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Long-term innovation outcomes of university-industry collaborations: the role of 'bridging' vs 'blurring' boundary spanning practices

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Abstract

We explore the link between the long-term innovation outcomes of university-industry collaborations (UICs) - in particular, whether the UIC has led to further exploitative or exploratory innovation - and the adoption of boundary spanning practices. This extends the current literature on UICs, which has mainly focused on short-term innovation outputs and on the features of boundary spanning individuals and teams. Relying on a unique, purposefully constructed evidence base combining information from 95 semi-structured interviews with participants in 75 UICs and from publicly available databases, we find that adopting a 'bridging' approach to boundary spanning – through formal and structured practices and communication procedures – increases the likelihood that the UIC will lead to further exploitative innovation. A 'blurring' approach to boundary spanning – through informal practices to de-emphasise boundaries between organisations – increases the likelihood that the UIC will lead to further exploratory innovation. The choice of each boundary spanning approach is in turn influenced by the collaborators' prior experience with internal knowledge creation and collaborative knowledge co-creation. Management and policy implications are discussed.

Key words: university-industry collaborations (UICs), boundary spanning, Knowledge Transfer Partnerships (KTPs), exploitative innovation, exploratory innovation

1. Introduction

University-industry collaborations (UICs) play an important role in business innovation processes (Czarnitzki et al., 2011), with many firms, particularly in research and development (R&D) intensive industries, considering universities as important sources of external knowledge (Arundel and Geuna, 2004; Brusoni et al., 2001; Etzkowitz 2017). Besides producing short-term benefits for the collaborating firm (such as new products, new processes, and measurable increases in economic performance; Bekkers and Bodas Freitas, 2008), UICs can influence the firm's long-term exploitative and exploratory innovation activities, for example they can lead to new networks, R&D projects, and investment (Motoyama, 2014; De Fuentes and Dutrénit, 2012; Rosli et al., 2018). Yet, while policymakers increasingly stress the importance of UICs' long-term impacts (Czarnitzki, et al., 2011), research so far has focused mainly on the determinants of their immediate outputs (Perkmann et al., 2011; Rosli et al., 2018).

Firms' participation in UICs could lead them to engage in further exploitative and exploratory innovation processes, the former intended as deepening the usage of existing knowledge, and the latter as expanding the scope of knowledge (Gupta, et al 2006); these are particularly important long-term impacts of UICs, as they affect the firm's future innovation trajectory. Firms' combined pursuit of exploitative and exploratory innovation helps them to ensure viability in a fast changing competitive environment (Jansen et al., 2006) as it allows them to be current in their new product offerings while remaining on the frontier of technological development. Exploitative and exploratory innovation processes have been discussed widely in relation to their role in knowledge acquisition strategies (Bercovitz and Feldman, 2007), their effects on organisational learning (March, 1991; Bednarek et al., 2016) and decision making (Jansen et al., 2006; Laureiro-Martínez et al., 2015), and their implications for performance (Yamakawa et al., 2011; Gupta et al., 2006). Among the antecedents of exploratory and exploitative innovation (Jansen et al., 2006), participation in UICs has so far attracted little attention (Rosli et al 2018).

Against this backdrop, the present study makes an original contribution by investigating how the adoption of boundary spanning practices (Leifer, and Delbecq, 1978; Bartram et al., 2020) in UICs influence the extent to which firms collaborating with universities engage in exploitative innovation (by building upon the knowledge

developed during the UIC using internal knowledge resources) and in the exploration of new innovation pathways (by integrating the knowledge developed during the UIC with further new external knowledge). Particularly, we focus on two archetypal approaches to boundary spanning (Evans and Scarbrough, 2014): (A) a *bridging approach* that entails the adoption of formal and structured routines and communication procedures and (B) a *blurring approach* that involves the adoption of informal practices to de-emphasise boundaries between organisations.

We hypothesise that the boundary spanning approaches adopted in a UIC mediate the relationship between the UIC collaborators' prior experience and the firm's engagement in further exploitative and exploratory innovation. The relevant hypotheses are tested with original empirical evidence about 75 UICs involving academics and firms, using a mixed method approach. The findings provide guidance to UIC practitioners seeking for better ways to organise their collaborations, and to policymakers seeking to increase the impact of their programmes.

The paper is organised as follows. The conceptual framework underpinning our empirical analysis is developed in Section 2. Data and methodology are presented in Section 3, and the empirical findings in Section 4. Findings and their implications for UIC management are discussed in Section 5.

