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TYPOLOGY OF INDUSTRIAL COLLABORATIVE IDEALS

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Abstract

University–Industry Collaboration (UIC) has been a well-established field of research for over 50 years, offering insights into best practices, precursors, and supporting factors while acknowledging industry partners as proactive contributors. However, a comprehensive understanding of how industry approaches UIC remains elusive. This study examines industry collaboration strategies with higher education institutions (HEIs) and defines ideal types of industrial collaborators, illustrating their engagement approaches. Using a qualitative, inductive methodology, we conducted 20 semi-structured interviews with senior management and strategic decision-makers from large enterprises engaged in academic collaboration. The data were analyzed following Gioia et al. (2013) to ensure qualitative rigor, and a typology was developed based on the framework of Doty and Glick (1994). Our analysis introduces a novel typology of industrial collaboration ideals, providing a theoretical framework to better understand the complex and multidimensional nature of UIC from an industry perspective. We identify key variations in organizational approaches, infrastructure, and support mechanisms that facilitate effective university engagement, highlighting differences in design and implementation. This study contributes critical insights into the underexplored industry perspective within the Triple Helix framework, offering a benchmark for assessing industry collaboration effectiveness and laying a foundation for optimizing UIC strategies.

Keywords

UIC, Industry perspective, Industry engagement typology, Ideal types, Collaborative approaches.

Introduction

Interest in university-industry collaboration (UIC) from both policy makers and scholars has increased dramatically over the last 30 years, given its ability to generate positive change (Ankrah & Al-Tabbaa, 2015; Tian, Su, & Yang, 2022; Bastos, Sengik, & Tello-Gamarra, 2021; Perkmann, Salandra, Tartari, McKelvey, & Hughes, 2021). UIC not only benefits collaborating partners, for example by facilitating knowledge harvesting and technology transfer (Ponomariov, 2013) and developing graduates with skills and knowledge aligned with the needs of the labour market (Bozeman & Boardman, 2013), it also contributes more broadly to the economic development of countries and regions (Rajalo & Vadi, 2017). Hence, aligned to their leading role they play in higher education and research, UIC has enabled Higher Educational Institutions (HEIs) to assume a prominent role within their regional and national innovation ecosystems (Goddard and Chatterton 1999). The increasing dynamic of the world economy intertwined with ever-changing business needs further the momentum of HEIs to contribute via organized academia-business collaborations (Galán-Muros, Sijde, Groenewegen, & Baaken, 2017).

Lacking the abilities from within, industry is increasingly turning to academia as a source of innovation and new knowledge, in order to achieve or maintain a competitive advantage (O'Regan, Ghobadian, & Sims, 2006; Ankrah & Al-Tabbaa, 2015) HEIs, in turn, benefit from UIC across education, research and commercialization domains (Galán-Muros et al., 2017). The symbiotic relationship of industry and academia is inducing structural changes and enhancements pertaining to the framework of the participating institutions. Specifically, HEIs are increasingly establishing technology transfer offices (TTOs) (Aldridge & Audretsch, 2011; Perkmann et al., 2013) and engagement centers (Shen, Coreynen, & Huang, 2022; Galán-Muros et al., 2017), while businesses utilize internal intermediaries or individuals tasked with strategically developing and/or implementing such linkages. Moreover, policy makers are actively promoting the creation and development of university-industry (U-I) interactions via the implementation of innovation policies (Galán-Muros et al., 2017; Perkmann et al., 2013). An increasing emphasis is placed on the transfer of knowledge not only from academia to industry and vice versa, but also between academia and society.

While being recognized as a separate discipline for the past 30 years (Gulbrandsen, Mowery, & Feldman, 2011; Galan-Muros & Davey, 2019), UIC literature has experienced increasing prominence over the past decade (Perkmann et al., 2021). Authors have generated extensive knowledge regarding the antecedents and enabling factors of UIC (Rybnicek & Königsgruber, 2019; Sjöö & Hellström, 2019), including barriers, motivations, and facilitators (Galan-Muros & Davey, 2019; Perkmann et al., 2021). Furthermore, important insights have emerged into collaboration activities (Perkmann & Walsh, 2007) as well as the mechanisms that support cooperation (Villani, Rasmussen, & Grimaldi, 2017).

Yet, despite significant advances in our understanding of UIC, the research field remains fragmented and biased (Galan-Muros & Davey, 2019), characterized by a lack of connections across empirical work and theoretical advancements (Skute, Zalewska-Kurek, Hatak, & de Weerd-Nederhof, 2019). Moreover, the focal point of research in multi-sectoral collaborations is skewed. Despite a vast diversity of participating stakeholders in UIC and despite recognition of industry partners as proactive contributors to UIC (Giones, 2019), much of the extant research focuses on the university and thus the academic perspective of such collaborations, as compared to the external partners (Skute et al., 2019). Notable exceptions have generated valuable insights into the industry partners' motivations and aims for cooperation (Perkmann, Neely, & Walsh, 2011), the effect of spill overs on industry (Martín-de-Castro, Delgado-Verde, López-Sáez, & Navas-López, 2011), the capacity for cooperation (Zahra & George, 2002).

Recently, authors have noted the diversity in collaboration strategies and tactics implemented by industry (Frølund & Riedel, 2018); Skute et al., 2019). However, we are yet to generate an in-depth understanding of existing and developing models utilized by industry for managing and successfully leveraging collaborations with HEIs. The fragmented nature of extant knowledge limits advances, as we lack the foundational understanding on which to advance knowledge and practice. Hence, this research seeks to address the following research question: (1) How do firms approach collaborations with HEIs? To answer the research question and thus to generate a sound conceptualization of firm's approaches to UIC, grounded in managerial practice, we inductively examine existing approaches firms, in particular large multi-national companies, take towards their collaborations with HEIs through a series of in-depth interviews. Taking into consideration the absorptive capacity, economies of scale, and the Schumpeterian hypothesis (Tsai, 2009; Fontana, Geuna, & Matt, 2006; Laursen & Salter, 2004; Fernández López, Pérez Astray, Rodeiro Pazos, & Calvo, 2015) - investigating the collaborative approaches of large enterprises is deemed fit. The analysis yields an in-depth understanding of (1) the dimensions across which organizational approaches to UIC differ, such as infrastructure elements and supporting mechanisms firms utilize to successfully engage with universities, and (2) the variations in the design and implementation of such elements, leading to a typology of industrial approaches to UIC.

The article is organized as follows. The next section details the background of the research including the theoretical underpinnings. The section following is set to provide the research methodology, which is succeeded by the results section presenting the typology of industrial approaches towards collaborations with academia. The article is then finalized by the discussion and conclusion sections.

Background

The participation of the industry in UIC constitutes an utmost vital part of the triple helix model (Etzkowitz & Leydesdorff, 2000). Hence, the widespread recognition of the importance of relations between industry and academia has led to prolific attention across academia (Perkmann et al., 2013; Galán-Muros et al., 2017), industry (Fernández López et al., 2015), and policy makers (Ponds, Oort, & Frenken, 2010; Lehmann & Menter, 2016; Plewa, Quester, & Baaken, 2006) in recent years. The research which specifically focused on the industry

perspective and participation in UIC has primarily addressed the benefit industry partners may gain, and more recently elaborating on best practice examples of strategic industry approaches to UIC (Frølund & Riedel, 2018).

The escalading intricacy and complexity of new technologies stimulates the industry participants to understand their inability to encompass necessary resources and capabilities which technological development and ultimately commercialization necessitate (Hamel & Prahalad, 1994; O'Regan et al., 2006). Industry is increasingly turning their problem-solving needs to the intellectual resources of a university (Elmuti, Abebe, & Nicolosi, 2005; Ankrah & Al-Tabbaa, 2015). A shift in the structure of corporate R&D has been moreover observed by (Arora, Belenzon, & Patacconi, 2018), where large firms are turning away from fundamental internal research and shifting their focus to internal development. Large enterprises are increasingly withdrawing efforts from internal core science research, fueled by technology market and competition growth (Aghion, Bloom, Blundell, Griffith, & Howitt, 2005), difficulties with appropriability, and moreover the increasing short-termism (Marginson & McAulay, 2008). The withdrawal from core research does not imply the complete withdrawal, as minimal investments into the fundamental research and science are hereby required to allow the absorption of externally generated scientific knowledge (Arora et al., 2018).

