and structured processes used to assess a UEC's success. Evaluation methods are crucial for maximising UEC impact and ensuring accountability (Iqbal et al., 2011). However, the evaluation of UECs poses distinct challenges due to their diverse objectives. The analysis revealed several key concepts in evaluating UEC success, including the use of evaluation tools and the establishment of key performance indicators (KPIs).

Preliminary research has identified a set of performance indicators that are believed to accurately assess the success of UECs at each collaboration stage (Fernandes et al., 2019). The Method for Measuring the Performance of University-Industry Collaborations (MPUIC) comprises a series of evaluation points to be assessed at five-time points throughout UECs, including program preparation, initiation, delivery, closure and post-program (Fernandes et al., 2019). Whilst the MPUIC (Fernandes et al., 2019) may demonstrate utility for assessing the success of research orientated university-industry collaborations be ineffective when quantifying the success of UECs orientated around societal or public health outcomes due to its focus on financial gain and technological achievements. Irrespective, there are a lack of standardised tools to evaluate UEC success (Fernandes et al., 2019). Whilst it may be helpful for future research to focus on the development of such tools, due to the diverse nature of UECs, the development of adaptable evaluation methods that consider the different ways UECs can succeed may be advantageous (Fernandes et al., 2019; Hogan et al., 2017; Hughes et al., 2014; Iqbal et al., 2011; Rybníček & Königgruber, 2019).

KPIs can take various forms in UECs, such as the number of patents, academic publications or new companies formed and may provide robust metrics to evaluate UEC success. However, these metrics may be limited to specific types of UECs such as technology transfer and co-research collaborations (Liyanage et al., 2020). In contrast, community-based collaborations intended to address societal needs may not be effectively quantified using these metrics. As such, the success of community-based collaborations often relies on subjective outcomes, such as improved quality of life, increased social capital or community engagement (Groulx et al., 2021; Hogan

Table 1 Structure sub-themes and concepts sources

Author(s), year	Evaluation methods	Recognition of achievements	Policies	Intellectual property	Formal agreements	Promotion	Interaction channels	Human capital development
Albats, Bogers & Podmetina et al., 2020				X			X	X
Albors, 2002								X
Al-Damen, 2021	X	X						
Anjum, 2020	X		X					
Ankrah & Al-Tabbaa, 2015	X		X	X	X	X	X	X
Arundel, Athreye & Wünsch-Vincent, 2021	X	X	X	X	X	X	X	X
Awasthy, Flint & Sankaranarayana et al., 2020		X	X	X			X	
Barbini, Corsino & Giuri, 2021			X	X			X	
Barker, 2004							X	
Bekkers & Freiretas, 2008							X	
Bruneel, D'Este & Salter, 2010			X	X	X		X	
Cai & Etzkowitz, 2020			X	X		X	X	
Cai & Liu, 2015	X		X	X			X	X
Cai, 2014			X	X			X	
Castro-Casal et al., 2013				X		X		

Table 1 (continued)

Author(s), year	Evaluation methods	Recognition of achievements	Policies	Intellectual property	Formal agreements	Promotion	Interaction channels	Human capital development
Coleman & Lang, 2012								X
Collier et al., 2011			X	X			X	X
D'Hombres & Scnepf, 2021	X							X
Dada, McKay, & Mateus et al., 2019	X							
Daly, 2011								X
de Souza Lessa, Ferreira & Aguiar et al., 2017	X							
Dee, Gill & Lacher et al., 2012			X	X	X			
D'Este, Guy & Iammarino, 2013			X					
Edler & Yeow, 2016			X					
Ertzkowitz & Zhou, 2017	X	X	X	X				X
Fernandes, Barbosa & Pinto et al., 2019	X							

Table 1 (continued)

Author(s), year	Evaluation methods	Recognition of achievements	Policies	Intellectual property	Formal agreements	Promotion	Interaction channels	Human capital development
Fernández Fernández et al., 2015	X							
Freitas, Marques & Silva et al. 2013			X	X		X		X
Galloway et al., 2014						X		X
Galvão, Mascarenhas & Marques et al., 2019			X					
Gorlach, 2017		X			X		X	X
Groulx et al., 2021						X		
Guimón, 2013					X		X	
Hermosura, 2019			X	X	X	X	X	
Hogan, Tynan & Covill, 2017	X		X					X
Huang & Turner, 2018	X		X					
Hughes, Nathwani & Sheen et al., 2014	X	X	X			X		
Iqbal, Khan & Iqbal et al., 2011	X		X	X	X			

Table 1 (continued)

Author(s), year	Evaluation methods	Recognition of achievements	Policies	Intellectual property	Formal agreements	Promotion	Interaction channels	Human capital development
Jones, Owen, & Wisner, 2016			X					
Kafouros Wang & Piperopoulos et al., 2015	X							
Kim & Jang, 2021			X					
Kivimaaab, Boon & Hyysalod et al., 2019			X					
Knockaert & Spiethoven, 2014			X			X		X
Larsen et al., 2016			X			X		
Leydesdorff & Ivanova, 2016				X		X	X	
Leydesdorff, 2012				X			X	
Lin & Bozeman, 2006			X					X
Link & Scott, 2012			X			X		
Link & Scott, 2017						X	X	
Liu, Liang & Tuuli et al., 2018	X		X		X	X	X	

Table 1 (continued)

Author(s), year	Evaluation methods	Recognition of achievements	Policies	Intellectual property	Formal agreements	Promotion	Interaction channels	Human capital development
Liyanage, McDonald & Amaraturunga et al., 2020	X		X					X
Löfsten et al., 2020	X		X			X	X	
Lopes & Lus-suano, 2021			X	X	X	X	X	
Maertz, Stoebert, & Marks, 2014	X				X	X		X
Mores et al., 2019	X		X			X	X	
Myoken, 2013							X	X
National Centre for Universities and Business (NCUB), 2021					X	X		
Njau, Karimi & Mwenda et al., 2019			X			X	X	
OECD, 2019	X		X			X	X	
Okamuro & Nishimura, 2013	X		X	X	X	X	X	
Olivier, Hunt & Ridde, 2016	X	X			X		X	
OECD, 2015			X			X		
Osafo & Yawson, 2019	X		X					X

Table 1 (continued)

Author(s), year	Evaluation methods	Recognition of achievements	Policies	Intellectual property	Formal agreements	Promotion	Interaction channels	Human capital development
Patton & Marlow, 2011							X	
Pellegrini & Johnson-Sheehan, 2021						X	X	
Peterson, 2009			X					
Proulx et al., 2014	X				X			
Rajalo & Vadi, 2017			X		X	X		
Ramli & Senin, 2015								X
Ranga & Etzkowitz, 2013			X					
Rybníček & Königsgrubner, 2019	X		X	X	X	X	X	
Saniter & Siedler, 2014								X
Schaeffer et al., 2020	X			X	X	X	X	
Seppo & Roolah, 2012	X		X				X	X
Siegel et al., 2003			X	X	X			
Strier, 2014	X							
Tantaneet et al., 2018					X	X	X	X

Table 1 (continued)

Author(s), year	Evaluation methods	Recognition of achievements	Policies	Intellectual property	Formal agreements	Promotion	Interaction channels	Human capital development
Tartari et al., 2012			X	X	X	X	X	
Thomas & Paul, 2019				X			X	
Vea, 2014								
Veletanlić & Sá, 2020	X		X			X		
Williamson, Young & Murray et al., 2016	X					X		
Weerasinghe & Jayawardane, 2018							X	
Wilson, 2012		X	X	X	X	X	X	

et al., 2017). In this context, relying solely on objective measures, such as KPIs, may fail to capture the nuanced nature of UEC success. Instead, engaging with community members through group discussions and one-to-one interactions may provide a more accurate understanding of a UECs success.

It is important to note the inherent limitations of both approaches to evaluating UEC success. Whilst KPIs may be reductionist, neglecting broader societal impacts, qualitative methods can be subjective and challenging to generalise. Therefore, a combination of both approaches may be beneficial. Irrespective, the effectiveness of an evaluation lies in its capacity to collect data that develops a coherent narrative about a UEC's ability to achieve its intended goals. Therefore, the evaluation method should align with each collaboration's goals and context. Nonetheless, clear and well-defined evaluation methods should be implemented to measure the ongoing success of UECs (Fernandes et al., 2019).

Recognition of Achievements

The term *Recognition of Achievements* refers to the acknowledgment and appreciation of stakeholder's contributions and successes within a UEC. The recognition of achievement serves several important purposes within UECs, namely motivation, strengthening relationships and showcasing success.

The development of reward structures creates an environment where collaborative success is celebrated and rewarded (Wilson, 2012), thereby motivating individuals to focus their efforts on UEC goals. Recognising achievements involves the explicit acknowledgement and celebration of milestones attained throughout collaborations. For example, explicit acknowledgements may manifest through various channels, including verbal commendations and sharing achievements across relevant platforms. Collectively, these recognition strategies extend beyond their conceptual importance and impact the success of UECs by increasing stakeholder motivation and promoting the concept of UECs to potential stakeholders.

UECs typically require sustained input from their collaborating stakeholders throughout their duration. Naturally, setbacks and delays can occur at any stage of a collaboration which can hinder stakeholder motivation. As such, the recognition of success motivates stakeholders to sustain their efforts toward the UEC's goals, thus contributing towards the success of a UEC. However, the recognition of achievements is closely related to other elements of the UEC framework such as promotion and relational factors. For example, publicly recognising achievements demonstrates the UEC's impact and value. In turn, highlighting successful UEC outcomes may promote UECs to potential stakeholders (OECD, 2015; OECD., 2019). Similarly, recognition of achievements may strengthen existing collaborative relationships.

Nevertheless, it is crucial to recognise potential limitations to recognising success within UECs, such as budget constraints and identifying universally-valued rewards. For instance, successful technology transfer UECs may utilise profit-sharing agreements in successful UECs, whilst recognition of community-based UECs addressing societal needs could manifest through media coverage and public ceremonies. However, it should be considered that the recognition of achievements within a UEC are dependent upon several cultural and material factors i.e., values and aspirations.

For example, community-based organisations may not have the necessary resources to recognise achievements in the same way as large, commercial organisations. Consequently, stakeholders should explore their approaches to recognising success to ensure that the recognition structures within UECs are appropriate for all stakeholders.

Policies

Policies encompass the principles that are proposed by an organisation to inform action. Policies are implemented by most entities, be it governments, enterprises or institutions, to serve as a framework for organisational activities and compliance with laws. However, in the context of UECs, the presence of policies from different stakeholders can lead to several challenges due to divergent policies and procedures. This may become more apparent when considering international stakeholders where laws may also diverge with those of another stakeholder. That said, the analysis revealed that UEC success hinges on carefully structured policies that address several key areas, including intellectual property (IP), equipment procurement, resource sharing, outputs and indemnities (Liu & Cai, 2018; OECD., 2019; Veletanlić & Sá, 2020).

UECs connect stakeholders, each with distinct approaches to IP. Divergent organisational priorities can lead to conflicts in ownership rights (Kafouros et al., 2015; Liu et al., 2018; Okamuro & Nishimura, 2013; Veletanlić & Sá, 2020). Universities prioritise knowledge dissemination, which often clashes with enterprises prioritising the commercialisation of knowledge (Tucker et al., 2023a). Furthermore, contributions from multiple stakeholders can lead to disputes over IP ownership, whilst ambiguities in contractual agreements may further exacerbate this issue. Additionally, inequality between stakeholders, with smaller organisations facing resource constraints, may feel compelled to concede ownership rights to more influential and well-established organisations. Therefore, robust IP policies are essential in safeguarding UEC outputs and equitable benefit distribution. Policies can encompass a range of protective measures that safeguard against unauthorised IP use and ensure the fair distribution of benefits derived from UECs (Okamuro & Nishimura, 2013; Rybníček & Königsgruber, 2019; Schaeffer et al., 2020; Siegel et al., 2003; Tartari et al., 2012; Tucker et al., 2023a; Wilson, 2012). For example, establishing mechanisms for identifying, protecting and exploiting IP (e.g. patents and copyrights) ensures that universities and enterprises benefit fairly from UEC outputs (Rybníček & Königsgruber, 2019).

Similarly, equitable access to shared resources is integral to UEC's success. Whilst central to UEC ethos, the principle of resource sharing is not immune to conflicts. Divergent interests and priorities among stakeholders can lead to tensions regarding the allocation and utilisation of resources (Tartari et al., 2012). Consequently, stakeholders should develop well-structured resource-sharing policies, considering all stakeholders' varying needs and expectations. That said, bureaucracy in the procurement of resources can impede UEC success (Rybníček & Königsgruber, 2019).