2. Theoretical background and hypotheses development

To provide the conceptual background for this study, we review the organisational literature on boundary spanning, identifying several ways to combine boundary-spanning practices within UICs. We then integrate relevant streams of literature on boundary spanning in inter-organisational collaborations, exploitative and exploratory innovation, and outcomes of UICs, to develop hypotheses that associate different boundary-spanning approaches to the firms' likelihood to engage in exploitative and exploratory innovation. As a further step to reach a comprehensive understanding of the phenomenon, we hypothesise that boundary spanning approaches mediate between the collaborators' prior experience with internal knowledge creation and with knowledge co-creation, and their subsequent engagement in exploitative and exploratory innovation.

2.1. Approaches to boundary spanning in UICs

Boundary spanning is increasingly important for contemporary organisations, where knowledge-producing activities are specialised, non-routine and require interdependent and coordinated actions across different organisational units (Dolfsma and van der Eijk, 2016) and across organisational boundaries (Boardman, 2011). Boundary spanning has been singled out as an important success factor for UICs (Pertuzé et al., 2010; Wright et al., 2008) where parties are characterised by cognitive, social, cultural and institutional distance (Thune, 2007; Muscio and Pozzali, 2013). In the context of UICs, boundary spanners have been studied mainly as individuals or teams with certain personal or relational characteristics (Comacchio et al., 2012). In particular, individuals with careers spanning academia and industry (Li et al., 2013; Belderbos et al., 2014) can provide "credible and 'trustworthy' voices within the projects" (Rosli et. al., 2018, p. 403), owing to their in-depth knowledge of both institutional contexts (Vogelgesang et al., 2010). Their knowledge and experience enable them to identify and exploit inter-organisational synergies and implement more integrative cross boundary structures (Balogun et. al., 2005). Sometimes, boundary spanners occupy brokerage positions in networks of relationships, connecting actors that are unconnected with each another: this gives them privileged access to information and knowledge (Kislov et al., 2017), and facilitates the creative combination of different sources of knowledge to generate innovation (Fleming et al., 2007; Fleming and Waguespack, 2007).

Some organisational literature has focused on boundary spanning as a *dynamic set of practices* (Leifer, and Delbecq, 1978; Bartram et al., 2020). A boundary spanning practice is a "mechanism that overcomes a knowledge boundary by engaging agents from different knowledge communities in collective activities" (Hawkins and Rezazade, 2012, p. 1806). Boundary spanning practices are not separable into sub-tasks that can be delegated to experts in each specialised domains, rather they are performed within a flexible space between the domains of expertise (Comacchio, et al., 2012). Particular attention has been paid to leadership (Ancona and Caldwell, 1992; Fleming and Waguespack, 2007), organisational diversity and team composition (Joshi et al., 2009).

Less attention has been paid to how boundary spanning practices are combined within collaborations. An exception is the work by Evans and Scarbrough (2014) who

empirically explored combinations of boundary spanning practices for knowledge transfer in the context of clinical collaborations. Evans and Scarbrough identified two archetypal approaches to combining boundary spanning practices[1]. The 'bridging' approach involves "designated roles, discrete events and activities to span the boundaries between communities" (Evans and Scarbrough, 2014, p.119): collaborators create a separate space where each side can engage for a strictly delimited time with the knowledge and insights offered by the other, following agreed-upon communication modes and a detailed work programme. To achieve this, interactions follow a planned structure and participants' roles and communication modes are clearly outlined in advance. Instead, the 'blurring' approach "de-emphasises the boundaries between groups, enabling a more continuous process of knowledge translation as part of day-to-day work-practices". (Evans and Scarbrough, 2014, p.119). The participants, whose roles in the collaboration are not well defined in advance, have a peer-to-peer relationship that might not reflect organisational hierarchies. There is an evolving, less prescriptive approach to developing study designs and plans, whereby work programmes are not specified in detail at the outset. Formal meetings can occur, but they are only one component of a broader set of ongoing interactions, and modes of communication can be informal. Since collaborators have to mutually adapt their practices to pursue the collaboration's goals, a high degree of commitment to the relationship on the part of the organisations is required.

These approaches to boundary spanning are not necessarily alternative, since specific practices can be combined in different ways. The collaborators might find it difficult to explicitly agree on a common approach (Perkmann et al., 2011) and might instead organise the collaboration in an 'emergent' way leading to a mix of practices (Motoyama, 2014; Thune, 2007; De Fuentes and Dutrénit, 2012). For instance, collaborators might agree on an upfront work programme and use formal relationship and communication management frameworks (Gertner et al., 2011; Ternouth, 2012), while at the same time also adopting informal relationship-building practices that indirectly help them to align goals, objectives (Ancona and Caldwell, 1992), routines (Bartel, 2001) and procedures (Hawkins and Rezazade, 2012).

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[1] Since the boundary spanning practices identified are not specific to clinical contexts but relate to general features of collaborations (for more detail, see Evans and Scarbrough 2014), their framework can be extended to the case of UICs in a straightforward manner.