Indeed, the existing body of literature pertaining to the collaborative sphere of university-industry interactions has been recently transformed into a complex multi-faceted field which exhibits numerous interlinkages and robust interpretations (Perkmann et al., 2013; Petruzzelli, 2011; Teixeira & Mota, 2012; Skute et al., 2019). Yet, the published research in the field of UIC does not appear to comprehensibly intertwine the previously developed empirical models as well as theoretical understandings, impeding the directionality of future research (Skute et al., 2019). Hence, despite the recognition of interdependence and importance of the relations between industry and academia, the research in the field of UIC stands fragmented and incomplete (Skute et al., 2019). Furthermore, there is a prominent lack of conceptual and theoretical frameworks pertaining to the mode of conduct within UIC (Galan-Muros & Davey, 2019; Villani et al., 2017). Due to the lack of a direct theoretical framework pertaining to UIC to utilize as a fundamental reference, aside from the Triple Helix Model (Etzkowitz & Leydesdorff, 2000), this research draws on the theoretical foundations of related disciplines, such as the interplay of relationship marketing, value co-creation, and the knowledge-based organizational theory.

Industry perspective and approaches to UIC

While limited, extant research examining the industry perspective or the role of industry in UIC has offered important insights into the industry partners' motivations and aims for cooperation (Perkmann et al., 2011), the subsequent effects of knowledge spill overs (Montoro-Sánchez, Ortiz-de-Urbina-Criado, & Mora-Valentín, 2011), and the capacity for cooperation (Zahra & George, 2002). The industry engagement has been outlined to be driven by four main reasons (Perkmann et al., 2011). Specifically, academic collaborations are an enabler for firms to access the latest scientific trends and developments within the academia, as well as to participate and contribute to further their R&D success (Perkmann et al., 2011). Firms seek advice and enhancement of their problem solving capabilities, via an extended workbench (Perkmann & Salter, 2012; Frølund & Riedel, 2018) in current R&D programs (Perkmann et al., 2011). Collaborating with the academia moreover allows the industry to attain more strategic objectives such as shaping the required future workforce and identify best talent, for example through engagement in academic curriculum design and delivery (Plewa, Galán-Muros, & Davey, 2015; Meerman et al., 2018). Furthermore, firms seek to leverage their R&D funding by maximizing the utility from their UI collaboration investments via government funding programs. Various governmental public funding programs aimed at firms for R&D activities conducted in conjunction with academia encourage and stipulate the contributions from the industry side (Perkmann et al., 2011).

Foundationally, industrial partners differ in their aims for engaging in UIC (Frølund, Murray, & Riedel, 2017), as evidenced in the type of UIC activities in which they engage, such as talent recruitment, research collaborations or a combination (Giones, 2019). The aims of the industrial partner have a range of implications for the approach taken for cooperation (Frølund et al., 2017). Science-based aims by industry tends to engender a more explicit and direct relationship lending itself to defined knowledge transfer mechanisms such as publications, patents consultancy and spin-offs with low intensity (Gilsing, Bekkers, Freitas, & Steen, 2011). Conversely, a development-based aim relates to more collaborative, localized, informal, and applied collaboration and often occurs involving intermediaries with more collaborative research domains such as joint R&D (Gilsing et al., 2011). Albeit being identified as very influential for improving the competence of firms (Santoro & Chakrabarti, 1999; Kunttu, 2017) the education collaboration aims are neglected in research. Closely aligned with aims is a firm's UIC strategy and the strategic context of the organization in which UIC is embedded (Pertuzé, Calder, Greitzer, & Lucas, 2010).

Other relevant elements of an industrial approaches to UIC noted in the literature are the establishment of

dedicated units for managing UIC (Frølund et al., 2017; Aldridge & Audretsch, 2011) or the establishment of boundary-spanning project managers (Pertuzé et al., 2010). The importance and role of UIC facilitators or intermediaries for UIC is commonly noted in the UIC literature (Malik, Bashir, & Ali, 2021; Howells, 2006), commonly investigated as third parties (Ankrah & Al-Tabbaa, 2015) or as embedded within university as compared to industry organizational structures (Villani, 2013; Villani et al., 2017).

Differences in approaches are likely to emerge depending on the type and extent of collaboration between firms and HEIs. Herein, given that collaborative activities between stakeholders follow multifaceted stages of integration - the seven stages as seen in (Frey, Lohmeier, Lee, & Tollefson, 2006), can be addressed to and aligned with the development of collaborative relationships between industry and universities. This model developed for measuring collaboration levels between grant partners by (Frey et al., 2006), incorporates the agency interaction model by (Peterson, 1991), levels of community linkage model by (Hogue, 1994), (Bailey & Koney, 2000) model, as well as the levels of integration model by (Gajda, 2004). This partnership continuum through the stages entails strategic initiatives being implemented by the industry such as Master Research Agreements, partner networks, and internal intermediaries tasked with strategic development of UI linkages. The continuum and progression of UI relationships through the seven stages does not however imply that multiple stages of collaboration cannot exist in parallel.

While extant literature offers initial insights into the diverse ways in which firms engage with universities, including an indication of ways in which such differentiation manifests, a comprehensive and clear understanding of institutional approaches to UIC remains amiss. To build a strong foundation for future academic and managerial advancement, this research utilizes an inductive approach to conceptualize firm's approaches to UIC, grounded in managerial practice.

Theoretical background

Due to the lack of a direct theoretical framework within the scope of UIC to build on, aside from the Triple Helix Model (Etzkowitz & Leydesdorff, 2000), this research draws on the theoretical foundations of related disciplines, being the interconnection of relationship marketing, value co-creation, and the knowledge-based organizational theory. We define each theory below and interconnect it with our inductive research at hand.

Relationship marketing (RM), is an area of marketing theory which has been thoroughly defined by (Sheth, Parvatiyar, & Sinha, 2015), as "…the ongoing process of engaging in collaborative activities and programs with immediate and end-user customers to create or enhance mutual economic, social and psychological value, profitably" (p 123). Yet the collaborative activities and programs are not only limited to customers and end-users, also comprising vertical and horizontal cooperation partners (Jüttner & Wehrli, 1995). A predominant axiom of the RM definition is that the collaborative interactions with customers and stakeholders lead to market value creation, such that the uniquely created value benefits the involved parties of the engaged relationship (Sheth et al., 2015). It can therefore be derived that relationship marketing exhibits itself through the creation and enhancement of economic, social, and psychological value (Sheth et al., 2015). A relationally oriented approach of RM hence entails long term collaborative relationships yielding value for the stakeholders, which is extended throughout vertical and horizontal cooperation partners (Jüttner & Wehrli, 1995). This falls in line with the concept of value co-creation, as well as closely ties together with university-industry relationships, as defined by (Plewa & Quester, 2007; Rosendo-Rios, Ghauri, & Zhang, 2016; Castro, Calderón, & Fayos, 2016).

Building on the foundations of RM, value co-creation has been conceptualized across service logic (Galvagno & Dalli, 2014) and service dominant logic (Vargo & Lusch, 2011). Drawing on (Grönroos, 2011) and the service logic, in a joint sphere of a firm acting as a value facilitator, and the customer being the value creator, opportunities exist for value to be cooperatively co-created. The service dominant logic furthermore implies that all involved parties whether firms, customers or others are service-providing, moreover value co-creating, hence all exchange can be also considered in the context of business-to-business (B2B) (Vargo & Lusch, 2011) Consequently, in the context of B2B, value can be co-created by organizations with a wide variety of stakeholders (Sarker, Sarker, Sahaym, & Bjørn-Andersen, 2012). For the purpose of this study, the focus lies on co-creating value through resource integration in university-industry interactions and carrying benefits throughout the triple helix (Etzkowitz & Leydesdorff, 2000; Castro, Calderón, & Fayos, 2016; Roser, DeFillippi, & Samson, 2013).

A knowledge based theory, in organizational context refers to the existence of firms in the way that they do, as an outcome of the ability to manage knowledge more efficiently than it is possible under another type of an organizational structure (Miles, 2012). The effective management, discovery, absorption, and the subsequent exploitation of knowledge a firm obtains either from the internal or external environments is vital to the determination of its success or failure (de Castro, Verde, Sáez, & López, 2010; Miles, 2012). Knowledge is a vital resource in this context, as all human productivity is dependent on knowledge, and technology for example is the

subsequent epitome of it (Miles, 2012). Hence, as (Grant, 1996) states, the production and output of a firm necessitates the integration of knowledge from many individuals. The knowledge assets of a firm are manifested through intellectual capital which includes human, structural, and relational capital (Martín-de-Castro et al., 2011; Miles, 2012). The relational, or sometimes referred to as social capital is the knowledge which is rooted within stakeholder relations, and is a form of knowledge integration which stimulates effectiveness through synthesis of information and ideas obtained from external interactions with either employees, customers, suppliers, partners, among others (Adler & Kwon, 2002; Kang & Snell, 2009; Kengatharan, 2019). The aftereffect of the accrued knowledge from networks, relationships, and interactions with external parties, contributes to the efficient processing and absorption of innovation and problem solving, in turn contributing to the firm's efficiency (Youndt & Snell, 2004; Zhang, Qi, Wang, Pawar, & Zhao, 2018).