UECs often operate on tight schedules, and any delays in procuring necessary resources can lead to missed deadlines and extended project timelines. In turn, bureaucratic inefficiencies can cause frustration among researchers which can effect relational and cultural aspects of a UEC. For example, bureaucracy can result in frustration for UEC stakeholders which may impact the research culture and collaborative working style. In addition, bureaucracy can impact trust and accountability within UECs if stakeholders fail to meet agreed deadlines. Therefore, stakeholders should develop transparent procedures for acquiring and sharing resources fairly. Moreover, stakeholders should consider strategies to minimise bureaucracy to prevent unnecessary delays (Tucker et al., 2023b).

Conflicts can arise in UECs due to disparate priorities between the academic publishing culture and enterprise commercialisation practices (Tucker et al., 2023a). Whilst researchers prioritise the publication of new knowledge, companies often seek to delay dissemination until patents are secured (Tucker et al., 2023a). A lack of transparency regarding publication delays or rationale can result in frustration and a lack of trust between stakeholders, which ultimately impacts UEC's success. As such, stakeholders should develop flexible policies that balance all stakeholders' priorities and expectations.

Effective policies can also clarify indemnities with a UEC. Indemnities clarify responsibilities, mitigate concerns about unforeseen circumstances and facilitate risk minimisation in UECs. Indemnities function as safeguards in unforeseen circumstances and prevent unexpected financial burdens. In turn, indemnity policies are essential in ensuring accountability and building trust within UECs. However, indemnity clauses favouring one stakeholder in terms of liability can be unfair and reduce trust between stakeholders. Moreover, smaller or less established organisations might be pressured or coerced into accepting unfavourable terms due to limited resources or dependence on their collaborating stakeholders. As such, stakeholders should implement well-defined indemnity policies that encourage responsible conduct, compliance and risk management to facilitate successful UECs.

Robust UEC policies can enhance the success of UECs via their impact on several relational factors. For example, effective IP policies build trust among stakeholders by providing assurances that their contributions will be protected and fairly compensated. When stakeholders trust that their intellectual property will be handled appropriately, they are more willing to share valuable insights and innovations, which enhances the overall success of UECs (Bruneel et al., 2010). As such, transparent policies for potential risks, coupled with the protective mechanisms and indemnities, cultivate the trust and accountability needed for successful UECs.

Intellectual Property

Intellectual property (IP) has emerged consistently in literature as both an enabler and barrier to successful UECs (Kafouros et al., 2015; Liu et al., 2018; Okamuro & Nishimura, 2013; Veletanlić & Sá, 2020). When analysed, intellectual property encompassed several distinct concepts, including shared intellectual property rights, intellectual property protection mechanisms and the establishment of specialised units (Tucker et al., 2023a). When embedded in robust policies, shared intellectual

property rights create a framework enabling stakeholders to mutually benefit from commercialising and disseminating knowledge gained through a UEC (Rybníček & Königsgruber, 2019; Williamson et al., 2016; Wilson, 2012).

However, acknowledging and managing cultural disparities in organisational practices concerning intellectual property is essential for UEC success. For example, certain technologies, such as those with military applications, may face restrictions on international transfer, adding a layer of complexity to IP generated through international UECs. Similarly, intellectual property laws, patent procedures and penalties across countries can lead to disparities in expectations and rights among stakeholders. Tax implications may also arise from the intellectual property generated in a UEC. As such, the deliberation of shared intellectual property rights should be considered in the initial stages of UEC planning. In turn, this will permit the development of well-defined agreements concerning the distribution of intellectual property (Ankrah & Al-Tabbaa, 2015; Wilson, 2012).

The analysis revealed that intellectual property mechanisms and specialised units dedicated to intellectual property are essential components within UECs (Awasthy et al., 2020; Rybníček & Königsgruber, 2019). Intellectual property protection mechanisms are paramount to safeguarding the innovations arising from UECs. Intellectual property mechanisms can fortify intellectual property rights, prevent unauthorised use through patents, copyrights and trademarks (Okamuro & Nishimura, 2013; Rybníček & Königsgruber, 2019; Schaeffer et al., 2020; Siegel et al., 2003; Tartari et al., 2012; Tucker et al., 2023a; Wilson, 2012). Similarly, specialised units guide adherence to intellectual property laws, protection and commercialisation to ensure legal compliance (Barbini et al., 2021; Bruneel et al., 2010). By effectively managing IP, these units enhance UEC success.

The availability of IP protection mechanisms and specialised units may encourage stakeholders to engage in UECs with the guarantee that their intellectual contributions will be safeguarded and their efforts will be compensated (Schaeffer et al., 2020; Wilson, 2012). This assurance also enhances several cultural and relational elements of UEC. For example, IP protection mechanisms may foster a positive research culture, where stakeholders are motivated to invest in UECs. Moreover, effective IP mechanisms build trust among partners by ensuring transparent and fair distribution of intellectual property. Accountability is also enhanced through clear IP policies and specialised units, as they ensure compliance.

Formal Agreements

In UECs, formal agreements delineate the roles, responsibilities and expectations of each stakeholder (Schaeffer et al., 2020). This clarity plays a crucial role in prospectively addressing stakeholder uncertainties and preventing misunderstandings and potential conflicts that might hinder UEC success. That said, although formal agreements provide structure and clarity in UECs, they have limitations. First, formal agreements require considerable resources from all stakeholders, such as legal expertise and time investments which may be challenging for smaller organisations. Second, rigidity in formal agreements may impede adaptability to unexpected issues that arise during a UEC. For example, unforeseen challenges or setbacks may

necessitate adjustments to formal agreements. In such instances, formal agreements may hinder the formation, continuity and completion of successful UECs. Therefore, stakeholders should consider the optimal use of formal agreements within a UEC by considering the capabilities of the other stakeholders involved and effective contingency planning.

Formal agreements also contribute to the relational elements of UECs by building trust and accountability between stakeholders (Bruneel et al., 2010; Dee et al., 2012; Proulx et al., 2014). Culturally, formal agreements support a collaborative working style where stakeholders feel that their contributions are recognised and compensated fairly. Materially, formal agreements ensure that resources are allocated and utilised efficiently, thus minimising disputes over resource sharing and potential conflicts. As such, formal agreements derive several benefits in UECs by cultivating a shared understanding between stakeholders and safeguarding against potential conflicts (Bruneel et al., 2010; Dee et al., 2012; Proulx et al., 2014).

Promotion

Promotion is an essential element of UECs. UEC *Promotion* demonstrates the value of collaboration between universities and enterprises to various potential stakeholders (OECD, 2015; OECD., 2019). Promoting UEC initiatives encourages future stakeholder engagement by communicating the positive outcomes and advantages resulting from UECs (Awasthy et al., 2020). UEC incentives can encompass grants, funding opportunities, recognition or access to specialised resources, stakeholders are motivated to engage in collaborative activities as well as career development opportunities, such as joint appointments, industry placements or research fellowships (OECD., 2019). Incentives provide tangible benefits for individuals involved in UECs and facilitate stakeholder engagement (OECD ., 2019).

However, it is essential to recognise that both the promotion and incentive strategies should be appropriate for their target stakeholder. In the case of UEC promotion, the strategy should access the target population. For example, large conferences and workshops may attract large organisations and business stakeholders. However, they may not be as effective at raising awareness of UECs among small businesses or community-based organisations (Tucker et al., 2023b). Therefore, promotion efforts should be developed with the target stakeholder's preferences in mind. Similarly, incentives should also be appropriate for the target stakeholder. For example, tax deduction incentives may incentivise large organisations but are unlikely to incentivise small businesses or community organisations that would not benefit from this incentive (Tucker et al., 2023b). As such, it is crucial to acknowledge that the effectiveness of both promotion and incentive strategies in facilitating UEC success is contingent upon their alignment with the target stakeholders.

Successful promotion allows the achievements of UEC endeavours to gain visibility in the public domain (OECD, 2015, 2019). This visibility, in turn, shapes a perception of UEC as a platform that facilitates mutually beneficial relationships between universities and external stakeholders. The concept of promotion links to the relational and cultural elements of UECs by promoting a culture of mutual learning and collaborative working among current and potential partners.

Interaction Channels

Interaction channels facilitate knowledge and technology exchange between academic institutions and enterprise partners. Science parks and incubators function as formal interaction channels for UECs (Albahari et al., 2019; Link & Scott, 2017; Löfsten et al., 2020). Science parks are typically located near universities and promote knowledge transfer, collaboration and innovation (Collier et al., 2011; Link & Scott, 2017). Similarly, incubators are university-hosted entities that offer resources and mentorship to potential stakeholders and provide a formal interaction channel for UECs (Pellegrini & Johnson-Sheehan, 2021; Al-Damen, 2021; Dee et al., 2012; Njau et al., 2019; Patton & Marlow, 2011). The pertinence of interaction channels to UEC becomes evident in their role in fostering collaborative networks (Link & Scott, 2017; Löfsten et al., 2020).

Nevertheless, the accessibility of both science parks and incubators may pose challenges for geographically dispersed stakeholders. Moreover, the establishment and maintenance of a science park entail substantial investments. In order to overcome these barriers, stakeholders should establish streamlined channels for UEC interactions. For example, virtual platforms and digital communication tools to facilitate remote participation and engagement, ensuring that geographically dispersed stakeholders can actively contribute to and benefit from UECs. This approach not only addresses the challenges associated with physical accessibility but also aligns with contemporary trends in fostering global collaborations and knowledge exchange.

The concept of interaction channels link to the relational elements of UECs by facilitating trust and mutual learning among stakeholders through structured communication and access to specialised staff and their knowledge. Interaction channels also support the cultural elements of UEC by embedding a collaborative ethos within the university and enterprise environments and encouraging open-mindedness towards the concept of UECs. Additionally, interaction channels contribute to the material aspects of UECs by ensuring stakeholders have access to the information and infrastructure needed to innovate effectively.

Human Capital Development

In UEC, it is essential to develop staff capabilities to engage in collaborative projects (Lin & Bozeman, 2006). UEC initiatives require human capital development investment to ensure they possess the essential skills and expertise to undertake collaborative endeavours successfully (Coleman & Lang, 2012). This involves subject-specific skills and knowledge and cross-functional abilities that enable effective communication, teamwork and problem-solving within collaborations. However, generic training programs may be ineffective as the skills required will be unique to each collaboration's context and objectives. For example, stakeholders should advocate for tailored training programmes aligned with specific project requirements and supplementary approaches such as collaborative learning opportunities and mentoring programs. The benefits of investing in human capital development reverberate throughout the UEC framework due to the impact on cultural and material aspects of

UEC. For example, by equipping staff members with the necessary skill set, stakeholders can ensure smoother project execution, an increased likelihood of achieving collaborative objectives and timely completion of collaborative projects. Similarly, human capital development may contribute towards the development of a collaborative working style.

Theme 2: Culture

The *culture* theme encompasses the shared values, beliefs and norms that shape organisational behaviour and decision-making in collaborative projects (Abu-Jarad et al., 2010). This theme was characterised by the following sub-themes: Research culture, collaborative working style, mutual learning, open-mindedness, aspirations, values, leadership and diversity. Each sub-theme encompassed several concepts (see Table 2).

Research Culture

An established research culture is essential for successful UECs. Developing a research culture encourages stakeholders to question assumptions, explore novel avenues and continuously learn (Rybníček & Königsgruber, 2019; Williamson et al., 2016). Academics often face challenges such as a lack of entrepreneurial drive, confidence in industry-oriented research and limited motivation due to heavy teaching and administrative workloads, which can hinder UEC efforts (Larsen et al., 2016; Tucker et al., 2023a). To address these issues and encourage successful UECs, institutions must develop practices that allocate time for research activities, incentivise collaboration with external stakeholders and provide resources for faculty development. For example, balancing teaching commitments with UEC responsibilities is essential for fostering a research culture that supports successful UEC initiatives.

However, it is vital to acknowledge the inherent diversity in research cultures between potential stakeholders. Academic literature typically conceptualises ‘research culture’ within an academic context, often overlooking the nuanced dynamics of research cultures in enterprise contexts. Therefore, stakeholders should collaborate to gain a comprehensive view of what constitutes a research culture in across organisations and contexts. Consequently, stakeholders can develop a research culture that is conducive to successful UECs. In turn, an established research culture can encourage stakeholders to bridge the gap between academic knowledge and real-world impact through UECs (Rybníček & Königsgruber, 2019; Williamson et al., 2016).