2.2. Boundary spanning and exploratory and exploitative innovation

We investigate whether different approaches to boundary spanning within the UICs can support the firm's subsequent engagement in exploitative and exploratory innovation. UIC success has often been measured in terms of immediate outputs, such as scientific publications and patents (Perkman et al., 2011), or the participants' subjective satisfaction with the collaboration (Bekkers and Bodas Freitas, 2008; Stock and Tatikonda, 2000). However, evidence suggests that the most impactful UICs generate long-term outcomes, continuing over time and leading to further innovation after the end of the UIC (Mora-Valentin et al., 2004; Perkman et al. 2011). Such innovation can be exploitative, when the firm enriches its knowledge base through "a pursuit of new use and development of things already known" (Levinthal and March 1993, p.105). In the case of UICs, the firm engages in further exploitative innovation when it builds on the knowledge developed during the UIC by using its own internal knowledge resources, investing in internal development (Motohashi, 2005). For instance, a firm may use knowledge developed during the UIC to improve current products, services and processes (March 1991; Gulati and Puranam, 2009; Yamakawa et al., 2011). On the other hand, innovation can be exploratory, when the firm increases its stock of knowledge, by integrating new knowledge that often departs from its existing knowledge base (Lavie et al., 2010; Caloghirou et al., 2004). A key mechanism for exploratory innovation identified in the literature is firms accessing new knowledge that is distant from their existing knowledge, and integrating these different knowledge bases to produce new products, services and processes (Benner and Tushman, 2002; Raisch et al., 2009). In the case of UICs, the firm engages in further exploratory innovation when it integrates the knowledge developed during the UIC with external knowledge, by collaborating with external networks (Rosli et al 2018; Jansen et al., 2006; Gulati and Puranam, 2009).

As the bridging approach to boundary spanning entails a highly structured relationship, clearly delineated communication practices, and clear separation between different roles, we argue that it may enable collaborators to engage in further exploitative innovation. This is for two reasons. First, structuring the collaboration and defining a clear work plan (Ternouth, 2012) minimise ambiguity (Kislov et al., 2017), discourage free-riding (Dyer and Singh, 1998), and protect proprietary assets (Kale et al., 2000), which allow collaborators to achieve project objectives smoothly

(Srinivasan and Brush, 2006). Since UIC projects usually target a business challenge (Lee and Miozzo, 2019), when the UIC's objectives are reached successfully they are likely to be further exploited within the firm to further address the challenge. Second, practices aimed at structuring the UIC and at improving the communication between the partners have been found to improve the firm's ability to acquire academic knowledge (Zollo et al., 2002; Yamakawa et al., 2011), which the firm then integrates into its own knowledge base (De Silva and Rossi, 2018). As a result, the firm can exploit the knowledge emerging from the UIC to produce innovations that are close to and improving its current knowledge base. Hence, we hypothesise that:

H1: The adoption of a bridging approach to boundary spanning during the UIC is positively associated with the firm's subsequent engagement in exploitative innovation

The blurring approach to boundary spanning on the other hand entails a less structured relationship, where roles are blurred, hierarchies are flatter, interactions and exchanges occur spontaneously and on an ongoing basis. Communication channels are informal. Therefore, we hypothesise that blurring practices may enable partners to experience a relatively more 'open-ended' relationship that facilitates the emergence of knowledge outcomes that go beyond those explicitly targeted by the UIC. These open up new possibilities and lead firms to explore new innovation pathways after the end of the UIC. This is for two reasons. First, practices aimed at aligning the goals, objectives, routines and practices of firms and universities result in the development of new knowledge that integrates element of the knowledge bases of both parties (Alin et al. 2011; De Silva and Rossi, 2018; Ring et al., 2005) and transcends the established specialist domains of each (Evans and Scarbrough, 2014; Amin and Roberts, 2008). These forms of knowledge are often serendipitous and unplanned (Leckel et al., 2020). They are also likely to be of interest to a broad variety of communities outside the collaboration, which means that the firm will find it easier to form new networks through which it will be able to access and integrate new external knowledge after the end of the UIC. Second, blurring practices help to build trust, increase co-operation, reduce transaction costs and improve relationship stability (Caloghirou et al., 2004; Dyer and Chu, 2003; Zollo et al., 2002). The relational experience gained during the UIC is likely to encourage firms to engage in further collaborations with external partners (Hemmert et al., 2014) after the UIC, leading to

the further exploration of new forms of knowledge. On this basis, we hypothesise that:

H2: The adoption of a blurring approach to boundary spanning during the UIC is positively associated with the firm's subsequent engagement in exploratory innovation