Relationship marketing exhibits itself as the creation of value through relational, collaborative interactions between stakeholders; value co-creation addresses both multitudes of interactions within the transactional and relational contexts, as value is subjective and does not refer to any particular setting. The knowledge-based theory demonstrates how this value being co-created by a firm using external interactions with a variety of stakeholders, generates knowledge, which is in turn leveraged and utilized by the firm to attain desirable outcomes. The above-mentioned interplay of value co-creation and RM, and knowledge-based theories in the context of university industry relations, can help to understand the complex nature of UIC, while allowing to explore the collaborative boundaries from the industrial point of view.

Research methodology

Sample

To ensure comprehensive understanding of the organization's engagement with HEIs, the suitable interviewees were sought for to be within the roles of management and/or strategic oversight of cooperation with academic institutions within their respective industrial organizations. The focus on large organizations is critical, given the role size and orientation of an organization has in developing a firm's approaches to UIC (Santoro & Chakrabarti, 1999), and in the likelihood of creating an agreement with an academic partner (Fontana et al., 2006). The broader, and more diverse is a knowledge base of firm, the greater is the potential of recombining the acquired knowledge. A high level of absorptive capacity offers an expansion of possible application fields and stimulates their subsequent adoption of the external and new knowledge (Melnychuk, Schultz, & Wirsich, 2021). *Table 1* details the breakdown of the participants (20) by their appropriate industry classification (13).

Table 1: Overview of study participants.

Interviewee Code	Industry Classification	Count of Participants
A100, R100	Automotive	2
B100, Q100, G100, I100, V100	Chemicals/Pharma	5
C100, F100	Defence	2
D100	Oilfield services & equipment	1
E100	Electronics	1
J100	Telecommunications	1
K100	Information Technology & Services	1
M100, N100	Industrial Automation	2
O100	Electrical & Electronic Manufacturing	1
P100	Computer Software	1
S100	Mechanical/Industrial Engineering	1
T100	Semiconductors	1
W100	Social Media	1
Total	**13 Industries**	**20 Participants**

A pre-interview survey was sent out to all the study participants, where a question inquiring on the extent of collaboration activities with universities on a scale from 1 to 10. The activities are numbered from 1 to 14 as following: (1) Collaboration in R&D (2) Consulting (3) Commercialization of R&D results (4) Mobility of staff (5) Mobility of students (6) Dual education programmes (7) Joint design of university curriculum (8) Joint delivery of the curriculum (9) Participation in lifelong learning for businesspeople (10) Academic entrepreneurship (11) Student entrepreneurship (12) Governance (13) Shared resources with university (14) University support.

The Collaboration of R&D (1), Mobility of students (5), and University support (14) are the most frequent collaboration activities which were seen across the study participants, as measured by the total sum of scores, respectively. Joint design of university curriculum (7) exhibited the lowest sum of scores across the study participants (*Figure 1*). Despite recognition of importance by (Santoro & Chakrabarti, 1999), collaborative activities with aims set for education are underrepresented by research and are furthermore the least important aim as seen by the study participants. The remainder of the collaboration activities exhibit a uniform distribution across the range.

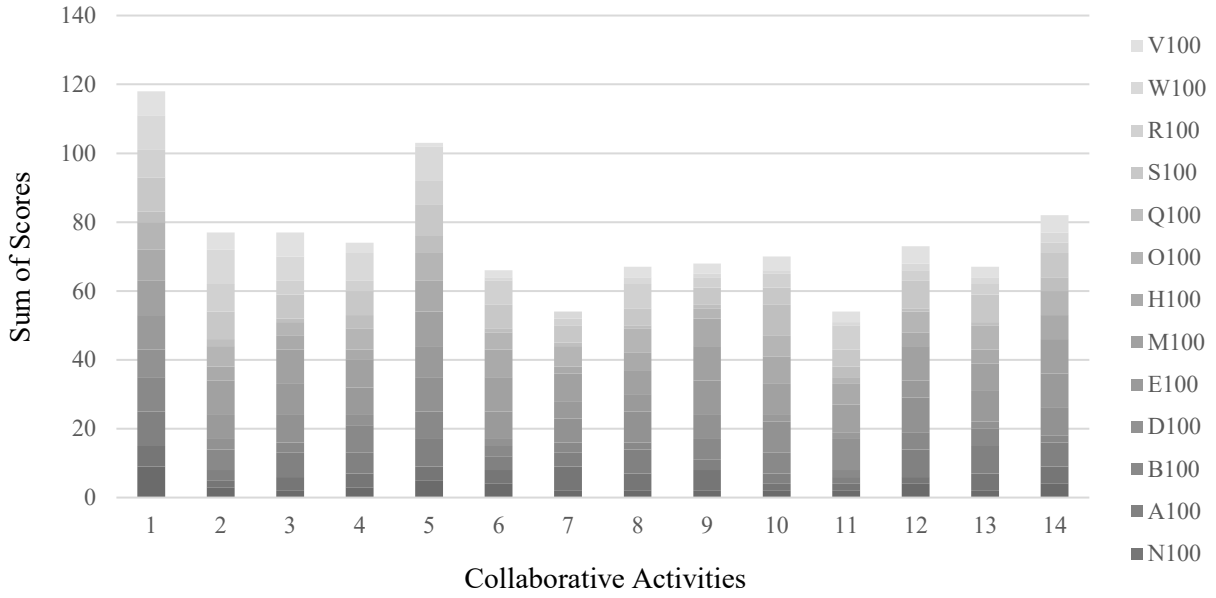

Fig. 1: Pre-interview survey - Extent of collaboration activities of study participants. Perception of extent of engagement in each activity on a 1-10 scale.

Data collection and analysis

The gathering of primary data was conducted via a series of in-depth semi-structured interviews targeting the industry participants of academic collaborations. The semi-structured interview collection of data from large enterprises, proceeded up until saturation of collected data and has yielded a total of 20 interviews. The participation in the study was voluntary, and the potential participants were located and approached using publicly available information. The interviews were 60 minutes in length and were held via online conferencing tools. Semi-structured interviews facilitate the collection of data from people that encompass experience in the research field of interest by obtaining reflective, engaging, and real-world situations/examples (Gioia, Corley, & Hamilton, 2013). The interview protocol was made sure to be thorough and facilitate the information exchange but moreover the effectiveness of the subsequent analysis.

The interviews commenced with an introduction where the participants were asked to provide their overall understanding of collaborations with academic institutions. Following the brief introduction, the interview proceeded in asking specific question regarding company core strategy pertaining to UIC. Specifically, inquiring about the participants collaboration aims, strategies, and research clusters that are utilized in their collaborations with academic institutions. To better understand how the collaborations manifest themselves, the interview proceeded by inquiring on the supporting mechanisms that facilitate collaborations between HEIs and the large enterprise. Specifically, inquiring about the presence dedicated internal functions, existing resource allocations (budgets), managerial sponsorships, and partner co-location. Diving into more detail, the interview proceeds in addressing the UIC mode of conduct of the participant. With the effort to understand and exhaustively collect data on how they conduct and collaborate with academia, specific and concrete questions in terms of type and selection of collaboration partner were enquired. The interviewees were asked to address the type of academic partners their company collaborates with, as well as how are these collaboration partners selected. To grasp the organizational structure, questions in terms of framing of strategic partnerships were posed where information regarding contractional relations was anticipated. Following the introduction and the mode of UIC conduct, the interview proceeded in collecting data by addressing the collaboration models and formats of the large enterprise. Specifically, questions regarding their aims and approaches that the organization engages in and how they have evolved over time. In more detail, the approaches that are undertaken by the organization and how are the UIC activities implemented. Furthermore, the typical temporal timeframes of how their partnerships and projects manifest themselves in were addressed.

The collection of this interview data which took place with senior management and strategic decision-makers from large enterprises engaged in academic collaborations, yielding a comprehensive dataset of how industry conduct their collaborations with UIC. The consensually recorded interviews were transcribed, then sent to the respective participants for verification. Upon confirmation, the qualitative analysis of the obtained interview data was analysed via (Gioia et al., 2013) methodology, with Nvivo12 software. The interview data and analysis

were then discussed among all the authors and the transcription was verified by an independent expert.

This software allows for the organization of non-numerical and unstructured data to be able to classify, sort and arrange information to be able to find links and examine relationships and combine information to build models thus, seek qualitative rigor with the inductive research. The manifestation of which is seen through interview transcriptions being coded to draw out the 1st order Concepts, which were gathered into 2nd order Themes, and subsequently Aggregate Dimensions, forming an effective data structure for further analysis (Gioia et al., 2013). Nvivo12 allows for dynamic mapping and building a model, where the dynamic interrelationships are considered. The arrows between the concepts, themes, and aggregate dimensions reveal the relationships and present the sought for model of qualitative data. Considering the relationships through the formation of arrows among the emergent concepts, this enables the possibility of theoretical insights that would not be identified by only looking at the raw data itself (Gioia et al., 2013).