Collaborative Working Style

A collaborative working style in UEC encompasses cooperative interactions and collective problem-solving between stakeholders (Proulx et al., 2014). It is suggested that a collaborative working style allows stakeholders to utilise collective expertise

Table 2 Culture sub-theme and concept sources

Author(s), year	Research culture	Collaborative working style	Mutual Learning	Open-Mindedness	Aspirations	Values	Leadership	Diversity
Albats, Bogers & Podmetina et al., 2020	X				X	X	X	
Albors, 2002		X						
Al-Damen, 2021	X							
Anjum, 2020		X	X					
Ankrah & Al-Tabbaa, 2015	X		X		X	X	X	
Arundel, Athreye & Wunsch-Vincent, 2021			X		X	X		X
Awasthy, Flint & Sankaranarayanan et al., 2020	X		X	X	X	X	X	
Barbini, Corsino & Giuri, 2021						X		X
Barker, 2004	X							
Bekkers & Freitas, 2008		X	X		X			
Bruneel, D'Este & Salter, 2010		X	X	X	X			
Cai & Etzkowitz, 2020					X	X	X	
Cai & Liu, 2015			X		X			
Cai, 2014	X		X		X			
Castro-Casal et al., 2013	X	X			X		X	
Coleman & Lang, 2012		X	X					
Collier et al., 2011	X			X	X			
D'Hombres & Seneff, 2021		X	X					

Table 2 (continued)

Author(s), year	Research culture	Collaborative working style	Mutual Learning	Open-Mindedness	Aspirations	Values	Leadership	Diversity
Dada, McKay, & Mateus et al., 2019	X	X				X		
Daly, 2011			X					
de Souza Lessa, Ferreira & Aguiar et al., 2017					X			
Dee, Gill & Lacher et al., 2012					X			
D'Este, Guy & Iammarino, 2013			X					
Edler & Yeow, 2016			X					
Eitzkowitz & Zhou, 2017					X		X	
Fernandes, Barbosa & Pinto et al., 2019					X	X		
Fernández Fernández et al., 2015	X						X	X
Freitas, Marques & Silva et al. 2013			X		X	X		
Galloway et al., 2014	X			X				X
Galvão, Mascarenhas & Marques et al., 2019	X				X	X		
Gorlach, 2017		X			X			
Groulx et al., 2021	X		X	X	X	X	X	
Guimón, 2013			X					
Hermosura, 2019	X							

Table 2 (continued)

Author(s), year	Research culture	Collaborative working style	Mutual Learning	Open-Mindedness	Aspirations	Values	Leadership	Diversity
Hogan, Tynan & Covill, 2017	X	X			X		X	
Huang & Turner, 2018		X			X			X
Hughes, Nathwani & Sheen et al., 2014	X	X	X	X	X		X	X
Iqbal, Khan & Iqbal et al., 2011	X			X	X			
Jones, Owen, & Wisner, 2016	X						X	
Kafourous Wang & Piperopoulos et al., 2015			X	X	X	X		
Kim & Jang, 2021	X	X						
Kivimaaab, Boon & Hyysalod et al., 2019		X		X	X			
Knockaert & Spiethoven, 2014					X			
Larsen et al., 2016	X							
Leydesdorff & Ivanova, 2016		X			X			
Leydesdorff, 2012		X						
Lin & Bozeman, 2006	X	X						X
Link & Scott, 2017	X	X						
Link & Scott, 2012	X	X						
Liu, Liang & Tuuli et al., 2018		X	X		X			
Liyanage, McDonald & Amaratinga et al., 2020	X							

Table 2 (continued)

Author(s), year	Research culture	Collaborative working style	Mutual Learning	Open-Mindedness	Aspirations	Values	Leadership	Diversity
Löfsten et al., 2020		X					X	
Lopes & Lussumo, 2021		X		X				
Maertz, Stoeberl, & Marks, 2014	X			X				
Mores et al., 2019		X		X	X			
Myoken, 2013	X	X	X					
National Centre for Universities and Business [NCUB], 2021	X	X	X	X		X		
Njau, Karimi & Mwenda et al., 2019	X	X						
OECD, 2019	X	X	X		X			
Okamuro & Nishimura, 2013	X				X			
Olivier, Hunt & Ridde, 2016	X	X	X		X	X		X
Organisation for Economic Co-operation and Development [OECD], 2015	X	X	X		X			
Osafio & Yawson, 2019	X		X	X		X	X	
Patton & Marlow, 2011			X					

Table 2 (continued)

Author(s), year	Research culture	Collaborative working style	Mutual Learning	Open-Mindedness	Aspirations	Values	Leadership	Diversity
Pellegrini & Johnson-Sheehan, 2021	X							
Peterson, 2009		X			X		X	
Proulx et al., 2014	X	X			X			
Rajalo & Vadi, 2017		X	X	X	X			
Ramli & Senin, 2015	X							
Ranga & Eitzkowitz, 2013	X	X	X					
Rybníček & Königsgruber, 2019	X	X		X	X	X	X	
Saniter & Siedler, 2014		X	X					
Schaeffer et al., 2020		X						
Seppo & Roolah, 2012	X	X			X	X		
Siegel et al., 2003	X					X		
Strier, 2014	X				X		X	
Tantaneet et al., 2018		X			X			
Tartari et al., 2012		X			X			X
Thomas & Paul, 2019		X		X				
Vea, 2014	X	X	X					

Table 2 (continued)

Author(s), year	Research culture	Collaborative working style	Mutual Learning	Open-Mindedness	Aspirations	Values	Leadership	Diversity
Veletanlić & Sá, 2020					X			
Williamson, Young & Murray et al., 2016	X	X	X	X				X
Weerasinghe & Jayawardane, 2018	X	X	X					
Wilson, 2012	X	X			X		X	X

to develop successful UECs (Proulx et al., 2014). Whilst a collaborative working style is generally it seen as advantageous to UECs, implementing and maintaining new working styles can be challenging for stakeholders. For example, differing work styles, organisation hierarchies and communication barriers can lead to conflicts, impede decision-making and ultimately hinder UEC success. Therefore, to cultivate a collaborative working style in UECs, stakeholders should develop policies and procedures to promote and accommodate collaborative working.

Whilst policies and procedures should provide clearly defined objectives, roles and responsibilities within a UEC, an overreliance on rigid policies and procedures may hinder UECs. For example, issues or delays that arise during a UEC may need prompt action, rather than strict adherence to policies and procedures. As such, stakeholders should consider developing flexible approach to collaborative working styles, by developing and utilising flexible policies and procedures to address the specific aims and potential issues of each UEC.

Mutual Learning

In UECs, mutual learning encompasses the shared knowledge, skills and experiences of stakeholders (Rybníček & Königsgruber, 2019; Williamson et al., 2016). This two-way exchange fosters the acquisition of new skills, insights and expertise between stakeholders (Ankrah & Al-Tabbaa, 2015; Collier et al., 2011). However, there is a lack of literature that has investigated methods by which mutual learning can be achieved in UECs. Nonetheless, establishing knowledge-sharing platforms or mentoring programs alongside UECs may strengthen knowledge exchange and skill development. As a result, UECs will be better equipped to tackle challenges and develop innovative solutions informed by diverse insights and competencies (Rajalo & Vadi, 2017).

Open-Mindedness

Open-mindedness is essential for successful UECs (Osafo & Yawson, 2019; Rybníček & Königsgruber, 2019). Open-mindedness involves creating an environment where inclusivity and diverse perspectives are shared openly (Osafo & Yawson, 2019; Rybníček & Königsgruber, 2019). In turn, high levels of openness facilitate the development of new capabilities and innovations (Kafourous et al., 2015). However, achieving true open-mindedness in UECs can be challenging due to pre-existing biases, cultural differences and individual opinions. That said, the uncritical acceptance of every idea may be counter intuitive in that it may lead to ineffective decision making. Instead, stakeholders should consider the implications and consequences of each stakeholders' idea. For example, stakeholders should assess the feasibility of proposed ideas and their alignment with the UEC objectives to ensure UEC success.

Aspirations

Alignment of stakeholder aspirations is imperative for the success of UECs. The divergence in aspirations between academia and enterprise is a common challenge in UEC (Albats et al., 2016). Enterprises are often driven by market demands and rapid returns on investment, seeking to develop products, services or solutions that can be commercialised quickly (Rybníček & Königsgruber, 2019). Conversely, universities prioritise robust scholarly research and the dissemination of knowledge through publications, which can take more time and may not align with the immediate timelines of enterprises (Iqbal et al., 2011; Seppo & Reino, 2012; Tartari et al., 2012).

These disparities in stakeholder aspirations pose challenges to this alignment process. For instance, whilst catering to the aspirations of enterprises holds significance, an excessive focus on immediate commercialisation may impede research endeavours with societal benefits or the exploration of scientific inquiries conducive to future breakthroughs. As such, stakeholder aspirations must be identified before collaboration, as differing priorities can hinder successful collaborations. The alignment of expectations, defining clear goals and establishing realistic timelines can create a mutually beneficial relationship for all stakeholders and contribute to UEC success (Mores et al., 2019).

Values

Values in the context of UEC refer to the principles, beliefs and ethical standards that shape the conduct and culture of stakeholders involved. Universities often uphold traditional academic values, including commitments to academic integrity, research excellence and knowledge dissemination (Arundel et al., 2021). Conversely, enterprises may prioritise commercialisation and real-world impact (Rybníček & Königsgruber, 2019). This inherent value divergence between academia and industry introduces complexity to UECs.

Whilst identifying and fostering shared values is crucial, it can be challenging due to deeply ingrained institutional cultures and contrasting reward systems. For example, commercialisation is a valuable goal, but prioritising it over other values can raise ethical concerns, limit the scope of research inquiries and potentially hinder the pursuit of knowledge for societal gain. Finding shared values might not always be feasible, particularly when collaborations involve ethical dilemmas or conflicting priorities. Therefore, successfully navigating this divergence necessitates practices to identify and foster shared values between enterprises and universities to facilitate successful UECs (Awasthy et al., 2020).

As a result, exploring the potential for mutually enriching interactions between academia and enterprise might be more productive than solely focusing on shared values. For example, establishing clear communication channels and developing ethical frameworks for decision-making may be crucial for mitigating divergent values between stakeholders to ensure all viewpoints are considered. However, further research is needed to explore how UECs can navigate stakeholder values whilst fostering successful UECs.

Leadership

Effective leadership aligns the aspirations of all stakeholders through a clear vision and strategy, ensuring that collaborative efforts are purposeful (Albats et al., 2020; Rybníček & Königsgruber, 2019). As such, effective leaders create an environment where expertise from both academia and enterprise synergise effectively, thus leading to successful UECs. However, leaders face challenges like navigating differing stakeholder priorities, managing complex communication channels and fostering collaboration across diverse organisational cultures.

Whilst a single effective leader can be valuable, relying solely on individual leadership might limit the success of a UEC. Therefore, stakeholders should explore leadership as a dynamic process shaped by the specific UEC objectives. Distributed or shared leadership models, where each stakeholder contributes their strengths to a UEC may offer advantages to UECs. That said, whilst effective leadership is crucial, it is not a straightforward solution to ensure the success of a UEC. For example, establishing clear communication channels and fostering trust among stakeholders, alongside adequate resource allocation, are equally crucial for successful UECs. Therefore, it is critical to also consider relational themes within this framework to further strengthen the development and maintenance of successful UECs.

Diversity

In UECs, diversity encompasses various aspects such as academic backgrounds, perspectives, skills, experiences and cultures. Nonetheless, possessing academic and industry experience is advantageous for UECs (Lin & Bozeman, 2006). Whilst embracing diversity is crucial, it should address underlying structural inequalities within academia and enterprise. Focusing solely on representation without addressing inclusivity and equity can hinder the realisation of diversity's benefits. Simply embracing diversity is not enough; UECs need effective strategies to leverage diverse perspectives and experiences.

The importance of diversity in UEC is underscored by its role in fostering respect for differences in behavioural practices, preferences and opinions among partners. This respect for diversity is crucial in building trust and mutual respect, foundational for developing successful UECs. Similarly, uniting diverse perspectives enhances the quality and variety of solutions and improves collaborative outcomes (Williamson et al., 2016). Therefore, embracing diversity in UECs enhances their potential to create dynamic learning environments and collaborative success. As such, stakeholders should implement strategies to prioritise diversity regarding representation, inclusion and equity. However, a notable research gap exists concerning effective strategies for cultivating truly inclusive environments within UECs. Future research should explore good practices for ensuring inclusivity and equity, methods to identify and dismantle unconscious biases hindering inclusivity and strategies for ensuring equitable participation in decision-making and leadership opportunities across diverse groups.