2.3. Collaborators' prior experience, boundary spanning and innovation

Past studies have discussed the influence of the collaborators' prior experience on their engagement in exploratory and exploitative innovation (Sjöö and Hellström, 2019; Bellini et al., 2019) and on the adoption of bridging and blurring approaches to boundary spanning (Evans and Scarborough, 2014), although these outcomes have not previously been considered together in a single study. It has also been argued that the collaborators' prior experience alone will not necessarily translate into innovation outcomes: it is only when collaborators learn from positive or negative experiences in order to adopt relevant practices, that prior experience has positive effects on innovation (Kaymaz and Eryiğit, 2011; Fındık and Beyhan 2015). In our context, this argument suggests that the collaborators' prior experience may lead them to adopt specific boundary spanning practices which in turn influence their probability to engage in exploratory and exploitative innovation: that is, boundary spanning approaches might play a mediation role between the collaborators' prior experience and subsequent innovation. We therefore present two further hypotheses about the mediation roles of bridging and blurring practices. Since we have already discussed the expected relationships between boundary spanning approaches and types of subsequent innovation in the development of H1 and H2, in order to establish the mediation role of boundary spanning, we first argue for the relationship between collaborators' prior experience and propensity to engage in different types of innovation, and subsequently, establish the link between collaborators' prior experience and the propensity to adopt specific approaches to boundary spanning.

We consider in particular two relevant types of collaborators' prior experience, which according to past literature are particularly influential in shaping the nature and outcomes of UICs (De Silva and Rossi 2018): the collaborators' experience in creating and developing knowledge internally within their organization (internal

knowledge creation experience), and their experience in collaborating with external partners to create knowledge (knowledge co-creation experience).

In the context of UICs, internal knowledge creation experience – for example, university personnel's experience with academic research and firms' experience with internal R&D – has been associated with the production of more valuable inventions, with greater potential for commercial or internal exploitation (Messeni Petruzzelli, 2011; Fassio et al. 2019). We can explain the link between the collaborators' internal knowledge creation experience and the UIC's greater likelihood to result in subsequent exploitative innovation on the basis of the link between such experience and the greater focus of the UIC on producing knowledge that is predominantly of use to the business. Businesses that possess internal research capabilities have a more internally focused knowledge development (Maes and Sels, 2014) and are better able to use external knowledge to achieve their own innovation objectives (Laursen and Salter 2004; Veugelers and Cassiman, 2005), while university partners have expertise to produce knowledge internally that can then be transferred to businesses during the UIC (D'Adderio and Pollock 2020). UICs whose participants have internal knowledge creation experience, are more likely to have focused and predefined objectives (Al-Tabbaa and Ankrah, 2016) regarding how to use university knowledge to be able to solve business challenges; consequently, they are more likely to produce knowledge that particularly enriches the business's existing knowledge base, which is particularly amenable to further exploitation (Fabrizio, 2009), rather than knowledge of use to external parties (Lee and Miozzo, 2019).

While past literature has argued that internal knowledge creation experience has a positive influence on the likelihood of further exploitative innovation, we suggest that this relationship is mediated by the use of bridging boundary spanning practices. There are several reasons to hypothesize that internal knowledge creation experience increases the likelihood of adoption of such practices. First, internal knowledge creation involves having working relationships, initiatives and structures facilitating communication and collaboration with internal parties (Hillebrand and Biemans, 2003; Blomqvist and Levy,2006) and internally focused practices and policies (D'Adderio and Pollock 2020). Therefore, organisations that engage in knowledge creation internally usually have independent knowledge creation processes (Iles and Yolles, 2002), which are costly and time consuming to adapt in order to engage in

UICs. In this case, the collaborators are likely to avoid any radical modification to their already established work practices, and instead adopt formal knowledge transfer mechanisms that are specific to the UIC and distinct from their mainstream internal practices (Lavis et al. 2003; Evans and Scarborough, 2014). This can be done by structuring the UIC around planned routines and communication procedures (Bellini et al., 2019) which allow the collaborators to carve a separate interaction space for the UIC, instead of altering their internal practices to accommodate the collaboration.

Second, organisations that engage in knowledge creation are likely to already possess practices to share knowledge internally, which usually rely on structured communication mechanisms (De Silva and Rossi 2018; Sherwood and Covin, 2008; Kang and Kang, 2009). The familiarity with structured mechanisms for knowledge sharing makes it more likely that a similarly structured approach will be replicated in the UIC. This is further supported by research that has highlighted the benefits of practices' replication (D'Adderio 2014; Aroles and McLean, 2016) to avoid the cost associated with the adoption of new ways of communication and working that might exceed the benefits of innovation (D'Adderio and Pollock, 2020).