The 1st-order analysis contains much of the raw interview answers which are categorized under themes (2nd-order). With the 2nd-order analysis, the answers of the interviews have taken a theoretical significance in which suggested concepts arise which may aid in the explanation of what is there and how it is answering the research question. Interestingly, the concepts that may arise that perhaps do not have an adequate theoretical reference in existing literature (Corley & Gioia, 2004) or those that are evidently deviating from what is already known should also be noted. Analysing the interview data, a set of 1st-order concepts, 2nd-order themes, and aggregate dimensions were agreed upon by all authors and has reached "theoretical saturation". This allows for the data to be structured and generate a grounded model to bring "qualitative rigor" in this qualitative data set. The Nvivo12 mapping and allocation of 1st order concepts, 2nd order themes, and aggregate dimensions were discussed and reviewed by all authors. This analysis method of the data, resulting in the data structure, not only allowed us to create a tangible visual model but allows to comprehensibly understand how the raw data progressed into concepts and themes. The resultant data structure served as a foundation for the development of the typology, following (Doty & Glick, 1994).

Coinciding with the collection of data and following the initial stages of analysis, we proceeded scanning the emerging data, topics, concepts, and dimensions as well as the related literature. This is paramount to ensure precedents for the current findings but moreover to explore if we have discovered new concepts. Hereby, the dynamism of relationships among the 2nd order concepts was investigated in the data structure, contributing to precedents of a dynamic grounded theory model (Gioia et al., 2013). Consultation with relevant literature to cultivate the expression of developing concepts and interactions of concepts was furthermore undertaken (Gioia et al., 2013) and is reflected in the results section.

The data analysed accounts for not only the major emergent concepts, themes, and dimensions, but at the same time for the dynamic interrelationships. With this research, a typology of industrial collaborative ideals was developed which contains the essential concepts, themes, and/or dimensions emergent the data structure. With this typology the dynamic interconnection between these concepts became evident. Due to the authors' close relationship with the raw data and the in-depth knowledge of the data, thereby considering the interconnection between the emerging concepts, facilitated the understanding of the theoretical insights and the possibility of creating a typological theory. Thereby, the resultant data structure/model served as a foundation for the development of a typology of industrial collaborative ideals, following (Doty & Glick, 1994).

The five ideal types were defined by constructing multivariate models that represent the ideal types of industry collaborators which were derived from the data structure. Specific attributes to an ideal type need to be weighted by its theoretical importance (Doty & Glick, 1994) thus creating elements within the typology with differing significance (Fiss, 2011), is an interplay of the relationships among constructs. This allows for the differentiation of the critical aspects and the nonessential elements in the typology. Literature indicates that ideal types in a typology are the "pure" form of a certain arrangement thereby deviating from this ideal type will result in an aberration from a specific dependent variable (in the case of this research, effectiveness) (Doty & Glick, 1994). It is vital to determine the critical aspects of the typology manifesting in the degree of relative theoretical importance, to understand the causal structure of a type. Theoretical specification of the ideal types of organizations (Doty & Glick, 1994) requires expert raters to assist in empirically modelling a type. One of the study participants who is a valued expert in the industry assisted in providing the relative theoretical importance for each first and second order constructs. These were discussed and agreed upon with the co-authors.

Results

The typological theory exhibits itself through the manifestation of first (X) and second (Y) order constructs in accordance with (Doty & Glick, 1994). *Table 2* highlights the definitions of each of the constructs present in the typology, as well as the relative theoretical importance which is used as the weighting matrix to determine

closeness of fit between an organization and an ideal type. The constructs and sub-constructs were inductively drawn out of the interview data to reflect the reality of industrial approaches towards collaborations with HEIs. The constructs and their respective sub-contructs are detailed in the sections below, across *Table 3* through to *Table 10*. We present a novel contribution in form of a theoretical construct as a typology of industrial collaborative ideals in *Table 11*.

Table 2: Overview of Constructs, their respective definitions, and a relative theoretical importance.

Construct Order[1]	**Construct**	**Definition**	**Proposed relative theoretical importance (%)**
X_1	Strategy	Design and designation of corporate strategies aimed at developing collaborations with academic institutions.	20
X_2	Collaborative Aims	The aims are broad goals which are sought to be reached via a strategy, through specified activities, or a range of activities	20
X_3	Collaboration Domains	Collaborative Aims with the respective Activities, allocated per appropriate collaboration domains.	10
X_4	Budget Allocation	Source of budgets towards UIC, and their allocation either towards infrastructure, projects, or both.	15
Y_1	Partner Level	Level of academic collaboration partners.	5
Y_2	Formalization	Presence of institution-wide framework research agreements.	10
Y_3	Collaborative Timeframe	Typical length of project lengths collaborating firms engage in.	5
Y_4	Internal Intermediary	Internal departments tasked with the organizational, legal, financial, and strategic aspects of U-I collaborations.	15

Industrial firms establish collaborations with higher education institutions (HEIs) through distinct sub-constructs of a broader University–Industry Collaboration (UIC) strategy. These sub-constructs define the extent to which firms formalize and integrate academic partnerships within their corporate objectives, shaping the structure and execution of UIC initiatives.

The first sub-construct, **Clearly Defined UIC Strategy**, represents a structured and strategic approach where firms deliberately align university collaborations with corporate goals to maximize competitive advantage. A100 emphasizes that this model ensures all interactions with HEIs contribute to technology leadership by embedding collaboration goals within selection mechanisms, interaction models, and proposal processes. Prior collaboration experiences are leveraged to refine engagement strategies, ensuring alignment between research objectives and corporate innovation frameworks (Todeva & Knoke, 2005; Gajda, 2004). Additionally, the global scope of large enterprises necessitates a strategic approach that accounts for regional differences. K100 highlights that firms operating across multiple continents require well-defined strategies to effectively navigate the vast academic landscape and ensure optimal returns on investment. This sub-construct reflects a proactive stance where UIC is a structured, long-term component of corporate innovation planning, supporting knowledge exchange and competitive positioning under the Triple Helix framework (Etzkowitz & Leydesdorff, 2000).

A second sub-construct, **UIC as Part of Overall R&D Strategy**, represents a more flexible, dynamic approach where academic collaborations are integrated within broader research and development efforts. Unlike firms with a distinct UIC strategy, organizations operating under this sub-construct adjust their engagement with HEIs based on evolving technological and market trends. B100 describes this approach as inherently opportunistic, with collaborations shifting in response to emerging scientific advancements. For instance, developments in artificial intelligence and machine learning have prompted increased engagement with universities due to their potential applications in computational modeling and data analytics. This sub-construct allows firms to maintain strategic focus while retaining adaptability, ensuring that university collaborations remain relevant to ongoing R&D priorities.

The third sub-construct, **No Explicit UIC Strategy**, reflects an absence of formalized or centrally coordinated engagement with HEIs. While firms within this sub-construct may still participate in academic

collaborations, these partnerships emerge on an ad hoc basis, often driven by individual business units or immediate project needs rather than a unified corporate strategy. D100 notes that despite active collaborations with universities, there is no formally documented UIC strategy guiding engagement decisions. This reactive approach means that while firms may benefit from university partnerships, their collaborations lack the structured intent seen in the other sub-constructs, potentially limiting long-term strategic value.

Table 3: Detailed description and definition of X1 Strategy Construct and its sub-constructs.

Construct Order[1]	**Construct**	**Relative theoretical importance (%)**	**Sub-Construct**	**Definition**
X_1	Strategy	20	Clearly defined UIC strategy'	A clearly defined stand-alone strategy towards collaborations with academic institutions
			Part of overall R&D Strategy	The strategy towards collaborations with academic institutions is a designed as a modular part of the overall R&D strategy of the firm
			No UIC Strategy	There is no strategy in place

Collaboration aims

The collaborative aims which an institution strives for, are tied to the strategy towards UIC, if in place. The aims are broad goals which are sought to be reached via a strategy, through specified activities, or a range of activities. *Table 4* details the range of aims which were mentioned by the study participants (*Table 1*) as most prominent for their collaborations with HEIs. The collaboration aims construct serves the purpose of stating which aims are most prominent for a particular type, without mutual exclusivity of the existence of additional, less addressed aims. It is fair to say that a company's aims will be driven by the industry they are in, hence the list is non-exhaustive. Below are some of the quotations from the participants of the study, which address the different collaboration domains involved.

Table 4: Detailed description and definition of the X2 Aims Construct and its sub-constructs.