The cultural elements inherent in UECs influence the relational aspects of the framework. Elements such as research culture, collaborative working style, mutual

learning, open-mindedness, aspirations, values, leadership and diversity establish the relational dynamics in UECs. These cultural elements influence how stakeholders interact, share knowledge and collaborate on joint projects. For example, a collaborative working style can promote and reciprocity trust, whilst effective communication enhances transparency and facilitates the establishment of formal agreements that ensure equality and accountability. Similarly, promoting reciprocity and equality in UECs strengthens collaborative networks. Therefore, integrating cultural elements with relational aspects supports the development of UECs and contributes to their success.

Theme 3: Relations

The *relations* theme refers to the interpersonal interactions and social networks formed within and outside an organisation and how these relationships shape organisational processes and outcomes. This theme was characterised by the following sub-themes: Transparency, trust, reciprocity, effective communication, equality, accountability, collaborative networks, networking and effective management. Each sub-theme encompassed several concepts (see Table 3).

Transparency

Transparency involves sharing information, objectives and processes among all stakeholders (Rybníček & Königsgruber, 2019). Transparency in UECs fosters shared understanding, mitigates misunderstandings and cultivates stakeholder confidence (Mores et al., 2019). Such transparency facilitates effective decision-making and collaborative problem-solving (Arundel et al., 2021; Groulx et al., 2021). As such, transparency is an essential factor that underpins collaborative success by enabling informed engagement and sustained collaborations between academic and enterprise stakeholders (NCUB, 2021).

However, confidentiality concerns regarding intellectual property can present challenges to transparency in UECs. For example, researchers have noted that enterprises raise concerns about academics stealing proprietary information, whilst universities are wary of industries poaching their faculty (Abendan, 2017). The inherent mistrust between enterprises and universities may prevent stakeholders from sharing crucial information, thus hindering the exchange of knowledge and collaborative efforts essential for successful UECs (Tucker et al., 2023a). Furthermore, whilst transparency is generally conducive to trust, it can reveal disagreements that require careful negotiation. Nonetheless, the current literature base suggests that collaborative success relies on transparency to facilitate informed engagement and ensure the continuity of collaborations (NCUB, 2021). However, it may be more feasible for stakeholders to consider different levels of transparency and strategic opacity in certain phases of UEC.

Table 3 Relations sub-theme and concept sources

Author(s)	Transparency	Trust	Reciprocity	Effective communication	Equality	Accountability	Collaborative networks	Networking	Effective management
Albats, Bogers & Podmetina et al., 2020		X	X	X			X	X	X
Albors, 2002							X		
Al-Damen, 2021								X	
Anjum, 2020						X	X		X
Ankrah & Al-Tabbaa, 2015		X	X	X		X	X	X	X
Arundel, Athreye & Wunsch-Vincent, 2021	X	X	X	X		X	X	X	X
Awasthy, Flint & Sankaranarayana et al., 2020	X	X	X	X			X	X	
Barbini, Corsino & Giuri, 2021		X					X	X	
Barker, 2004							X		
Bekkers & Freitas, 2008						X			
Bruneel et al., 2010		X	X						X
Cai & Etzkowitz, 2020		X	X				X		
Cai & Liu, 2015		X	X			X			X
Cai, 2014		X	X	X					X
Castro-Casal et al., 2013		X		X					X

Table 3 (continued)

Author(s)	Transparency	Trust	Reciprocity	Effective communication	Equality	Accountability	Collaborative networks	Networking	Effective management
Coleman & Lang, 2012				X					
Collier et al., 2011		X				X	X		X
D'Hombres & Senepf, 2021			X						
Dada, McKay, & Mateus et al., 2019			X						
Daly, 2011						X			X
de Souza Lessa, Ferreira & Aguiar et al., 2017				X					
Dee, Gill & Lacher et al., 2012		X				X	X	X	
D'Este, Guy & Iammarino, 2013		X	X			X	X		
Edler & Yeow, 2016	X			X			X		X
Eitzkowitz & Zhou, 2017		X	X	X	X		X	X	X
Fernandes, Barbosa & Pinto et al., 2019									X
Fernández Fernández et al., 2015		X		X	X		X	X	
Freitas, Marques & Silva et al. 2013	X						X	X	X

Table 3 (continued)

Author(s)	Transparency	Trust	Reciprocity	Effective communication	Equality	Accountability	Collaborative networks	Networking	Effective management
Galloway et al., 2014							X		
Galvão, Mascarenhas & Marques et al., 2019			X	X		X	X		X
Gorlach, 2017	X								
Groulx et al., 2021	X	X	X	X	X		X		X
Guimón, 2013							X	X	
Hermosura, 2019			X						
Hogan, Tynan & Covill, 2017		X	X	X		X			X
Huang & Turner, 2018				X					
Hughes, Nathwani & Sheen et al., 2014		X		X	X	X	X	X	
Iqbal, Khan & Iqbal et al., 2011	X		X	X					
Jones, Owen, & Wisner, 2016				X			X		
Kafourous Wang & Piperopoulos et al., 2015				X			X	X	X
Kim & Jang, 2021		X		X				X	X
Kivimaaab, Boon & Hyysalod et al., 2019				X					

Table 3 (continued)

Author(s)	Transparency	Trust	Reciprocity	Effective communication	Equality	Accountability	Collaborative networks	Networking	Effective management
Knockaert & Spithoven, 2014				X			X	X	X
Larsen et al., 2016	X	X	X				X	X	X
Leydesdorff & Ivanova, 2016				X			X		
Leydesdorff, 2012				X			X		X
Lin & Bozeman, 2006							X		
Link & Scott, 2017							X		
Link & Scott, 2012									X
Liu, Liang & Tuuli et al., 2018		X					X		X
Liyanage, McDonald & Amaratinga et al., 2020	X							X	X
Löfsten, Kjöfsten & Cadorn, 2020							X	X	X
Lopes & Lussuamo, 2021		X							X
Maertz, Stoeberl, & Marks, 2014									X

Table 3 (continued)

Author(s)	Transparency	Trust	Reciprocity	Effective communication	Equality	Accountability	Collaborative networks	Networking	Effective management
Mores, Lee & Bae, 2019	X		X	X	X	X	X	X	X
Myoken, 2013							X		
National Centre for Universities and Business (NCUB), 2021		X		X			X	X	X
Njau, Karimi & Mwenda et al., 2019								X	
OECD, 2019	X	X							
Okamuro & Nishimura, 2013	X	X	X	X			X		X
Olivier, Hunt & Ridde, 2016	X	X	X	X	X				
Organisation for Economic Co-operation and Development (OECD), 2015	X					X			
Osafo & Yawson, 2019	X	X	X	X		X	X	X	X
Patton & Marlow, 2011							X	X	

Table 3 (continued)

Author(s)	Transparency	Trust	Reciprocity	Effective communication	Equality	Accountability	Collaborative networks	Networking	Effective management
Pellegrini & Johnson-Sheehan, 2021					X	X			
Peterson, 2009							X		
Proulx et al., 2014	X	X	X	X	X	X	X	X	
Rajalo & Vadi, 2017		X		X			X	X	X
Ramli & Senin, 2015	X		X						
Ranga & Etzkowitz, 2013	X	X		X			X	X	
Rybníček & Königsgrober, 2019	X	X	X	X		X	X		X
Saniter & Siedler, 2014							X		
Schaeffer et al., 2020	X					X			
Seppo & Roolah, 2012		X		X					X
Siegel et al., 2003			X			X		X	
Strier, 2014		X			X				X
Tantaneet et al., 2018			X			X	X	X	

Table 3 (continued)

Author(s)	Transparency	Trust	Reciprocity	Effective communication	Equality	Accountability	Collaborative networks	Networking	Effective management
Tartari et al., 2012	X	X				X	X		X
Thomas & Paul, 2019	X	X	X			X	X	X	
Vea, 2014		X						X	
Veletanlić & Šá, 2020						X	X		
Williamson, Young & Murray et al., 2016	X	X	X	X			X	X	
Weerasinghe & Jayawardane, 2018			X				X	X	
Wilson, 2012	X	X	X	X			X	X	X

Trust

Trust is a fundamental element in UECs (Albats et al., 2020). Trust establishes credibility and dependability among stakeholders (Collier et al., 2011; Williamson et al., 2016). In UECs, trust is the basis for effective communication, knowledge sharing and research culture, which is vital for innovative UEC outcomes (Awasthy et al., 2020; Hogan et al., 2017; Williamson et al., 2016). However, building and maintaining trust in UECs is a complex task. Unequal power dynamics between stakeholders and the ability to sustain trust in the event of setbacks and failures can all present challenges in UECs. As such, the assumption of trust *universality* across all stages of UECs may need to be critically examined. Nonetheless, trust can foster open dialogue and the exchange of ideas between stakeholders, thus creating an environment conducive to successful UECs. Therefore, stakeholders should recognise contextual nuances and consider the role of other factors, such as clear communication and shared aspirations, in ensuring successful UECs.

Reciprocity

Reciprocity involves a mutual exchange of value. Upholding the balance between stakeholder contributions and returns in UECs allows universities and enterprises to gain benefits from the collaboration (Rybníček & Königsgruber, 2019). In essence, the equitable distribution of inputs, outputs, indemnities and responsibilities reinforces a collective commitment to collaboration, aligning the interests of all involved parties (Dada et al., 2019). Although reciprocity aims for equitable distribution of outputs, power imbalances or divergent aspirations might result in the unequal realisation of benefits for stakeholders. Whilst upholding a sense of balance is critical for collaboration (Dada et al., 2019; Rybníček & Königsgruber, 2019), it is essential to consider that long-term benefits or those arising from a UEC might defy a strictly reciprocal model. For example, academic stakeholders may receive delayed but profound benefits through enhanced reputation, intellectual capital or extended research opportunities. Therefore, stakeholders should adopt a nuanced perspective on reciprocity, acknowledging that the realisation of benefits from UECs may not adhere to immediate, quid-pro-quo arrangements.

Effective Communication

Effective communication ensures the transfer of information between stakeholders (Mores et al., 2019; Thomas & Paul, 2019). Clear and frequent communication is vital in UECs as it aligns goals, reduces misunderstandings and enables rapid adaptation to changing circumstances (Edler & Yeow, 2016; Groulx et al., 2021; Hogan et al., 2017; Rajalo & Vadi, 2017; Rybníček & Königsgruber, 2019). Various conflicts can impede UEC's success, such as conflicting interests, inadequate planning and implementation, bureaucratic constraints, uncertainty regarding expected outcomes, conflicting values, resource competition and discontinuity (Strier, 2014).

Nonetheless, effective communication can aid conflict resolution, which is crucial for the continuity of collaborative efforts.

Kivimaa and colleagues (2019) noted that intermediaries are vital in facilitating effective communication in UECs. Whilst they do not have vested interests in the collaboration, intermediaries encourage co-creation and innovation among stakeholders by ensuring that effective communication is maintained between stakeholders (Edler & Yeow, 2016; Knockaert et al., 2014). Whilst intermediaries can contribute to successful UECs (Kivimaa et al., 2019), it is essential not to over-rely on them, as it might hinder direct communication among stakeholders. Consequently, stakeholders should facilitate effective communication beyond the use of intermediaries. For example, stakeholders should encourage open lines of communication between stakeholders.

Equality

Equality involves treating all partners fairly and respectfully, regardless of their status or background. In UECs, equality ensures that decisions are made collectively and that each stakeholder's input is valued (Groulx et al., 2021). In UECs, equality encourages participation from all stakeholders, which can enhance diversity in terms of knowledge and skill sets and ultimately improves UEC success. Equality is an essential guiding principle and a complex goal within UECs. Systemic inequalities and unconscious biases can present ongoing challenges. Moreover, power imbalances, which can stem from differing positions, resources and influence held by academic institutions and enterprises (Strier, 2014), pose potential challenges within UECs. As such, stakeholders with less power, such as small- and community-based organisations, may hesitate to challenge dominant voices. Therefore, stakeholders should proactively address and mitigate systemic inequalities and unconscious biases to uphold equality within UECs.

Accountability

Accountability involves taking responsibility for commitments and actions. In UECs, accountability ensures all stakeholders meet their obligations, maintain transparency and uphold agreed expectations. In turn, accountability establishes trust among stakeholders. On the other hand, overemphasising accountability in UECs may lead to risk aversion and a stakeholder's effort focusing on procedural compliance rather than achieving collaborative goals. Whilst accountability among collaborators fortify the foundation of successful collaboration (Mores et al., 2019; Rybníček & Königsguber, 2019), other factors like shared values, trust and commitment to a common goal might be equally crucial for UEC's success. Therefore, stakeholders should strategically integrate accountability measures whilst fostering a culture that promotes commitment to the objectives of the collaboration.