Hence, we expect internal knowledge creation experience to increase the likelihood of further exploitative innovation as well as the adoption of bridging practices. In turn, as we previously argued, the bridging approach to boundary spanning, facilitates the achievement of project objectives and the acquisition of university knowledge (De Silva and Rossi 2018) that the firm integrates within its own knowledge base and can further exploit to improve its own products, services or processes. Therefore we hypothesize that:

H3: The bridging approach to boundary spanning mediates the relationship between internal knowledge creation experience and the firm's subsequent engagement in exploitative innovation

Knowledge co-creation involves universities and businesses working together by crossing inter-organisational boundaries (Sjöö and Hellström, 2019) and integrating each other's knowledge (De Silva and Rossi 2018) to generate common value (De Silva and Wright 2019). Experience with knowledge co-creation results in less salient professional and disciplinary boundaries (Ulhøi et al. 2012), and greater readiness to draw on and combine insights from different perspectives and other communities (De

Silva and Wright 2019; Sjöö and Hellström, 2019). Therefore, UIC partners that have knowledge co-creation experience are better able to combine different knowledge bases to produce new, interdisciplinary knowledge (Kazadi et al. 2016; Wirsich et al. 2016). This type of knowledge is often of interest to other external parties, with whom businesses can engage in for further exploratory innovation after the UIC. Moreover, partners with knowledge co-creation experience are more likely to consider the UIC as an opportunity to produce new knowledge that goes beyond resolving the original business challenge, which is likely to have more uses or create innovation (Yang, 2005), and is conducive to subsequent exploratory innovation after the UICs.

While past literature has argued that knowledge co-creation experience has a positive influence on the likelihood of further exploratory innovation, we suggest that this relationship is mediated by the use of blurring boundary spanning practices.

We highlight two main reasons for which prior knowledge co-creation experience increases the likelihood of adoption of such practices. First, universities and businesses with knowledge co-creation experience are already used to participate in versatile, open-ended relationships that usually carry greater uncertainty (Blomqvist and Levy 2006). These relationships are usually managed by adopting informal communication and interaction practices that can help the partners to develop mutual understanding of each other's norms, habits, and routines (Laursen and Salter 2006; Evans and Scarbrough, 2014). Hence, having knowledge co-creation experience is likely to lead the UIC collaborators to adopt those same informal practices, adaptable to the needs of the collaboration, that had worked well in previous relationships (Schaeffer et al., 2020). Second, the adoption of such informal communication and interaction practices is easier for organisations with prior knowledge co-creation experience, because their own practices, norms and structures are already designed to accommodate interactions with external partners (De Silva and Rossi 2018). They can more easily accommodate within their processes direct, peer-to-peer relationships with their UIC partners, which lead to an ongoing, non-hierarchical and open flow of communication between them (Blomqvist et al. 2005). Knowledge co-creation experience provides partners with confidence to adopt loosely defined plans and working patterns (Schaeffer et al., 2020). The experience of working closely with other organizations also implies that partners, even if they have not directly worked with each other previously, are likely to have 'generally' aligned goals (Hong et al.,

2010), practices and relational proximity (Kale et al., 2000), and thus are less likely to adopt separate structures and practices for UICs (Al-Tabbaa and Ankrah, 2019).

Hence, we expect knowledge co-creation experience to increase the adoption of blurring practices. In turn, as we argued previously, the blurring approach to boundary spanning facilitates the development of new knowledge integrating elements of the knowledge bases of both parties, which is conducive to further exploration with external parties (Ring et al., 2005; De Silva and Rossi, 2018), and hence increases the likelihood of further exploratory innovation. Therefore we hypothesise that:

H4: The blurring approach to boundary spanning mediates the relationship between knowledge co-creation experience and the firm's subsequent engagement in exploratory innovation

Since internal knowledge creation and knowledge co-creation experience are vested within individual partners, collaborators in a single UIC may have both types of experience, and this may result in the adoption of both types of approaches and in both types of subsequent innovation. Hence, we consider exploratory and exploitative innovations as different processes (He and Wong, 2004; Jansen et al., 2006; Mueller et al., 2013; Raisch et al., 2009; Lin et al., 2013), which can occur simultaneously when different boundary spanning approaches are adopted at the same time (Andriopoulos and Lewis, 2009; Jansen et al., 2006).

3. Data and methodology

3.1 Data collection and empirical strategy

The empirical study relies on evidence from the "Knowledge Transfer Partnership" (KTP) university-industry collaboration scheme, implemented in the United Kingdom since 2003, with funding from fifteen government organisations led by the public innovation agency InnovateUK. This scheme funds collaborative partnerships between a business partner and an academic partner, who jointly recruit and supervise a recent graduate (associate) in order to deliver a project of strategic value to the firm (Rossi et al., 2017). The latter is very often an SME, although large firms and charitable organisations can participate. Each project lasts between 12 and 36 months. This scheme provides an appropriate empirical context to study UICs. First, while the scheme has some specific operational rules, most of its features are common to many UICs, including the freedom to choose how the collaboration is organised and

managed, design goals, select partners, and the possibility for further outcomes to emerge after the end of the collaboration (Rosli et al 2018; Rossi et al 2017). Second, the scheme is associated with a large, openly accessible base of evidence collected by InnovateUK: a public database of nearly 10,000 completed and current KTPs, including details of the collaborators, theme, duration and funding received by each KTP.