Construct Order	**Construct**	**Relative theoretical importance (%)**	**Sub-Construct**	**Definition**
X_2	Collaboration Aims	20	Competitive Edge	*"…elaboration on cutting edge technology and research to create competitive advantage in technology leadership" (A100)*
			Innovation Scouting	*"…collaboration on an insight into technology as it relates to our research goals" (E100)*
			External Competencies	*"…to access skills, facilities that perhaps we don't necessarily have in house." (J100)*
			External Perspective	*"Another driving factor for us might be, we had a dataset that we've explored, but we're interested in seeing whether other people with their algorithms or their approaches can get insights that we didn't. What would you characterize that? A new insight on existing data." (W100)*
			Early-Stage Innovation	*"…to develop science that is ultimately going to build a bedrock, an underlying*

				foundation to give us the confidence to invest in something in the future." (B100)
			De-risking Research	*"…to reduce the risk of carrying out research that we wouldn't want to carry all the risk in doing." (S100)*
			IP Generation	*"…we're committed to doing research which publishes as well as just generating intellectual property. So we're moving the field forward in key areas for us is also an important aim." (J100)*
			Entrepreneurship	*"…from our perspective its usually a joint effort, it could be a joint venture… we look for startups as possible investments." (Q100)*
			Technology Transfer	*"…technology transfer in both directions. Those are, in my view, byproducts of collaboration, not the primary purpose." (P100)*
			Funding Leveraging	*"take the form of very low TRL research where we would look for leverage from government investment into co-funding of activity." (C100)*
			Access to Thought Leaders	*"We do want to have a multi-generational proposal because we're not simply looking at academics just to be a place that we outsource stuff. We really want them to have a vision as well, and tell us something we don't know." (E100)*
			Talent Acquisition	*"So today one of the major aim is again, one the human resources views. So ability to get in touch and attract the best brains that are in the market early in the development." (K100)*
			Talent Retention	*"…recognizing that our researches have, in some cases forfeited the opportunity of tenure to join W100. So by allowing them to collaborate, if they feel good and they connected with university systems" (W100)*
			Reputation	*"Shape the image of M100 in the academia." (M100)*
			Shaping Future of Education	*"…we are working with academia to actually advise them on what we are expecting from the future graduates. Actually, we are doing this in a different way. We are working with the career services and professors who are teaching and so on." (D100)*
			Obtaining Education	*"…if we're new to a field it's an education bringing us up to speed" (G100)*
			Social Responsibility	*There is a second aspect to this, which is largely philanthropic. Our company came from university research. We feel that we should contribute, and much of industry is advanced by academic collaboration, so*

				part of this is a sense of giving back to that community. (P100)
			Social Interactions	*"…one of the ways in which do that maybe to sponsor a PhD, which gives you a kind of touch point into a larger academic group, and a way of accessing some of that state-of-the-art thinking and technology." (C100)*

Collaborative domains

Traditionally UIC research focused on commercialization as a central activity (Galán-Muros et al., 2017), the more recent broadening of the UIC concept entails the presence of HEI interactions with the industry across the education, research, and valorization domains (Galan-Muros & Davey, 2019; Davey et al. 2011). Given the non-exhaustiveness of the collaborative aims as seen *Table 4,* which have been identified by the study participants, we include the respective collaborative domains to encompass the extent of collaborations (Galan-Muros & Davey, 2019), carried out by the industry.

Table 5: Detailed Summary of the X3 Collaborative Domains Construct and its sub-constructs. (1 - Galan-Muros & Davey, 2019).

Construct Order	**Construct**	**Relative theoretical importance (%)**	**Sub-Construct**	**Definition**
X_3	Collaborative Domains	10	Education[1]	Collaboration for the two-way educational purposes.
			Research[1]	Collaboration for the purpose of conducting, developing, and undertaking research
			Valorization[1]	Any form of valorization of the obtained research results
			Social Responsibility	Initiatives for the greater or public good
			Informal Interactions	Networking between academic and industry counterparts
			Mixed	Any combination of the above collaborative domains

Budget allocation

The allocation of budgets and funding for HEI collaborations follows multiple channels, including direct bilateral agreements and public funding programs. Firms strategically allocate funding from either centralized corporate budgets, business unit (BU) budgets, or a combination of both. A key objective in budget allocation is to maximize the return on investment by leveraging government funding programs that support R&D collaborations between industry and academia (Perkmann et al., 2011). These budgets not only finance specific collaborative projects but also support the internal infrastructure required to oversee and facilitate long-term partnerships with HEIs. The budget allocation construct consists of four sub-constructs, each representing a distinct approach to financial structuring in UIC engagements.

The first sub-construct, **Central Funding for Infrastructure and Projects with BU Contributions**, reflects a model where corporate-level budgets are allocated to maintain a stable funding base for university collaborations, while business units have the option to contribute additional resources. G100 describes how this approach ensures that each strategic university partner has an individual budget assigned, creating a structured mechanism for engagement. In this model, central funding enables the initiation of large-scale projects that individual BUs may not have the financial capacity to support independently. B100 highlights that in cases where collaborations require substantial investment, central catalytic funding is used as a foundational resource, while individual business units contribute additional funding as needed. This structured approach not only ensures financial stability for major collaborations but also strengthens long-term partnerships by providing continuity

despite economic fluctuations. A100 emphasizes that central funding offers resilience in shifting business climates, helping maintain a consistent number of academic alliances and sustaining ongoing partnerships even in uncertain economic conditions.

The second sub-construct, **Centrally Funded Infrastructure with BU-Funded Projects**, represents a model where corporate funding is restricted to covering the internal costs of maintaining UIC infrastructure, while BUs are responsible for financing all collaboration projects. Here, central funding is allocated towards operational overheads, legal frameworks for collaboration agreements, and other institutional costs, but excludes direct project funding. S100 explains that, under this structure, while some strategic corporate-level funding exists, project-specific funding is fully decentralized, with business units taking full ownership of their research initiatives. This approach ensures that BU-led projects remain directly aligned with business priorities, as the units funding the research have a vested interest in its outcomes. The rationale behind this model is to maintain a strong incentive structure, ensuring that business units remain engaged and selective in their academic collaborations.

The third sub-construct, **Decentralized Budget**, refers to a fully decentralized financial structure where all UIC-related costs are independently covered by individual business divisions. Unlike the previous sub-construct, where central funding is available for infrastructure, this model does not provide any corporate-level financial support for maintaining UIC frameworks. D100 describes how, in this case, funding decisions are left entirely to the discretion of engineering centers or other specialized divisions, with allocations varying from year to year. Without centralized coordination, financial support for academic partnerships fluctuates based on BU priorities, leading to a less structured but highly autonomous approach to collaboration.

The fourth sub-construct, **No Dedicated Budget**, represents the absence of any stable financial commitment toward UIC, whether from corporate or BU-level sources. Q100 states that in this model, no internal budget is formally assigned for university collaborations, with the majority of funding instead originating from external investments. While this does not preclude collaboration altogether, engagements occur opportunistically, often initiated by technical leads or specific business units without structured financial backing. The absence of dedicated funding results in a highly ad hoc approach, where partnerships may form on a case-by-case basis rather than as part of a long-term strategy.

Table 6: Detailed description and definition of the X4 Budget Allocation Construct and its sub-constructs.

Construct Order[1]	**Construct**	**Relative theoretical importance (%)**	**Sub-Construct**	**Definition**
X_4	Budget Allocation	15	Central funding for infrastructure/projects & BU funded projects	Central sources of funding for the internal infrastructure necessary for conducting UIC, and moreover covers budgets necessary for conducting collaborative projects, in addition to the funding various business divisions can allocate either towards infrastructure, projects, or both
			Central funding for infrastructure & BU funded projects	Central funding is only allocated towards the internal UIC infrastructure, excluding any funding being allocated towards collaboration projects. Business Units must fund all the activities they engage in themselves, whereas the collaborative infrastructure is set centrally
			Decentralized budget	All the funding for UIC related costs comes from the separate business division engaging in collaborations at their own accord
			No dedicated budget	Non-existing budgets whether central or business division driven, towards collaborations with academic partners

Partner level

The partner level construct defines the hierarchical level at which firms engage with academic collaborators, shaping the structure and scope of University–Industry Collaboration (UIC). The collaboration level is closely tied to the formalization construct, as firms that establish Master Research Agreements (MRAs) or framework agreements tend to collaborate at higher institutional levels. This construct consists of four sub-constructs, each representing a different approach to partner engagement.

The first sub-construct, **Individual-Level Collaboration**, represents engagement with specific researchers, professors, or faculty members within a higher education institution (HEI). P100 describes how firms following this approach interact directly with individual academics or research groups rather than forming partnerships at the institutional level. This model allows for highly specialized, targeted collaborations based on the expertise of particular researchers, ensuring flexibility and direct knowledge transfer. However, it often lacks the long-term strategic depth seen in higher-level institutional engagements.