Collaborative Networks

Collaborative networks represent the relationships within and beyond the institution or organisation. Within UECs, the establishment of collaborative networks broadens knowledge exchange, facilitates entry into enterprise and amplifies the prospects for innovation (Ankrah & Al-Tabbaa, 2015; Awasthy et al., 2020; Barbini et al., 2021). However, it is crucial to recognise that having an extensive collaborative network does not guarantee UEC's success. Instead, the quality and relevance of collaborative connections are essential. That said, maintaining and actively engaging with a collaborative network requires ongoing financial and time investments. Therefore, stakeholders should strategically allocate resources to nurture and maintain collaborative relationships, ensuring that the network remains dynamic, responsive and conducive to the continuous success of UECs. In turn, collaborative networks enhance the collaborative landscape and provide more opportunities for the formation of UECs, thereby contributing to their overall success.

Networking

Networking allows potential collaborators to connect and build rapport (Awasthy et al., 2020). Networking activities allow academics and industry professionals to share insights and explore avenues for joint initiatives (Barbini et al., 2021). These interactions often lead to identifying shared objectives and complementary expertise, thus facilitating the formation of UECs that address real-world challenges (Freitas et al., 2013). In essence, networking acts as a catalyst for collaboration and subsequent success. However, it is important to be critical and acknowledge that networking alone does not guarantee success. Building meaningful collaborations requires deliberate follow-up and the right combination of compatibility, timing and resources. Additionally, networking can sometimes focus on superficial connections or perpetuate power imbalances. Therefore, stakeholders should approach networking as a strategic endeavour, emphasising genuine and mutually beneficial connections whilst ensuring that subsequent collaborations are built on a foundation of shared goals, equitable participation and a commitment to long-term success.

Effective Management

Effective management encompasses strategic planning, resource allocation and conflict resolution (Galvão et al., 2019). In UECs, effective management ensures that projects are executed efficiently, resources optimised and challenges are addressed promptly (Osafo & Yawson, 2019). In essence, effective management contributes to the overall success of UECs, ensuring their continued progression and achievements (Rybníček & Königsguber, 2019). However, effective management in UECs requires adaptable, context-specific approaches, as traditional corporate or academic management styles might not always translate to external stakeholders. Therefore, stakeholders should embrace adaptable and context-specific approaches to effective management in UECs.

Relational factors play a critical role across various aspects of UECs, influencing both structural and cultural elements as previously discussed, as well as material components within the collaborative framework. With regards to the material elements of this UEC framework, relational elements such as trust, effective communication and collaborative networks, are integral to the success and efficacy of UECs. For example, effective communication facilitates knowledge exchange and enhances absorptive capacity, enabling stakeholders to leverage new insights and technologies. Moreover, relational elements underpin stakeholder investment in UECs by building trust, clarifying expectations and promoting mutual commitment to shared goals. Additionally, relational factors enhance absorptive capacity by facilitating the assimilation and application of external knowledge and technologies. Openness to external ideas and expertise, supported by trust and collaborative networks, enables UECs to adapt and innovate effectively, thereby strengthening their capacity to integrate new knowledge into organisational practices.

Theme 4: Materials

The *material* theme covers the physical resources, technology and infrastructure necessary for collaborations to operate effectively. This theme was characterised by the following sub-themes: human capital, research capability, stakeholder investment and absorptive capacity. Each sub-theme encompassed several concepts (see Table 4).

Human Capital

The term *human capital* encompasses the knowledge, skills, experience and other attributes that individuals possess that contribute to their economic value (Srivastava & Das, 2015). Knowledge is essential to UECs, epitomising the intellectual and experiential wealth of academic and enterprise partners. Knowledge is often tacit in universities, but UECs enable the dissemination of this knowledge among various stakeholders (Maertz Jr et al., 2014). In UECs, knowledge transfer facilitates the convergence of theoretical insights from academia with practical knowledge from industry, fostering a unique synthesis of expertise (Ankrah & Al-Tabbaa, 2015; Bruneel et al., 2010). Moreover, collaborative research efforts serve as a conduit for valuable learning experiences among stakeholders, giving rise to deliberate and serendipitous knowledge exchanges (D Este Cukierman et al., 2013). This transfer of knowledge catalyses innovative problem-solving thus driving UECs towards impactful outcomes (Bruneel et al., 2010). However, a critical question is whether the knowledge exchange is truly reciprocal or if one stakeholder primarily benefits from the other's human capital? Therefore, to promote greater equity in knowledge exchange within UECs, stakeholders direct their attention towards the relational aspects of a UEC.

Although knowledge is considered as a material theme in UECs, knowledge exchange is dependent upon several relational elements involved in UECs. Exchanging knowledge effectively, involves practicing transparency and fostering open

communication between all stakeholders. That said, several structural elements also play crucial roles. For example, the formulation of policies and implementation of effective evaluation methods and strategies to recognise achievements within a UEC. In essence, stakeholders should develop policies and formal agreements that unambiguously define intellectual property rights, publication authorship and establish protocols for data sharing to ensure appropriate credit and compensation for all contributors. Furthermore, regular evaluations of knowledge exchange allow stakeholders to identify their perceptions of reciprocal benefits and areas for enhancement. Finally, stakeholders should actively acknowledge and celebrate collaborative publications, patents or commercialised products resulting from the UEC, thereby highlighting the contributions of both academic and enterprise partners.

Although knowledge is one element of human capital that provides the necessary foundation to embark on a UEC, a workforce that processes the necessary practical skills to execute collaborative endeavors is essential for the effective application of knowledge. In other words, the synergy between theoretical understanding and practical expertise is the fundamental aspect of human capital which together is crucial for the success of UECs.

A skilled workforce consists of individuals with a wide range of expertise and competencies (e.g. specialised knowledge, research, administrative and management skills), which they bring to collaborative projects (Collier et al., 2011; Galloway et al., 2014; Rajalo & Vadi, 2017). This diversity of skills fosters a rich exchange of ideas, perspectives and insights, essential for innovative problem-solving. However, in UECs, mismatches between theoretical knowledge and practical applications can still exist. Whilst diversity of skills is essential, it can also present challenges in various aspects of collaborations, e.g. communication, working styles and expectations between stakeholders. Therefore, UECs might necessitate investments in inter-disciplinary training, bridging cultural gaps and establishing common standards beyond the assumed ‘skills’ individuals possess (Ramli & Senin, 2015). Nonetheless, combining academic knowledge with practical enterprise insights allows the workforce to approach challenges from multidimensional angles, resulting in successful UECs (Ramli & Senin, 2015). However, further research is needed to develop effective strategies to optimise the integration of academic and entrepreneurial knowledge within UECs.

Overall, UECs leverage human capital to foster knowledge transfer between academia and enterprise, thus enhancing the success of UECs (Kafouros et al., 2015). However, considering human capital in this regard, treats individuals as interchangeable units. This approach overlooks the intrinsic motivations that drive individuals, such as a desire for personal growth, intellectual challenge and contributing to meaningful outcomes (Amabile, 1997). As such, ignoring these intrinsic motivators can lead to disengagement which may hinder UEC success (Deci & Ryan, 2000). Individuals seeking fulfilment and genuine collaboration may leave the UECs searching for environments that value their unique contributions. This may lead to the depletion of the human capital necessary for UEC success. Consequently, retaining human capital is also a critical factor in UEC success (Castro-Casal et al., 2013). Therefore, stakeholders should move beyond transactional perspectives and consider

Table 4

Author(s)	Skilled workforce	Research capability	Stakeholder investment	Technology	Absorptive capacity
Albats, Bogers & Podmetna et al., 2020	X	X	X	X	
Albors, 2002	X			X	X
Al-Damen, 2021	X	X		X	
Anjum, 2020	X				
Ankrah & Al-Tabbaa, 2015	X		X	X	X
Arundel, Athreye & Wunsch-Vincent, 2021	X		X	X	X
Awasthy, Flint & Sankaranarayana et al., 2020	X	X	X		X
Barbini, Corsino & Giuri, 2021			X	X	
Barker, 2004	X				
Bekkers & Freitas, 2008		X			
Bruneel, D'Este & Salter, 2010			X	X	
Cai & Etzkowitz, 2020					X
Cai & Liu, 2015			X	X	
Cai, 2014		X	X	X	
Castro-Casal, Neira-Fontela & Álvarez-Pérez, 2013	X	X		X	X
Coleman & Lang, 2012	X				
Collier, Gray & Ahn, 2011	X	X	X	X	X

undefined(continued)

Author(s)	Skilled workforce	Research capability	Stakeholder investment	Technology	Absorptive capacity
D'Hombres & Scnepf, 2021	X				
Dada, McKay, & Mateus et al., 2019				X	
Daly, 2011			X		
de Souza Lessa, Ferreira & Aguiar et al., 2017	X		X		
Dee, Gill & Lacher et al., 2012	X		X		
D'Este, Guy & Iammarino, 2013	X	X	X		X
Edler & Yeow, 2016	X			X	X
Eitzkowitz & Zhou, 2017			X		
Fernandes, Barbosa & Pinto et al., 2019		X	X		
Fernández Fernández et al., 2015		X			
Freitas, Marques & Silva et al. 2013		X	X	X	X
Galloway, Marks, & Chillas, 2014				X	
Galvão, Mascarenhas & Marques et al., 2019	X				
Gorlach, 2017					
Groulx et al., 2021	X		X		
Guimón, 2013	X	X	X	X	X

undefined(continued)

Author(s)	Skilled workforce	Research capability	Stakeholder investment	Technology	Absorptive capacity
Hermosura, 2019	X				
Hogan, Tynan & Covill, 2017	X		X		
Huang & Turner, 2018	X				
Hughes, Nathwani & Sheen et al., 2014	X				
Iqbal, Khan & Iqbal et al., 2011		X			X
Jones, Owen, & Wisner, 2016	X		X		
Kafouros Wang & Piperopoulos et al., 2015	X	X	X	X	X
Kim & Jang, 2021	X	X			
Kivimaaab, Boon & Hyysalod et al., 2019			X		
Knockaert & Spithoven, 2014	X	X	X	X	X
Larsen et a., 2016		X	X		
Leydesdorff & Ivanova, 2016	X	X	X	X	X
Leydesdorff, 2012	X		X	X	
Lin & Bozeman, 2006	X	X	X	X	
Link & Scott, 2017	X				
Link & Scott, 2017	X				
Liu, Liang & Tuuli et al., 2018	X	X	X	X	X

undefined(continued)

Author(s)	Skilled workforce	Research capability	Stakeholder investment	Technology	Absorptive capacity
Liyanage, McDonald & Amaratunga et al., 2020	X	X	X	X	X
Löfsten, Klofsten & Cadorin, 2020	X	X			
Lopes & Lussuamo, 2021	X		X	X	
Maertz, Stoeberl, & Marks, 2014	X		X		
Mores, Lee & Bae, 2019	X	X	X	X	
Myoken, 2013	X				
National Centre for Universities and Business [NCUB], 2021	X	X	X	X	X
Njau, Karimi & Mwenda et al., 2019			X		
OECD, 2019	X				
Okamuro & Nishimura 2013	X	X	X		X
Olivier, Hunt & Ridde, 2016	X		X		
Organisation for Economic Co-operation and Development [OECD], 2015			X		
Osafo & Yawson, 2019	X		X		
Patton & Marlow, 2011			X		
Pellegrini & Johnson-Sheehan, 2021			X		

undefined(continued)

Author(s)	Skilled workforce	Research capability	Stakeholder investment	Technology	Absorptive capacity
Peterson, 2009	X				
Proulx et al., 2014	X		X	X	
Rajalo & Vädi, 2017	X		X	X	X
Ramli & Senin, 2015	X		X	X	
Ranga & Eitzkowitz, 2013	X	X	X	X	X
Rybníček & Königsgrubner, 2019	X		X	X	
Saniter & Siedler, 2014	X		X		
Schaeffer, Öcalan-Özel & Pénin, 2020	X	X	X	X	X
Seppo & Roolah, 2012	X	X	X		
Siegel, Waldman & Link, 2003	X		X	X	
Strier, 2014	X				
Tantane, 2018	X	X			X
Tartari, Salter & D'Este, 2012	X				
Thomas & Paul, 2019	X			X	
Vea, 2014			X		
Veletanlić & Sá, 2020	X	X	X		
Williamson, Young & Murray et al., 2016	X	X			
Weerasinghe & Jayawardane, 2018		X			
Wilson, 2012	X	X	X	X	

the intrinsic motivations of stakeholders and ensure equitable treatment. In turn, this may improve human capital retention and contribute to UEC success.