Over a 12 month-period in 2014-2015, we conducted in-depth interviews, each lasting between 30 and 60 minutes, with 95 individuals who had participated in at least one KTP: 27 business partners, 44 academic partners and 23 associates, and 1 individual involved in the management of KTPs at university level.[2] The interviewees were purposefully chosen based on predefined criteria (purposive sampling) and recommendations by other interviewees (snowball sampling).

During the interviews, these 95 individuals discussed their involvement in 75 different KTPs. Table A1 in the Appendix lists the 75 KTPs, along with their general knowledge field, the scientific field of the university department, the sector of the business, and the number of interviewees.

We built a database with 75 observations, corresponding to the 75 KTPs discussed in the interviews. The database included variables built through qualitative content analysis and variables derived from secondary sources. The former were constructed from the interview transcripts, as follows. All the transcripts were read and annotated by one coder (one of the authors), who created variables by attributing scores to the transcripts based on the presence or absence of certain elements.[3] In particular, the variables' construction involved scoring each interview transcript according to whether: the academic and business partners had prior UIC and industry experience; the academic and business partners, and the academic and the associate, had collaborated prior to the KTP, and they continued the collaboration after the KTP; the

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[2] Four more individuals involved in KTP management were interviewed in relation to the general process of setting up and managing KTPs, without discussing specific KTP projects. Hence, information from these four interviews was not used to build the KTP database used in this analysis.

[3] Intercorder reliability was ensured by the involvement of the three other authors at various stages of the process. First, they reviewed and evaluated the coder's initial annotations independently to enhance the interpretative rigour of the findings (Eisenhardt and Graebner, 2007). Second, the outcomes of this independent analysis were discussed in the context of three joint meetings (including the coder and the three other authors) where a consensus was reached initially on the definition of the variables and, later, on the attribution of the scores. Intracoder reliability was ensured through a clear process of variable construction (Bryman and Bell, 2007) based on precise and narrow definitions of each variable to be scored.

management of the collaboration involved certain elements (the associate worked at the firm's premises, there were regular project meetings, the firm was committed to the project, communication within the project was effective, there was a clear structure to the interaction, project goals were clearly identified); the KTP led to further activities on the part of the university (projects, publications, teaching activities), the firm (increased reputation, economic outcomes, training, investment, projects, business ventures, products, networks) or the associate (employment in the firm, qualifications).

Further variables were extracted from publicly available online databases: InnovateUK's KTPs database (academic and business partners' names, job roles, addresses, firm size and sector, KTP objective, knowledge field, grant amount, funding body); Scopus (number of publications and co-publications of university, firm, academic and business partner and associate), Espacenet (number of patents and co-patents of university, firm, academic and business partner and associate), the Times Higher Education Ranking Guide 2016 (university's ranking).

The evidence base was analysed using a mixed method approach. The database was used to investigate associations between relevant variables, using a Structural Equation Modelling (SEM) approach, and qualitative evidence was used to further substantiate those associations. We also ran several robustness checks to further validate our hypotheses. These involved using alternative definitions for the bridging and blurring variables, and testing the hypotheses using a multiple regression setting.

3.2. Variables' construction

Several indicators have been proposed to capture the long-term innovation outcomes of UICs. Some of these aim to capture how firms have made further investments to exploit the knowledge created during the UIC, in order to develop new products and processes (Barbolla and Corredera, 2009; Bekkers and Bodas Freitas, 2008), or to grasp business opportunities (Rosli et al., 2018): these align with our definition of exploitative innovation. Other indicators capture whether, as a result of the UIC, the firm has engaged in seeking further knowledge by entering new collaborations, either with same collaborators (Mora-Valentin et al., 2004), or with others (Rosli et al., 2018): these align with our definition of exploratory innovation.

To measure the long-term innovation outcomes of the UICs we used two variables:

- *Exploitative innovation*, a binary variable equal to 1 if the firm sought to further build on the knowledge developed during the KTP by making additional investments internally after the KTP, and zero otherwise.

- *Exploratory innovation*, a binary variable equal to 1 if the firm sought to integrate the knowledge developed through the KTP with external knowledge by collaborating with external networks after the KTP, and zero otherwise.