The second sub-construct, **Institutional-Level Collaboration**, involves partnerships established at the university-wide level, often through formalized agreements. O100 highlights how firms adopting this model develop strategic alliances with HEIs, enabling broader, multi-disciplinary collaborations under a structured framework. These engagements often provide firms with access to multiple research groups and facilitate large-scale, coordinated research efforts. Institutional-level collaborations typically involve formal mechanisms such as MRAs, framework agreements, or dedicated university partnership programs that streamline engagement processes.

The third sub-construct, **Hybrid Collaboration (Individual & Institutional)**, combines elements of both individual and institutional engagements. Firms operating under this model maintain flexibility by collaborating with specific researchers while also leveraging formal institutional agreements for broader access. W100 describes this approach as highly inclusive, allowing firms to engage with any academic entity capable of contributing to research objectives. This dual-level collaboration strategy enables firms to benefit from the specialization of individual researchers while also maintaining structured, long-term relationships with universities.

The fourth sub-construct, **Ecosystem-Level Collaboration**, extends beyond traditional individual or institutional partnerships by fostering **multi-stakeholder, networked collaborations**. K100 explains that this approach moves beyond one-on-one interactions, establishing interconnected research networks where firms collaborate simultaneously with multiple universities and stakeholders. This model is characterized by **1:X and X:X interactions**, where knowledge flows dynamically between multiple academic partners, industry players, and research institutions. By developing collaborative ecosystems, firms enhance their ability to co-create knowledge, integrate external expertise, and build innovation networks that facilitate cross-disciplinary research. Such ecosystems are structured to not only strengthen direct firm-university relationships but also to promote inter-university collaborations within the broader network.

Table 7: Detailed description and definition of the Y1 Partner Level Construct and its sub-constructs.

Construct Order[1]	Construct	Relative theoretical importance (%)	Sub-Construct	Definition
Y_1	Partner Level	5	Individual	Collaborations are typically concluded on an individual level, which involves either particular researchers or whole research groups.
			Institutional	Collaborations are typically concluded on an institutional level
			Mixed	Collaborations are done with a mix of institutional and individual arrangements
			Ecosystem	interactions are individual and institutional, and moreover are conducted on a 1:X and X:X bases

Formalization

The **formalization construct** defines the extent to which firms establish structured agreements with higher education institutions (HEIs) to govern University–Industry Collaboration (UIC). This primarily involves **Master**

Research Agreements (MRAs) or institutional **framework agreements**, which set boundaries for collaboration regarding intellectual property rights, technology transfer, and partner responsibilities (Bogers, 2011; Carson, Madhok, & Wu, 2004). These agreements eliminate the need for repeated negotiations, ensuring efficiency and reinforcing contractual formality and shared governance, both of which enhance collaboration success (Gretsch, Tietze, & Kock, 2020).

The first **sub-construct**, **Framework Agreements**, reflects firms that engage in structured, long-term partnerships through formalized agreements. K100 emphasizes that having predefined contracts streamlines collaboration, ensuring that key aspects such as IP rights and publication policies are clear from the outset. By establishing agreements with selected universities in advance, firms avoid the inefficiencies of renegotiating terms for every new collaboration, which contributes to stability and trust. I100 further describes how MRAs function as standardized templates that simplify the process of initiating new projects, reducing administrative overhead while fostering long-term relationships.

The second **sub-construct**, **No Framework Agreements**, refers to firms that do not engage in predefined, institution-wide agreements, instead negotiating collaborations on a case-by-case basis. Without a structured framework, each engagement requires independent legal and administrative setup, which can slow down the process and introduce inefficiencies. While this approach allows for flexibility, it may also limit the scalability and sustainability of academic partnerships.

Table 8: Detailed description and definition of the Y2 Formalization Construct and its sub-constructs.

Construct Order[1]	Construct	Relative theoretical importance (%)	Sub-Construct	Definition
Y_2	Formalization	10	Framework Agreements	Research framework agreements are concluded with HEIs within the scope of UIC "We've got a list of strategic universities that we work with, and we have set agreements in place with them so it's really easy to execute new projects." (G100)
			No Framework Agreements	Research framework agreements are not concluded with HEIs within the scope of UIC "There isn't actually, no". (J100)

Collaborative timeframes

Collaborative timeframes structural construct represents the variation of the typical temporal project lengths, which collaborating firms engage in, as identified by the study participants. It is important to note that there is no mutual exclusivity between the sub-constructs, where a firm which primarily engages in long-term projects with their academic partners, may also engage in short term projects as well. The purpose of this construct is to infer the typical temporal, desired length of collaborative projects.

The temporal range represented in *Table 9* varies from *Short* to *Long Term*, with *Mixed* and *Random* constructs. Long term collaborative timeframes extend above a 3-year period, where Short Term falls under. Mixed implies a mixed variety or project lengths, without a protruding average time length. A Random, opportunity driven construct, is as the name suggests a very opportunistic approach towards collaborative timeframes, where the perceived benefits of a collaboration dictate the subsequent lengths of a project.

Table 9: Detailed description and definition of the Y3 Collaboration Timeframes Construct and its sub-constructs.

Construct Order[1]	Construct	Relative theoretical importance (%)	Sub-Construct	Definition and Quote

Y_3	Collaborative Timeframe	20	Random	No particular typical length of collaborative projects – infers an opportunistic approach, where the perceived benefits dictate the subsequent lengths of a project. "So, we need the results faster. Therefore, we are looking into different ways of collaboration." (D100)
			Short Term	Length of projects up to 3 years "…normally we are in the range of 2 to 3 years. So a mid-term" (I100)
			Long Term	Length of projects over 3 years "The majority of our projects we intend to be medium to long term, so typically three years or more." (P100)
			Mixed	A mixture of short and long terms durations take place. "It's mixed. It depends on the call." (N100)

Internal intermediary

The **internal intermediary construct** refers to the organizational units responsible for managing the legal, financial, and strategic aspects of University–Industry Collaboration (UIC). These intermediaries, often titled **University Relations (UR), Academic Liaison, or External Innovation**, act as the interface between firms and academia, facilitating partnerships, scouting collaboration opportunities, negotiating agreements, and leveraging funding. Their structure, hierarchy, and influence vary across firms, depending on corporate strategy and the level of investment in UIC management. The **internal intermediary construct** consists of five distinct sub-constructs, each reflecting a different organizational approach to managing academic collaborations.

The first **sub-construct**, **Central Team – Ecosystem Orchestrators**, refers to an internal intermediary closely linked to the corporate core, typically with direct ties to senior management. This team operates as a central hub, coordinating a broad network of collaboration partners where interactions extend beyond individual engagements. W100 describes its role as building communities of interest around university engagement, functioning centrally while decentralizing execution by enabling business units to engage with academia independently. This approach ensures strategic oversight while maintaining flexibility.

The second **sub-construct**, **Central Team – BU-Specific Initiatives**, represents a variation where a central UR team exists, but additional UIC efforts are carried out by business units through dedicated personnel specializing in their respective fields. C100 highlights that while the central team provides oversight and support, academic partnerships are often managed within business units by technical staff who balance university engagement alongside other responsibilities. This model retains strategic coordination while allowing domain-specific expertise to drive partnerships.

The third **sub-construct**, **Decentralized BU-Specific Personnel**, is characterized by complete decentralization, where each business unit independently manages its UIC efforts. Unlike the previous model, there is no central team coordinating activities, leading to multiple UR roles being replicated across different divisions. E100 notes that while divisions collaborate across company lines, each BU maintains its own independent university engagement program, prioritizing local decision-making over corporate-level coordination.

The fourth **sub-construct**, **Decentralized Intermediary**, represents a bottom-up approach where technical experts initiate and manage collaborations with minimal internal oversight. In this model, operational rather than strategic decisions drive partnerships, with transactional costs dictating engagement rather than long-term institutional benefits (Todeva & Knoke, 2005). D100 describes this process as highly autonomous, where technical experts identify promising academic research and connect universities with internal teams based on interest and alignment.

The final **sub-construct**, **No Intermediary**, reflects the absence of a formalized UR function within the company. While individual employees may handle specific UIC aspects, such as legal agreements, there is no overarching unit responsible for managing academic collaborations. O100 confirms that in this model, there is no dedicated support structure for university engagement, resulting in ad hoc, unsystematic interactions.

Table 10: Detailed description and definition of the Y4 Internal Intermediary Construct and its sub-constructs.