Research Capability

Research capability refers to stakeholder's ability to conduct research and assimilate findings into innovative solutions. However, research capability is multifaceted and is reliant upon human capital, adequate infrastructure, technology and resources (Awasthy et al., 2020; Castro-Casal et al., 2013; Iqbal et al., 2011). Human capital, as previously discussed, encompasses specialised knowledge and practical skills, which facilitates the translation of knowledge into practical applications (Castro-Casal et al., 2013). That said, human capital also includes supporting staff that enable UEC success by effectively managing the collaboration's administrative, logistical and technical aspects (Larsen et al., 2016). In this regard, human capital streamlines the research process and facilitates efficient collaborative activities.

Technology, on the other hand, is essential to research capabilities. Technology is a conduit for knowledge transfer. In other words, technology aids the transformation of academic insights into industry practices and vice versa (Ankrah & Al-Tabbaa, 2015). Notably, specialised equipment and infrastructure represent a vital component of this technological landscape. Such specialised equipment enables the realisation of novel research endeavours and product development processes, which enhance the capacity of UECs to drive innovation (Ankrah & Al-Tabbaa, 2015). Technology also encompasses collaborative platforms, which streamline stakeholder communication (Awasthy et al., 2020). In UECs, such technological platforms enhance connectivity and collaboration between academia and enterprise by promoting knowledge exchange and efficient coordination. Consequently, technology allows UECs to operate efficiently and effectively to achieve innovative outcomes.

In some cases, technological disparities exist between stakeholders. For example, universities or enterprises with limited access to technology and specialised equipment may encounter challenges in contributing meaningfully to collaborative efforts. That said, digital divides may be more pronounced in less economically developed countries (LEDCs) (Tucker et al., 2023a, 2023b). Therefore, stakeholders should address technological gaps before beginning a collaboration to ensure inclusivity and equitable participation for all stakeholders, particularly when conducting collaborations with stakeholders in LEDCs.

It is also suggested that adequate infrastructure encompassing state-of-the-art laboratories and specialised equipment are needed to conduct rigorous research, thus playing a fundamental role in successful UECs (Larsen et al., 2016; Weerasinghe & Jayawardane, 2018). However, the assumption of "adequate infrastructure" overlooks the stark resource disparities between universities and enterprises. For example, universities or small organisations with limited funding may be unable to match the resources of large enterprises, which may skew the research agenda towards industry priorities. Therefore, some stakeholders may have concerns about equitable access and the potential for industry needs to overshadow academic research priorities.

That said, whilst research capability serves as a material component within the framework of a successful UEC, its efficacy is intricately tied to the interdependent relational themes, such as transparency and reciprocity, emphasising the cohesive and symbiotic nature of these crucial themes within the framework. For example, stakeholders should engage in open dialogues to understand each stakeholders' research capabilities from the outset. In turn, this will allow stakeholders to address resource disparities and work collaboratively to establish mechanisms that promote equitable access to UECs. Simultaneously, stakeholders should consider strategies by which they can increase their research capabilities. For example, stakeholders may establish shared resource centers, cost-sharing models or procure external funding to alleviate the financial burden on small and community-based organisations or stakeholders in LEDCs to promote equitable access to UECs. Moreover, stakeholders must advocate for '*in-house*' policies and initiatives that support the development of research capabilities within their organisation, such as investment in infrastructure or technology and knowledge transfer agreements with outside stakeholders.

Stakeholder Investment

Stakeholder investment is critical in UECs and represents various stakeholders' commitment, resources and active involvement in the collaboration (Rybníček & Königsgruber, 2019). Stakeholder investment encompasses financial support, technology and knowledge sharing and shared dedication to collaborative success (Awasthy et al., 2020; Larsen et al., 2016; Rybníček & Königsgruber, 2019; Vea, 2014). However, the unequal distribution of resources among stakeholders can lead to power imbalances. For example, large enterprises may have a more significant influence, directing research towards commercially driven outcomes rather than addressing broader societal challenges. As such, stakeholders should develop strategies to maintain stakeholder investment throughout UEC.

UECs can involve a diverse range of stakeholders, including government bodies, private enterprises and non-government organisations (Proulx et al., 2014; Wilson, 2012). Universities typically rely on a combination of government and private sector investment to support research activities (Albors, 2002; Wilson, 2012). However, stakeholder investment can impose limitations regarding the scope of UECs. For example, government grants often tie research to national priorities, potentially hindering the pursuit of more innovative UECs. Regardless, it is imperative to obtain adequate stakeholder investment prior to the commencement of a UEC (Proulx et al., 2014; Wilson, 2012).

Whilst stakeholder investment is a material component within this UEC framework, it is interlinked with the relational elements, such as transparency and accountability. Therefore, all stakeholders should be involved in allocating and managing financial resources and investments and exercise transparency and accountability to enhance the success of UECs (Rybníček & Königsgruber, 2019). This proactive approach to securing adequate funding ensures the sustained viability of the collaboration throughout its intended duration (Proulx et al., 2014; Wilson, 2012). Resultingly, UECs are well-positioned to address real-world challenges, facilitate technology transfer and achieve outcomes that resonate across academia, enterprise and society (D Este Cukierman et al., 2013; Myoken, 2013; Rybníček & Königsgruber, 2019).

Absorptive Capacity

Absorptive capacity facilitates technology transfer and fuels a continuous learning process where collaborators refine and expand their skills (Castro-Casal et al., 2013). Whilst absorptive capacity is vital for the success of UECs, factors such as resource constraints and cultural differences can impede knowledge absorption (Arundel et al., 2021). Both human capital and technology represent critical resources in this regard. Proficient and knowledgeable personnel capable of comprehending, interpreting and effectively applying external knowledge are indispensable to UECs. As such, allocating adequate resources to support collaborative activities is essential for success. However, it is pertinent to acknowledge that cultural differences can significantly influence absorptive capacity, particularly in low- and middle-income countries.

Low- and middle-income country stakeholders may face challenges in possessing sufficient absorptive capacity to engage effectively in collaborative projects (Arundel et al., 2021). Consequently, good practices dictate that stakeholders exercise transparency whilst developing collaborations to assess their organisational capacity and capabilities for research and knowledge absorption (NCUB, 2021). Irrespective, absorptive capacity is essential within UECs, embodying the collective competence of stakeholders in effectively acquiring, integrating and applying novel knowledge and insights (Awasthy et al., 2020).

Alike the other elements in this framework, the material elements of UECs are not standalone concepts. Rather, they interact with various cultural, relational and structural elements to synergistically drive the success UECs. For example, stakeholder investment, is influenced by cultural elements like trust and reciprocity, which foster confidence and commitment among stakeholders, thereby securing sustained engagement and financial support. Similarly, research capability within UECs benefits from structural elements such as policies and evaluation methods, which provide frameworks for effective project planning, management and evaluation. Moreover, human capital development is intricately linked to all aspects of UECs. Relational factors like collaborative working styles and mutual learning contribute to skill development and knowledge exchange among participants, enhancing human capital within collaborative settings.

Conclusions

This paper has presented a conceptual UEC framework by synthesising key concepts from the existing body of UEC literature. The framework presents the fundamental aspects of successful UECs but may need to be extended to adapt to the specific objectives of individual UECs across various contexts. However, it is important to note that the identified themes within this framework are not isolated entities; instead, a degree of interdependency exists among various themes and subthemes. That said, existing UEC research often addresses individual themes such as policies, intellectual property or human capital in isolation. Consequently, there is a notable gap in studies that investigate how these concepts interact and influence each other. This fragmented approach limits the understanding of how various concepts

collectively contribute to the success of UECs. Thus, future research should aim to bridge this gap by exploring the internal relationships between the themes/concepts introduced in this framework to provide more nuanced insights and practical recommendations to ensure UEC success. That said, the conceptual UEC framework presented can be used as a foundation to guide UEC practices. Nonetheless, continuous research, empirical validation and refinement of the UEC framework will be essential to ensure its efficacy. In conclusion, developing this conceptual UEC framework constitutes a significant step toward developing relationships between universities and enterprises. Its adaptability and conceptual basis have the potential to enhance collaborative outcomes.

Limitations/Future Research Directions

Whilst helpful in identifying key themes, sub-themes and their underlying concepts, thematic analysis (Braun & Clarke, 2006) relies on researcher interpretation. Therefore, thematic analysis (Braun & Clarke, 2006) of existing UEC literature may not fully capture the complexities of individual stakeholder structures and cultures. Therefore, future research is needed to assess the feasibility and validity of the framework to determine its applicability to real-world UECs. That said, most UEC literature has been derived from the academic perspective of UECs. As such, future research should consider non-academic stakeholder experiences of UEC to gain an all-round understanding of the factors critical to UEC success. The findings from future research would subsequently permit the refinement of the framework for practical application across various types of UEC. Nonetheless, the conceptual framework presented provides a theoretical understanding of the critical domains within UEC that require attention to ensure the success of UECs.

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Declarations

Conflict of Interest The authors declare no competing interests.

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References

- Abdulai, A., Murphy, L., & Thomas, B. (2020). University knowledge transfer and innovation performance in firms: The Ghanaian experience. *International Journal of Innovation Management*, 24(03), 2050023.
- Abendan, R. (2017). Establishing industry-academe linkages: The STRIDE experience [Powerpoint Slides]. In *Paper presented at the national research innovation and extension conference*.
- Abu-Jarad, I. Y., Yusof, N., & Nikbin, D. (2010). A review paper on organizational culture and organizational performance. *International Journal of Business and Social Science*, 1(3), 26–46.
- Adamczyk, A., Crawford, K., & Kim, Y. (2022). Assessing the benefits of college internships at a Hispanic serving institution. *Journal of Hispanic Higher Education*, 21(4), 432–449.
- Adeosun, O. T., Shittu, A. I., & Owolabi, T. J. (2022). University internship systems and preparation of young people for world of work in the 4th industrial revolution. *Rajagiri Management Journal*, 16(2), 164–179.
- Albahari, A., Klofsten, M., & Rubio-Romero, J. C. (2019). Science and technology parks: A study of value creation for park tenants. *The Journal of Technology Transfer*, 44(4), 1256–1272.
- Albats, E., Bogers, M., & Podmetina, D. (2020). Companies' human capital for university partnerships: A micro-foundational perspective. *Technological Forecasting and Social Change*, 157, 120085.
- Albats, E., Bogers, M. L., & Podmetina, D. (2016). Companies' human capital required for collaboration: Toward a focus on university relations. Paper presented at the *University-Industry Interaction Conference-Amsterdam, Netherlands*.
- Albors, J. G. (2002). Networking and technology transfer in the Spanish ceramic tiles cluster: Its role in the sector competitiveness. *The Journal of Technology Transfer*, 27(3), 263–273.
- Al-Damen, R. A. (2021). Business incubator and its impact on business success: A case study of Jordan enterprise development corporation (JEDCO). *Journal of Management and Sustainability*, 11(1), 1–35.
- Amabile, T. M. (1997). Entrepreneurial creativity through motivational synergy. *The Journal of Creative Behavior*, 31(1), 18–26.
- Anjum, S. (2020). Impact of internship programs on professional and personal development of business students: A case study from Pakistan. *Future Business Journal*, 6(1), 1–13.
- Ankrah, S., & Al-Tabbaa, O. (2015). Universities–industry collaboration: A systematic review. *Scandinavian Journal of Management*, 31(3), 387–408.
- Arundel, A., Athreye, S., & Wunsch-Vincent, S. (2021). *Harnessing public research for innovation in the 21st century: An international assessment of knowledge transfer policies*. Cambridge University Press.
- Avvisati, F., Jacotin, G., & Vincent-Lancrin, S. (2013). Educating higher education students for innovative economies: What international data tell us. *Tuning Journal for Higher Education*, 1(1), 223–240.
- Awasthy, R., Flint, S., Sankarnarayana, R., & Jones, R. L. (2020). A framework to improve university–industry collaboration. *Journal of Industry-University Collaboration*, 2(1), 49–62. <https://doi.org/10.1108/JIUC-09-2019-0016>
- Barbini, F. M., Corsino, M., & Giuri, P. (2021). How do universities shape founding teams? Social proximity and informal mechanisms of knowledge transfer in student entrepreneurship. *The Journal of Technology Transfer*, 46(4), 1046–1082.
- Barker, D. (2004). The scholarship of engagement: A taxonomy of five emerging practices. *Journal of Higher Education Outreach and Engagement*, 9(2), 123–137.
- Bekkers, R., & Freitas, I. M. B. (2008). Analysing knowledge transfer channels between universities and industry: To what degree do sectors also matter? *Research Policy*, 37(10), 1837–1853.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Bruneel, J., d'Este, P., & Salter, A. (2010). Investigating the factors that diminish the barriers to university–industry collaboration. *Research Policy*, 39(7), 858–868.
- Cai, Y. (2014). Implementing the Triple Helix model in a non-Western context: an institutional logics perspective. *Triple Helix*, 1(1), 1–20.
- Cai, Y., & Etzkowitz, H. (2020). Theorizing the triple helix model: Past, present, and future. *Triple Helix*, 7(2–3), 189–226.
- Cai, Y., & Liu, C. (2015). The roles of universities in fostering knowledge-intensive clusters in Chinese regional innovation systems. *Science & Public Policy*, 42(1), 15–29. <https://doi.org/10.1093/scipol/scu018>
- Casper, S., & Kettler, H. (2001). National institutional frameworks and the hybridization of entrepreneurial business models: The German and UK biotechnology sectors. *Industry and Innovation*, 8(1), 5–30.