Both variables were scored from the transcripts as binary variables, with 1 indicating that the activity was mentioned, and 0 otherwise. Examples of how these variables were coded are provided in Table 2. Table 1 shows the combinations of exploitative and exploratory outcomes achieved. Exploitative and explorative innovation outcomes have a positive but not significant correlation, as shown in Table A2 in the Appendix (rho = 0.161, p-value = 0.17). One of the advantages of using SEM is that it can be used in situations where multiple outcomes occur, as in this case.

Table 1. Exploitative vs. exploratory innovation outcomes

		Exploratory innovation outcomes		
		0	1	Total
Exploitative innovation outcomes	0	12	23	35
	1	8	32	40
	Total	20	55	75

To test hypotheses H1 and H2, we constructed two variables proxying the bridging and blurring approaches to boundary spanning. To do so, we relied on four variables coded from the interview transcripts, each of which describes a different aspect of the features and management of the project. These variables are listed in Table 2, where we also provide some examples of how these variables were coded. Each variable is binary, with 1 indicating that the implementation of the practice was mentioned in the transcript, and 0 indicating that the implementation of the practice was not mentioned (or it was explicitly said to be lacking).

Table 2. Variables coded from interview transcripts

Variable name	Description	Example of coding
Exploitative innovation	Whether the firm sought to further build on the knowledge developed during the KTP by making additional investments internally after the KTP	Excerpt coded as 1: *".....and then in the KTP project, new streamlined business processes and new systems are developed and implemented , but I say ERP material management systems, a full year to implement it. Then, they [business partner] put 5 million investment in to build an improved production line [after the KTP] as part of the new business system [developed during KTP]. So, this new investment of the improved production line has increased demand, that enabled them to become much bigger."* [KTP ID 60, Academic advisor]
Exploratory innovation	Whether the firm sought to integrate the knowledge developed through the KTP with external knowledge by collaborating with external networks after the KTP, and zero otherwise	Excerpt coded as 1: *"From one KTP we've worked with two academics and then [after the KTP] we're talking to other companies since the output of KTP seemed to have many potentially new applications. [Company X] is a massive fan of what we're doing. The only reason we have been invited into their inner sanctum to work with them to develop…[a new service] is because of what we were doing with the KTP"* [KTP ID 54, Business partner]
Structure	Whether there was a clear structure to the interaction, such as meetings	Excerpt coded as 1: *"… the local management committee. We have those quite regularly [..] lots of people at those local management committee, the team kind of mentor of the Industrial Partner and then there was also the Executive Director of Education and Research and then the KTP advisor. [...] So, that was actually the chief means of contact between everybody."* [KTP ID 50, Associate]
Communication	Whether there were clearly structured formal communication channels between partners	Excerpt coded as 1: *"I think the lecturers and the company were very good, they were very available, they were always responsive – I had quite a lot of face to face meetings with them as well so the communication was definitely there…we had a planned frequent, regular meetings".* [KTP ID 15, Associate]
Commitment	Whether there was commitment from the firm (willingness to invest effort and time to engage with the university)	Excerpt coded as 1: *"... the idea that some companies have got more capacity to absorb new knowledge than others and I think that's something to do with the company leadership. One of the characteristics is whether the management of the company is enthusiastic about the idea of generating new knowledge…this requires working very closely with us".* [KTP ID 23, Academic partner]
Associate empowerment	Whether the associate was empowered to work on the project independently: low hierarchical structuring and a more fluid role definition within the collaboration	Excerpt coded as 1: *"When I went in as a KTP into that organisation, I came basically straight in at the Board because it was about strategic planning and business growth and I never would have had that opportunity if I hadn't been the Knowledge Transfer Associate […] but because of the relationship between those three parties, because the expectation of the company – they had complete trust in those academic partners and in me – which meant that they had … their expectations [about the associate's role] weren't specific"* [KTP ID 14, Associate]

The *Structure* and *Communication* variables align with the bridging approach to boundary spanning, while the *Commitment* and *Associate Empowerment* variables align with the blurring approach. From these, we created two binary variables capturing the two possible approaches: *Bridging*, a binary variable which takes value 1 if both *Structure* and *Communication* are equal to 1 and zero otherwise; and *Blurring*, a binary variable which takes value 1 if both *Commitment* and *Associate Empowerment* are equal to 1 and zero otherwise[4]. The rationale of scoring 1 for the presence of both practices is to capture their combined effect, since each approach is characterised by a combination of practices. UICs might adopt either approach, or

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[4] The two variables *Bridging* and *Blurring* have a correlation of 0.213 (significant at 10%).

both approaches at the same time. They might also not adopt either of these. This situation occurred when the presence of boundary spanning practices was not clearly mentioned in the transcripts, suggesting that the participants lacked awareness about their importance.