Construct Order[1]	**Construct**	**Relative theoretical importance (%)**	**Sub-Construct**	**Definition**
Y_4	Internal Intermediary	20	Central Team – Ecosystem orchestrators	Internal intermediary which directly linked to the corporate core function, usually with direct ties to the managing board, and serving all functions of the enterprise
			Central Team - BU-specific initiatives	Derivative of an entirely central UR team, whereas there are additional efforts exhorted by various BUs
			Decentralized BU specific personnel	UIC being managed by each a separate BU within their respective fields of expertise
			Decentralized Intermediary	Bottom up: the technical experts are engaging in collaborations they deem suitable with minimal internal support

Typology of industrial collaborative ideals

The typology of collaboration approaches in form of ideal types exhibits itself in five types, ranging from (1) Opportunity – 'Situationship, (2) Supplier – 'Extended Workbench', (3) Peer – 'On eye level', (4) Partner – 'Strategic Alliance', and (5) Broad Stakeholder – 'Research and Innovation Ecosystem'. The is evident progression from Type 1 to Type 5, in terms of presence of structural elements, the abundance of collaborative domains, and importantly the broad outreach of aims. While Types 1,2,3 and 4 are manifestations of increasing focus and strategic organization of UIC, the 5th type brings the presence of a whole collaborative ecosystem with multi-stakeholder engagements (*Table 11*). Each ideal is thoroughly explained in the sections below.

Table 11: Typology of industrial collaborative ideals.

Constructs	**Opportunity – 'Situationship'**	**Supplier – 'Extended Workbench'**	**Peer – 'On eye level'**	**Partner – 'Strategic Alliance'**
Strategy	No UIC strategy	No UIC strategy	Part of overall R&D strategy	Clearly defined UIC strategy
Collaboration Aims	Reputation Talent Acquisition	Competitive Edge Innovation Scouting Talent Acquisition	Innovation Scouting Entrepreneurship Talent Acquisition Reputation	External Competencies External Perspective De-risking Research Funding Leveraging Shaping the Future of Education
Collaboration Domains	Education Informal	Research Education	Research Education Valorisation	Mixed
Internal Intermediary	No intermediary	No intermediary	De-centralized BU-specific personnel	Central Team - BU-specific initiatives
Budget Allocation	No dedicated Budget	De-centralized Budget	De-centralized Budget	Centrally funded infrastructure & BD funded projects
Partner Level	Individual	Individual	Mixed	Institutional
Formalization	No framework agreements	No framework agreements	No framework agreements	Framework agreements
Collaborative Timeframe	Random, opportunity driven	Short-term	Mixed	Long-term

Type 1: Opportunity – "Situationship"

A 'Situationship' ideal type exhibits itself with an opportunistic approach towards collaborations, where no specific strategy nor intermediary is put in place. The partner level is typically concluded on an individual level, lacking any formalization integrations such as framework agreements. The collaborative timeframes are random and are driven by the presented opportunity. The collaboration domains are focused on Education and Informal Interactions, where the Valorisation and Research domains are less prioritized. The collaborative aims are focused on reputation within the specific HEIs, and outside. Moreover, the 'Situationship' type aims to acquire suitable talent sourced from the HEIs.

Type 2: Supplier – "Extended workbench"

An 'Extended Workbench' is a supplier relationship between a HEI and a firm, where the interactions are transactional. Much like with the 'Situationship' there is no strategy nor an intermediary which concerns UIC. The budgets are however, decentralized where the various business divisions which are engaging in R&D related contract research with HEIs, are funding the said activities. Due to the transactional nature of the 2nd type, the interactions with academic institutions are focused on very particular R&D aspects, hence the typical level of collaboration partners is individual, or specific chairs and research groups. There are no institutional framework agreements set in place. The subsequent collaboration domains are Research, and Education, where the latter is focused on talent acquisition activities, and most activities are carried out in regard to directed research. The aims which the 'Extended Workbench" seeks to attain, manifest themselves within the innovation scouting and gaining a competitive edge, as well as aiming to acquire talent. The collaboration timeframes are typically short-term projects, which set to eradicate a particular R&D task in an 'extended workbench' format.

Type 3: Peer – 'On eye level'

The 'on eye level' ideal type is a collaboration approach which is more integrated into the existing R&D strategy of a firm, through specifying a strategy for collaborations with HEIs as part of the overall R&D strategy. Moreover, the internal intermediary is allocated within each business division in form of dedicated personnel who concern themselves with division-specific R&D activities. The budgets to support the UI activities are de-centralized, where each business division utilizes their R&D allocated funding, as sees fit. The collaborative timeframes and the level of collaboration partners are mixed, yet no institutional framework agreements are being established with HEIs due to the segmented per business division approach to collaborations. The collaboration domains are mixed, where a particular focus often protrudes, depending on the industry. The aims which the 'On eye level' seeks to attain are seen through the innovation scouting projects, which could also lead to Entrepreneurship. Reputation often plays a significant role, and this type also aims to acquire suitable talent.

Type 4: Partner – 'Strategic alliance'

The fourth collaborative approach is very much a relational one, where although the strategy towards UIC is clearly defined – there are prominent differences. In addition to the business division specific personnel, there is central coordination through a central intermediary. This further elaborates in form of centrally funded infrastructure to support the framework agreements with strategic academic partners, as well as the overhead costs for the central academic relations intermediary. The level of collaboration partners is institutional, albeit being one-on-one basis. This indicates relations being established with institutions, and the collaborations occurring between a firm and one HEI at a time. The collaborative timeframes are long term, and the collaborative domains extend from Research, Valorisation, Education to informal domains. Specifically, the aims are to obtain an external perspective on research, de-risk it, and moreover to gain access to certain skills/facilities. The 'Strategic Alliance' often aims to engage in shaping the future of education activities.

Type 5: Broad stakeholder – 'Research and innovation ecosystem'

The fifth industrial ideal type approach towards collaborations with academic institutions, is one that is most advanced in terms of focus, simultaneous engagement of multiple parties, and spanning of boundaries between industry and academia. The 'Research and Innovation Ecosystem' is a complete environment set up for collaborations, where there is a very clear, dedicated strategy towards UIC in place. There internal intermediary is further elevated from the 'Strategic Alliance' type to ecosystem orchestrators and facilitators. This type often comprehends the benefits that various collaborative engagements bring and focuses on eliminating barriers. The

budgets are allocated centrally towards the infrastructure, moreover for projects, which is in addition to any funding, any particular business division can contribute. A further distinction is the level of collaboration partners is mixed, but in such a way that the partners can be both individual and/or institutional, with interactions between each other, and the firm, creating an ecosystem. This collaborative ecosystem operates on a wide variety of timeframes, along with a whole width of collaborative domains, entailing the whole spectrum of aims and activities. The aims tend to be very forward thinking, where the access to thought leaders, talent retention & acquisition are of importance. The Broad Stakeholder aims to engage in early-stage innovative research as well as obtain education and promote social responsibility.

Beyond the five types

The five industrial approach types towards collaboration with academic institutions serve the purpose of ideals, whilst a simplification they represent a conceptual framework which allows to understand the ways industry interacts and collaborates with academia. There is a possibility for hybrid configurations of the types, which only emerge from a transition from one type to the other.

Typological theory - Modelling and grand theoretical assertions

Following (Doty & Glick, 1994), to clarify the intended purpose of the proposed typological theory, a Grand Theoretical Assertion is in order: Collaborative aims dictate the subsequent approach towards academic collaborations, where the supporting mechanisms are adapted accordingly. Therefore, having a clear focus in a sense of defining a strategy towards UIC, entailing necessary structural mechanisms, will result in efficiency, hence maximization of value being co-created with collaboration stakeholders.

The constructs presented in *Table 2* are segmented in to first order (X) and second order (Y) constructs. The concrete estimates of the relative theoretical importance of each construct are also present. This allows the examination of the extent to which deviation from the ideal type predicts the dependent variable – efficiency. Furthermore, a weighted Euclidean distance formula can be used to assess the deviation from the ideal type (Doty & Glick, 1994). *Figure 2* serves to be a visualization of the Euclidean distances, presented per construct. The closer is the proximity to each construct, the better is the prediction of the dependent variable. M100 was scored by the study participant, in reference to Type '*Partner – Strategic Alliance'*. Constructs X_1, X_3, Y_1, Y_2, and Y_4 were given the full score, indicating complete attainment of the manifestation of the mentioned construct. Constructs X_2, Y_3, and X_4 were given a score of 75%, 60%, and 53%, respectively (*Figure 2*). The manifestation of constructs mentioned above, demonstrates the deviation of M100 from the ideal type '*Partner – Strategic Alliance'*.