- Castelló, M. L., Barrera, C., & Seguí, L. (2023). Bridging the academia-industry gap in the food sector through collaborative courses and internships. *Education for Chemical Engineers*, 42, 33–43.
- Castro-Casal, C., Neira-Fontela, E., & Álvarez-Pérez, M. D. (2013). Human resources retention and knowledge transfer in mergers and acquisitions. *Journal of Management & Organization*, 19(2), 188–209.
- Chow, M., Hua, J., & Hung, W. (2020). Tertiary education and innovation in the greater bay area. *Asian Education and Development Studies*, 9(3), 325–336.
- Coleman, B., & Lang, M. (2012). Collaboration across the curriculum: A disciplined approach to developing team skills. Paper presented at the *Proceedings of the 43rd ACM Technical Symposium on Computer Science Education*, 277–282.
- Collier, A., Gray, B. J., & Ahn, M. J. (2011). Enablers and barriers to university and high technology SME partnerships. *Small Enterprise Research*, 18(1), 2–18.
- Dada, S., McKay, G., Mateus, A., & Lees, S. (2019). Lessons learned from engaging communities for Ebola vaccine trials in Sierra Leone: Reciprocity, relatability, relationships and respect (the four r's). *BMC Public Health*, 19(1), 1665. <https://doi.org/10.1186/s12889-019-7978-4>
- Daly, A. (2011). Determinants of participating in Australian university student exchange programs. *Journal of Research in International Education*, 10(1), 58–70.
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227–268.
- Dee, N., Gill, D., Lacher, R., Livesey, F., & Minshall, T. (2012). A review of research on the role and effectiveness of business incubation for high-growth start-ups. Centre for Technology Management Working Paper Series, 1, 2012
- de Souza Lessa, B., de Souza, A. C. A. A., Ferreira, R. C., & Aguiar, Í. C. (2017). Innovating for social demands—A double case study in effective social enterprises from the Brazilian semi-arid. *Revista Gestão E Desenvolvimento*, 14(2), 4–18.
- Dos Santos, E. F., & Benneworth, P. (2019). Makerspace for skills development in the industry 4.0 era. *Brazilian Journal of Operations & Production Management*, 16(2), 303–315.
- D'Este Cukierman, P., Guy, F., & Iammarino, S. (2013). Shaping the formation of university–industry research collaborations. *Journal of Economic Geography*, 13(4), 537–558. <https://doi.org/10.1093/jeg/lbs010>
- d'Hombres, B., & Schnepf, S. V. (2021). International mobility of students in Italy and the UK: Does it pay off and for whom? *Higher Education*, 82(6), 1173–1194.
- Edler, J., & Yeow, J. (2016). Connecting demand and supply: The role of intermediation in public procurement of innovation. *Research Policy*, 45(2), 414–426.
- Etzkowitz, H., & Zhou, C. (2017). The triple helix: University–industry–government innovation and entrepreneurship. Routledge.
- Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, 5(1), 80–92.
- Fernandes, G., Barbosa, J., Pinto, E. B., Araújo, M., & Machado, R. J. (2019). Applying a method for measuring the performance of university–industry R&D collaborations: Case study analysis. *Procedia Computer Science*, 164, 424–432.
- Fernández Fernández, M. T., Blanco Jiménez, F. J., & Cuadrado Roura, J. R. (2015). Business incubation: Innovative services in an entrepreneurship ecosystem. *The Service Industries Journal*, 35(14), 783–800.
- Fischer, B., Guerrero, M., Guimón, J., & Schaeffer, P. R. (2021). Knowledge transfer for frugal innovation: Where do entrepreneurial universities stand? *Journal of Knowledge Management*, 25(2), 360–379.
- Freitas, I. M. B., Marques, R. A., & e Silva, E. M. d. P. (2013). University–industry collaboration and innovation in emergent and mature industries in new industrialized countries. *Research Policy*, 42(2), 443–453.
- Galloway, L., Marks, A., & Chillas, S. (2014). The use of internships to foster employability, enterprise and entrepreneurship in the IT sector. *Journal of Small Business and Enterprise Development*, 21(4), 653–667. <https://doi.org/10.1108/JSBED-09-2014-0150>
- Galvão, A., Mendes, L., Marques, C., & Mascarenhas, C. (2019). Factors influencing students' corporate social responsibility orientation in higher education. *Journal of Cleaner Production*, 215, 290–304.
- Gorlach, I. (2017). A success of university–industry partnership. *New Trends and Issues Proceedings on Humanities and Social Sciences*, 4(6), 17–25. <https://doi.org/10.18844/PROSOC.V4I6.2907>
- Groulx, M., Nowak, N., Levy, K., & Booth, A. (2021). Community needs and interests in university–community partnerships for sustainable development. *International Journal of Sustainability in Higher Education*, 22(2), 274–290.

- Guimón, J. (2013). Promoting university-industry collaboration in developing countries. *World Bank*, 3, 12–48.
- Hénard, F., Diamond, L., & Roseveare, D. (2012). Approaches to internationalisation and their implications for strategic management and institutional practice. *IMHE Institutional Management in Higher Education*, 11(12), 2013.
- Hermosura, J. B. (2019). Fostering human capital development through the triple helix model of innovation: Cases from selected Local Colleges and Universities (LCUs) in Metro Manila. *Paper presented at the Iapa Proceedings Conference*, 788–814.
- Hidalgo, E. S. (2019). Adapting the scrum framework for agile project management in science: Case study of a distributed research initiative. *Heliyon*, 5(3), e01447.
- Hogan, K. S., Tynan, J. M., Covill, V. J., Kilmer, R. P., & Cook, J. R. (2017). A capacity building framework for community-university partnerships. *Collaborations*, 1(1), 1. <https://doi.org/10.33596/coll.10>
- Huang, M., & Chen, D. (2017). How can academic innovation performance in university–industry collaboration be improved? *Technological Forecasting and Social Change*, 123, 210–215.
- Huang, R., & Turner, R. (2018). International experience, universities support and graduate employability - Perceptions of Chinese international students studying in UK universities. *Journal of Education and Work*, 31(2), 175–189. <https://doi.org/10.1080/13639080.2018.1436751>
- Hughes, T., Nathwani, T., Sheen, J., Brennan, J., & Durazzi, N. (2014). Research and analysis on the benefits of international opportunities. *British Council*. https://www.britishcouncil.org/sites/default/files/research_and_analysis_on_the_benefits_of_international_opportunities_cfe_research_and_lse_enterprise_report_0.pdf. Accessed 18 Jan 2023.
- Iqbal, A. M., Khan, A. S., Iqbal, S., & Senin, A. A. (2011). Designing of success criteria-based evaluation model for assessing the research collaboration between university and industry. *International Journal of Business Research and Management*, 2(2), 59–73.
- Jones, S., Oven, K. J., & Wisner, B. (2016). A comparison of the governance landscape of earthquake risk reduction in Nepal and the Indian State of Bihar. *International Journal of Disaster Risk Reduction*, 15, 29–42.
- Kafourous, M., Wang, C., Piperopoulos, P., & Zhang, M. (2015). Academic collaborations and firm innovation performance in China: The role of region-specific institutions. *Research Policy*, 44(3), 803–817.
- Kang, J., & Girouard, A. (2022). Impact of UX internships on human-computer interaction graduate students: A qualitative analysis of internship reports. *ACM Transactions on Computing Education (TOCE)*, 22(4), 1–25.
- Kim, L., & Jang, D. (2021). Culturing atmosphere for spontaneous innovation: academic action and triple-helix dynamics in South Korea. *Higher Education Policy*, 34(2), 429–455.
- Kivimaa, P., Boon, W., Hyysalo, S., & Klerkx, L. (2019). Towards a typology of intermediaries in sustainability transitions: A systematic review and a research agenda. *Research Policy*, 48(4), 1062–1075. <https://doi.org/10.1016/j.respol.2018.10.006>
- Knockaert, M., Spithoven, A., & Clarysse, B. (2014). The impact of technology intermediaries on firm cognitive capacity additionality. *Technological Forecasting and Social Change*, 81, 376–387.
- Kobayashi, S., Dolin, J., Søborg, A., & Turner, J. (2017). *Building academic staff teaching competencies: How pedagogic continuous professional development for academic staff can be organised and developed in research-intensive universities* (pp. 103–128). Strengthening Teaching and Learning in Research Universities.
- Kraft, C., Jeske, D., & Bayerlein, L. (2019). Seeking diversity? consider virtual internships. *Strategic HR Review*, 18(3), 133–137. <https://diversityatlas.io/wp-content/uploads/2023/08/2019-Seeking-diversity-Consider-virtual-internships.pdf>. Accessed 15 Feb 2023.
- Larsen, K., Bandara, D. C., Esham, M., & Unantenne, R. (2016). *Promoting university-industry collaboration in Sri Lanka: Status, case studies, and policy options*. World Bank Publications.
- Leydesdorff, L. (2012). The knowledge-based economy and the triple helix model. *arXiv Preprint arXiv:1201.4553*.
- Leydesdorff, L., & Ivanova, I. (2016). “Open innovation” and “triple helix” models of innovation: Can synergy in innovation systems be measured? *Journal of Open Innovation: Technology, Market, and Complexity*, 2(1), 1–12.
- Li, L., & Li, J. (2013). Hospitality education in China: A student career-oriented perspective. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 12(1), 109–117.
- Li, Z., & Zhu, G. (2021). Knowledge transfer performance of industry-university-research institute collaboration in China: The moderating effect of partner difference. *Sustainability*, 13(23), 13202.