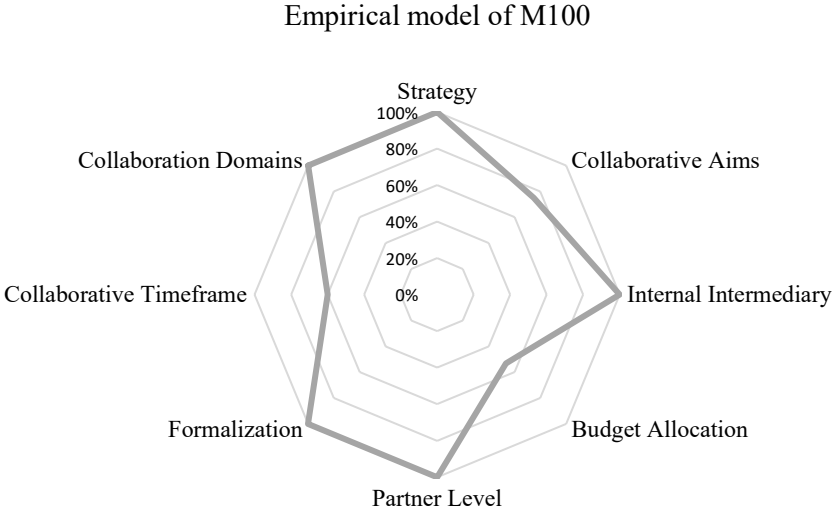

Fig. 2: Empirical model of M100 in accordance with the scope of the Typology of collaboration approaches. Type 'Partner - Strategic Alliance' used as the ideal type of reference. Each construct was given a score by the interviewee based on the relative theoretical importance of each construct.

Discussion

The existing body of literature (Bastos et al., 2021; Perkmann et al., 2021) provides primary insights on best practices (Frølund & Riedel, 2018), success factors (Mora-Valentin, Montoro-Sanchez, & Guerras-Martin, 2004; Albats, Fiegenbaum, & Cunningham, 2018) and recognition of industry partners as proactive contributors to UIC (Giones, 2019). However, the comprehensive and clear understanding of institutional approaches to UIC remains to be deduced (Skute et al., 2019). Our inductive, exploratory analysis has yielded a typology of collaborative approaches which large industrial enterprises uptake towards collaborations with HEIs. As a unique form of theory building, a typology facilitates an understanding of a complex, holistic interface of UIC from the industrial perspective (Doty & Glick, 1994).

Given the grand theoretical assertion that the establishment of goals for the collaboration dictates the subsequent approach and the adaptation of supporting mechanisms – it can be deduced that defining a strategy towards UIC which addresses the necessary structural mechanisms will facilitate efficiency, and hence maximization of value being co-created with collaboration stakeholders. This imperative is reflected through first (*X*) and second (*Y*) order typological constructs and the theoretical assertion is evidenced through the ideal types and grounded in supporting theory. An interplay of theories was referenced to, namely how the knowledge-based theory demonstrates the value being co-created (VCC) by a firm using external interactions with a variety of stakeholders (RM), generates knowledge, which is in turn leveraged and utilized by the firm to attain desirable outcomes.

We address our first research question of "*How do firms approach collaborations with HEIs?*" by deriving a comprehensive set of 5 industrial collaborative ideal types, which comprehensively exhibit the approaches which the industry uptakes towards academic collaborations. There is evident development from the *Situationship* ideal type through to *Research and Innovation Ecosystem* ideal type, facilitated through structural elements, collaborative domains, and importantly the broad outreach of aims. Types 1 through 4 are manifestations of increasing focus and strategic organization of UIC, and the 5th type is a more elevated progression of collaborative ideals, bringing the presence of a whole collaborative ecosystem with multi-stakeholder engagements. The second research question of how the collaborative approaches have evolved in practice is supported by the major drivers behind the evolution of aims. As identified by the study participants - the collaboration aims became more strategic, forward thinking, and innovative. This is in line with the progression through the ideal types, and resonates with (Frey et al., 2006) where the partnership continuum through the collaboration levels entails integrations such as strategic initiatives being implemented by the industry such as MRAs, partner networks, and internal supporting intermediaries.

Our analysis provides a much sought-for, in-depth understanding of the dimensions across which organizational approaches to UIC differ. The infrastructure and supporting mechanisms firms utilize to successfully engage with universities are addressed, in addition to the variations in the design and implementation of such elements, yielding a typology of industrial approaches to UIC.

Theoretical contributions

Given that the currently published UIC research (Bastos et al., 2021; Perkmann et al., 2021) does not appear to comprehensibly intertwine the previously developed empirical models as well as theoretical understandings, this inhibits the directionality of future research (Skute et al., 2019). With our results we comprehensively intertwine the existing literature and concepts, not only to support our findings but to intertwine the previously developed empirical models as well as theoretical understandings, facilitating the grounds for further research.

Our theoretical contributions stem from developing our conceptual understanding of the industrial collaborative ideals, which depict the different approaches firm's uptake for their collaborations with HEIs. As an important contribution to the UIC literature, we identify eight main constructs seen in *Table 2* – strategy, collaboration aims, collaboration domains, budget allocation, partner level, formalization and collaborative timeframes and internal intermediary – that reflect and characterize different organizational ideals in the context of UIC, with the subsequent sub-constructs (*Table 3* through to *Table 10*). These dimensions capture both the overall framing of the approach, as well as manifest themselves in describing the set of ideal industrial collaborator types, which is a novel typological theory in the field of UIC. Furthermore, the interconnection of relationship marketing (RM), value co-creation (VCC), and knowledge-based theories – all being sourced from related disciplines serve as a unique theoretical foundation which additionally depicts the phenomenon of UIC and sets the stage for further theoretical development.

We demonstrate, the ordinance of aims in the derivation of the subsequent approach of the industry towards academic partnerships. Not limited to the above, the aims are moreover the driving factor behind the

evolution of how industry collaborates with academia. With the research and findings of this dissertation, the research gap in terms of the underrepresented industry perspective on UIC (Skute et al., 2019) is fulfilled.

Managerial implications

The typology of collaborative approaches furthermore contributes a strong foundation for future academic and managerial advancement. Addressing the research question of how firms approach collaborations with HEIs - our five ideal types of industrial collaborators have been defined across an extensive array of dimensions, and concrete estimates for each construct were provided, facilitating the potential for typological testing. This novel contribution furthermore allows the researcher and practitioner communities to encompass and comprehend the collaboration models established by firms. Furthermore, the typological types, as they are ideals - can serve as a guide for practitioners, who seek to not only understand the ways in which industry collaborates with academia, but moreover to establish collaborations or develop approaches of their own. More specifically, managers can empirically assess their status quo in terms of UIC whereby the ideal types are a benchmark, which can be modelled (as seen in *Figure 2*) hereby deriving weighted Euclidean distances. This allows for practitioners to examine the extent to which their mode of collaboration deviates from the ideal type, thereby depicting closeness to an ideal, and hence achievement of effectiveness as a dependent variable. The relative theoretical importance for each construct is provided, which can serve as a guide for practitioners to apply it to their own collaboration approaches.

Limitations and future directions

The larger and more diversified the company's knowledge base, the greater is the potential to recombine the knowledge gained (Melnychuk et al., 2021). Moreover, given the likelihood of creating an agreement with an academic partner (Fontana et al., 2006), size and orientation of the organization in developing the company's approach to UIC (Santoro & Chakrabarti, 1999), it is critical to focus on large organizations. However, given the extensive opportunities for SMEs to generate innovation and value from engaging with (Kurdve, Bird, & Laage-Hellman, 2020), future research to expand this work across other types of organizations. Another limitation of our research is that the presented aims in *Table 4*, although inductively drawn out of the data, are non-exhaustive. There can potentially be other aims for collaborating with academic institutions, in addition to the ones stated. We tried to mitigate this by bringing in overarching collaborative domains, which encompass more, but due to their granularity level – are less descriptive than specific aims. Furthermore, as already mentioned with our section on the evolution of approaches, we note that the main driver is the evolution of aims. This will continue to occur, and new drivers will emerge, further evolving the approaches the industry exhibits towards their academic collaborations. Hereby, we call for longitudinal research in this regard, to examine the changes, progress the research on UIC from the industry perspective, and further test and develop our typology of ideals.

Conclusion

This study advances the theoretical and practical understanding of how large industrial firms approach university–industry collaborations (UIC) by offering a novel, empirically grounded typology of collaborative ideals. Through an inductive and exploratory methodology, we have conceptualized five ideal types that reflect the evolution and strategic refinement of industry engagement with higher education institutions. These types encapsulate a spectrum of collaboration—ranging from situational, ad hoc engagements to fully developed, ecosystem-based partnerships—characterized by eight interrelated constructs. By synthesizing existing literature and extending theoretical frameworks such as value co-creation, relationship marketing, and knowledge-based theory, our work addresses a significant gap in UIC research: the lack of a comprehensive, industry-centric perspective.

Beyond academic contribution, the typology offers tangible utility for practitioners. It enables firms to benchmark and assess their collaborative approaches, and supports managers in aligning strategy, structure, and aims for greater effectiveness in university partnerships. Despite the focus on large firms, the framework lays a foundation for future research to test, adapt, and expand across different organizational contexts, particularly SMEs. As collaboration aims and mechanisms continue to evolve, we encourage longitudinal studies to trace these developments, refine the typology, and deepen the understanding of UIC from the industry's vantage point. In doing so, future research can build on this study to inform both scholarly discourse and practical innovation in university–industry collaboration.

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