- Li, Z., Wan, T., & Lan, J. (2022). Substitution or complementarity: Influence of industry–university–research-institute cooperation governance mechanism on knowledge transfer—An empirical analysis from China. *Sustainability*, 14(13), 7606.
- Liang, L., Chen, L., Wu, Y., & Yuan, J. (2012). The role of Chinese universities in enterprise–university research collaboration. *Scientometrics*, 90(1), 253–269.
- Ligita, T., Nurjannah, I., Wicking, K., Harvey, N., & Francis, K. (2022). From textual to visual: The use of concept mapping as an analytical tool in a grounded theory study. *Qualitative Research*, 22(1), 126–142.
- Lin, M., & Bozeman, B. (2006). Researchers' industry experience and productivity in university–industry research centers: A "scientific and technical human capital" explanation. *The Journal of Technology Transfer*, 31(2), 269–290. <https://doi.org/10.1007/s10961-005-6111-2>
- Link, A. N., & Scott, J. T. (2012). Employment growth from public support of innovation in small firms. *Economics of Innovation and New Technology*, 21(7), 655–678.
- Link, A. N., & Scott, J. T. (2017). *US university research parks*. Edward Elgar Publishing.
- Liu, C., & Cai, Y. (2018). Triple helix model and institutional logics in Shenzhen special economic zone. *Science and Public Policy*, 45(2), 221–231.
- Liu, A. M., Liang, O. X., Tuuli, M., & Chan, I. (2018). Role of government funding in fostering collaboration between knowledge-based organizations: Evidence from the solar PV industry in China. *Energy Exploration & Exploitation*, 36(3), 509–534.
- Liyanage, C., Thakore, R., Amartunga, D., Mustapha, A., & Haigh, R. (2018). The barriers to research and innovation in disaster resilience in higher education institutions in Asia. *Procedia Engineering*, 212, 1225–1232.
- Liyanage C, McDonald R, Amaratunga D and Haigh R (2020) *University-industry partnerships (UIPs) for research and innovation in disaster resilience*. : National Science Foundation of Sri Lanka.
- Löfsten, H., Klofsten, M., & Cadorin, E. (2020). Science parks and talent attraction management: University students as a strategic resource for innovation and entrepreneurship. *European Planning Studies*, 28(12), 2465–2488.
- Lopes, J., & Lussuamo, J. (2021). Barriers to university–industry cooperation in a developing region. *Journal of the Knowledge Economy*, 12(3), 1019–1035.
- Ma, Z., Augustijn, K., de Esch, I. J., & Bossink, B. (2022). Collaborative university–industry R&D practices supporting the pharmaceutical innovation process: Insights from a bibliometric review. *Drug Discovery Today*, 27(8), 2333–41.
- Maertz, C. P., Jr., Stoeberl, P. A., & Marks, J. (2014). Building successful internships: lessons from the research for interns, schools, and employers. *Career Development International*, 19(1), 123–142. <https://doi.org/10.1108/CDI-03-2013-0025>
- Matthews, A., McLinden, M., & Greenway, C. (2021). Rising to the pedagogical challenges of the fourth industrial age in the university of the future: An integrated model of scholarship. *Higher Education Pedagogies*, 6(1), 1–21.
- Mdleleni, L. (2022). University as a vehicle to achieve social innovation and development: Repositioning the role of the university in the society. *Social Enterprise Journal*, 18(1), 121–139.
- Miller, K., McAdam, M., & McAdam, R. (2014). The changing university business model: A stakeholder perspective. *R&D Management*, 44(3), 265–287.
- Mores, L. S., Lee, J., & Bae, W. (2019). University–community partnerships: A local planning co-production study on calabarzon, philippines. *Sustainability*, 11(7), 1850.
- Mougin, C., Campbell, P. G., Couderchet, M., Denèfle, P., Martin-Laurent, F., Roland, P., Slaveykova, V. I., Vincent, T., & Delaunay, D. (2021). Academic expertise in assisting private companies in the fields of environment and environmental toxicology: The role of individual expertise. *Environmental Science and Pollution Research*, 28, 1283–1286.
- Myoken, Y. (2013). The role of geographical proximity in university and industry collaboration: Case study of Japanese companies in the UK. *International Journal of Technology Transfer and Commercialisation*, 12(1–3), 43–61.
- Naeem, M., Ozuem, W., Howell, K., & Ranfagni, S. (2023). A step-by-step process of thematic analysis to develop a conceptual model in qualitative research. *International Journal of Qualitative Methods*, 22, 16094069231205789.
- Nama, G. F., & Kurniawan, D. (2017). An enterprise architecture planning for higher education using the open group architecture framework (TOGAF): Case study university of Lampung. Paper presented at the 2017 Second International Conference on Informatics and Computing (ICIC), 1–6.
- NCUB. (2021). *Best practice strategies for successful innovation through university-business collaboration*. (). Best practice strategies for successful innovation through university-business collaboration

- Njau, J. M., Mwenda, L. K. M., & Wachira, A. W. (2019). Effect of infrastructural facilities support provided by business incubators on technology based new venture creation in Kenya.
- Noble, D., Charles, M. B., & Keast, R. (2017). New development: Towards a collaborative competency framework to enhance public value in university- industry collaboration. *Public Money & Management*, 37(5), 373–378. <https://doi.org/10.1080/09540962.2017.1328799>
- OECD. (2015). Enquiries into intellectual property's economic impact. [https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/ICCP\(2014\)17/CHAP1/FINAL&docLanguage=En](https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/ICCP(2014)17/CHAP1/FINAL&docLanguage=En). Accessed 18 Jan 2023.
- OECD. (2019). *University-Industry Collaboration New Evidence and Policy Options*. OECD Publishing. https://www.oecd.org/en/publications/university-industry-collaboration_e9c1e648-en.html. Accessed 18 Jan 2023.
- Okamuro, H., & Nishimura, J. (2013). Impact of university intellectual property policy on the performance of university-industry research collaboration. *The Journal of Technology Transfer*, 38(3), 273–301.
- Olivier, C., Hunt, M. R., & Ridde, V. (2016). NGO–researcher partnerships in global health research: Benefits, challenges, and approaches that promote success. *Development in Practice*, 26(4), 444–455.
- Osafo, E., & Yawson, R. M. (2019). The role of HRD in university–community partnership. *European Journal of Training and Development*, 43(5/6), 536–53.
- Osorno-Hinojosa, R., Koria, M., del Carmen, D., & Ramírez-Vázquez. (2022). Open innovation with value co-creation from university–industry collaboration. *Journal of Open Innovation*, 8(1), 1–16. <https://doi.org/10.3390/joitmc8010032>
- Page, S., Trudgett, M., & Bodkin-Andrews, G. (2019). Creating a degree-focused pedagogical framework to guide indigenous graduate attribute curriculum development. *Higher Education*, 78, 1–15.
- Patton, D., & Marlow, S. (2011). University technology business incubators: Helping new entrepreneurial firms to learn to grow. *Environment and Planning c: Government and Policy*, 29(5), 911–926.
- Pellegrini, M., & Johnson-Sheehan, R. (2021). The evolution of university business incubators: Transnational hubs for entrepreneurship. *Journal of Business and Technical Communication*, 35(2), 185–218.
- Peterson, A. (2009). Civic republicanism and contestatory deliberation: Framing pupil discourse within citizenship education. *British Journal of Educational Studies*, 57(1), 55–69.
- Polese, F., Ciasullo, M. V., & Montero, R. (2021). Value co-creation in university-industry collaboration. An exploratory analysis in digital research projects. *Sinergie Italian Journal of Management*, 39(2), 117–134.
- Proulx, K. E., Hager, M. A., & Klein, K. C. (2014). Models of collaboration between nonprofit organizations. *International Journal of Productivity and Performance Management*, 63(6), 746–765.
- Rajalo, S., & Vadi, M. (2017). University-industry innovation collaboration: Reconceptualization. *Technovation*, 62, 42–54.
- Ramli, M. F., & Senin, A. A. (2015). Success factors to reduce orientation and resources-related barriers in university-industry R&D collaboration particularly during development research stages. *Procedia-Social and Behavioral Sciences*, 172, 375–382.
- Ranga, M., & Etzkowitz, H. (2013). Triple helix systems: an analytical framework for innovation policy and practice in the knowledge society. *Industry & Higher Education*, 27(4), 237–262. <https://doi.org/10.5367/ihe.2013.0165>
- Rosas, S. R., & Camphausen, L. C. (2007). The use of concept mapping for scale development and validation in evaluation. *Evaluation and Program Planning*, 30(2), 125–135.
- Rosas, S. R., & Ridings, J. W. (2017). The use of concept mapping in measurement development and evaluation: Application and future directions. *Evaluation and Program Planning*, 60, 265–276.
- Rybníček, R., & Königsgruber, R. (2019). What makes industry–university collaboration succeed? A systematic review of the literature. *Journal of Business Economics*, 89(2), 221–250.
- Saniter, N., & Siedler, T. (2014). Door opener or waste of time? The effects of student internships on labor market outcomes.
- Schaeffer, V., Öcalan-Özel, S., & Pénin, J. (2020). The complementarities between formal and informal channels of university–industry knowledge transfer: A longitudinal approach. *The Journal of Technology Transfer*, 45(1), 31–55. <https://doi.org/10.1007/s10961-018-9674-4>
- Seppo, M., & Reino, A. (2012). The policy suggestions concerning motivations and barriers of university-industry cooperation. *Discussions on Estonian Economic Policy: Theory and Practice of Economic Policy*, 20(1)
- Shinn, T. (2003). The ‘triple helix’ and ‘new production of knowledge’ as socio-cognitive fields. *Social studies of science and technology: Looking back, ahead* (pp. 103–116). Springer.

- Siegel, D. S., Waldman, D., & Link, A. (2003). Assessing the impact of organizational practices on the relative productivity of university technology transfer offices. *Research Policy*, 32(1), 27–48. [https://doi.org/10.1016/S0048-7333\(01\)00196-2](https://doi.org/10.1016/S0048-7333(01)00196-2)
- Sjöö, K., & Hellström, T. (2019). University–industry collaboration: A literature review and synthesis. *Industry and Higher Education*, 33(4), 275–285.
- Srivastava, K., & Das, R. C. (2015). Human capital management: Economics of psychological perspective. *Industrial Psychiatry Journal*, 24(2), 115–118.
- Starov, O., Sklyar, V., Kharchenko, V., Boyarchuk, A., & Phillips, C. (2014). A student-in-the-middle approach for successful university and business cooperation in IT. Paper presented at the *Proceedings of the University-Industry Interaction Conference, Barcelona, Spain*, 193–207.
- Stockwell, P., Colomb, R. M., Smith, A. E., & Wiles, J. (2009). Use of an automatic content analysis tool: A technique for seeing both local and global scope. *International Journal of Human-Computer Studies*, 67(5), 424–436.
- Strier, R. (2014). Fields of paradox: University–community partnerships. *Higher Education*, 68(2), 155–165.
- Tantane, S., Buranajakorn, P., & Apichayakul, P. (2018). University-industry linkages in the disaster resilience sector: A case study of Thailand. *Procedia Engineering*, 212, 519–526.
- Tartari, V., Salter, A., & D'Este, P. (2012). Crossing the rubicon: Exploring the factors that shape academics' perceptions of the barriers to working with industry. *Cambridge Journal of Economics*, 36(3), 655–677.
- Thomas, A., & Paul, J. (2019). Knowledge transfer and innovation through university-industry partnership: An integrated theoretical view. *Knowledge Management Research & Practice*, 17(4), 436–448.
- Trochim, W. M. (1989). An introduction to concept mapping for planning and evaluation. *Evaluation and Program Planning*, 12(1), 1–16.
- Trochim, W. M., & McLinden, D. (2017). Introduction to a special issue on concept mapping. *Evaluation and Program Planning*, 60, 166–175.
- Tucker, R. C., Liyanage, C., Robinson, S. J., Montebon, D. R., Gotangco Gonzales, C. K., Olpoc, J. C., Patacsil, L. B., Tantane, S., Buranajakorn, P., & Apichayaku, O. S. (2023a). Understanding university enterprise collaboration for disaster resilience in South-east Asia. *International Journal of Disaster Resilience in the Built Environment*. <https://doi.org/10.1108/IJDRBE-02-2023-0010>
- Tucker, R. C., Robinson, S. J., & Liyanage, C. L. (2023b). What makes university-enterprise collaborations successful? An integrative review. [manuscript submitted for publication].
- Universities Australia. (2019). *Work-integrated learning in universities*. Retrieved 07 July 2023, from https://ltr.edu.au/resources/WIL_in_universities_-_final_report_April_2019.pdf
- Urquía-Grande, E., & Perez Estebanez, R. (2020). Bridging the gaps between higher education and the business world: Internships in a faculty of economics and business. *Education Training*, 63(3), 490–509.
- Utami, V. H. B., Dewi, A., & Listiowati, E. (2018). The role of faculty of medicine and health sciences in the preparation of human resources for academic health center concept at Muhammadiyah Gamping Hospital, Yogyakarta. Paper presented at the *4th International Conference on Public Health 2018*, 252.
- Vea, R. B. (2014). Industry-academe collaboration for research and development (No. 2014-10). PIDS Discussion Paper Series. <https://hdl.handle.net/10419/126973>
- Veletanlić, E., & Sá, C. (2020). Implementing the innovation agenda: A study of change at a research funding agency. *Minerva*, 58(2), 261–283.
- Weerasinghe, R. N., & Jayawardane, A. K. (2018). University-industry partnerships for innovation: Sri Lankan experiences. *Annals of Spiru Haret University, Economic Series*, 9(1), 25–45.
- Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: A reference framework for academic program development. *Sustainability Science*, 6, 203–218.
- Williamson, H. J., Young, B., Murray, N., Burton, D. L., Levin, B. L., Massey, O. T., & Baldwin, J. A. (2016). Community–university partnerships for research and practice: Application of an interactive and contextual model of collaboration. *Journal of Higher Education Outreach and Engagement*, 20(2), 55.
- Wilson, T. (2012). A review of business–university collaboration.
- Yusof, S. M., & Aspinwall, E. (2000). Total quality management implementation frameworks: Comparison and review. *Total Quality Management*, 11(3), 281–294.

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