To test hypotheses H3 and H4, we use two ordinal variables:

Internal knowledge creation experience is equal to 2 if the academic advisor and the business advisor both engaged in internal research (they both had a positive number of publications in Scopus), 1 if only one of them did, and zero if neither did.

Knowledge co-creation experience is equal to 2 if the academic advisor and the business advisor had both already participated in at least one UIC before the current one (not necessarily together), 1 if only one of them had, and zero if neither had. This information was coded from the transcripts.

The dependent and independent variables were constructed carefully to minimise the possibility of reverse causality effects. *Exploitative innovation* and *Exploratory innovation* captured activities that were indicated in the transcripts as having occurred *after* the KTP, so that they could not influence the choice of boundary spanning practices. *Knowledge co-creation experience* was coded based on activities that were indicated in the transcripts as having occurred *before* the KTP, so that it could not be influenced by the choice of boundary spanning practices or by the type of subsequent innovation. *Internal knowledge creation experience* was derived from information present in Scopus at the time of the data collection, but since we coded the presence or absence of publication activity (rather than the number of publications) the variable captured the collaborators' general experience with internal research, which is likely to pre-date the KTP.

We also introduce several control variables that have been shown to influence the long-term outcomes of UICs, though they are not necessarily aligned with a particular type of innovation process. Since we use SEM, these control variables affect both boundary spanning and innovation approaches, thus improving the accuracy of our model.

The ordinal variable *Past relationship* takes on value 2 if the academic advisor knew both associate and business advisor personally before the KTP, 1 if the academic advisor knew only one of them before the KTP, and zero if there had been no prior

acquaintance. This information was coded from the transcripts, and captured prior acquaintance between these individuals developed in any setting (for example, academic and business advisor might have known each other professionally, academic advisor and associate might have met during the latter's enrollment in a degree programme). Collaborators who were previously acquainted are more likely to experience mutual trust, which a key success factor for UICs (Mcdonald and Gieser, 1987; Mora-Valentin et al., 2004; Thune, 2007; Rosli et al., 2018).

The ordinal variable *Collaborators seniority* takes value 2 if both the academic and the business advisors were in senior hierarchical positions (the academic was a professor, the business advisor was the managing director), 1 if only one was in a senior position, and zero if they were both in junior positions. A more experienced team should, at least in principle, be able to identify the most appropriate boundary spanning practices for its objectives, which should increase the success of the UIC.

We also control for: the ranking of the university (*University ranking*), based on the Times Higher Education Survey, to account for the greater research orientation of the academic partner, which might reduce their engagement in an applied project like a KTP, reducing the likelihood of achieving further innovation outcomes; the size of the collaborating firm, which might affect its ability to dedicate resources to the collaboration and hence the long-term prospects of the UIC (*Firm size* equals 1 for micro-enterprises, 2 for small firms, 3 for medium-sized firms and 4 for large firms); the field of the KTP, distinguishing between science, technology and management.

Table 3. Descriptive statistics on the variables used

Variable	Obs	Mean	Std. Dev.	Min	Max
Exploitative innovation	75	0.733	0.445	0	1
Exploratory innovation	75	0.533	0.502	0	1
Bridging	75	0.467	0.502	0	1
Blurring	75	0.573	0.498	0	1
Internal knowledge creation experience	75	1.027	0.677	0	2
Knowledge co-creation experience	75	0.973	0.697	0	2
Past relationship	75	0.280	0.481	0	2
Collaborators seniority	75	0.773	0.709	0	2
University ranking	75	2.560	2.250	1	8
Firm size	75	2.533	0.905	1	4
Science KTP	75	0.160	0.369	0	1
Technology KTP	75	0.293	0.458	0	1
Management KTP	75	0.547	0.501	0	1

4. Findings

We conducted both quantitative and qualitative analyses. As for the former, we conducted a step-wise analysis, using SEM (Table 4). Direct, indirect and total effects were also calculated (Iacobucci et al., 2007; Preacher and Hayes, 2008; Rosenbusch et al., 2013) to further strengthen the rigour of the analysis (Table 7). The direct effects refer to the unmediated effects of internal knowledge creation experience and knowledge co-creation experience on exploitative innovation and exploratory innovation, respectively. The indirect effects represent the paths from both types of experience to boundary spanning approaches and from the boundary spanning approaches to both types of innovation. The levels of significance of the mediation effects were assessed by the 'bootstrapping' method (Preacher and Hayes, 2008). We used bias-corrected Maximum Likelihood Estimators, especially suitable for relatively small sample sizes as ours (Chen et al., 2017). Additionally, we present qualitative evidence (in Tables 5, 6, 8 and 9) that confirms our quantitative findings and provides reasons for the presence of the relationships found in the SEM model, which improves the internal validity of model.

Table 4. Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Exploratory innovation←Bridging	.058 (.113)	.041 (.129)			
Exploratory innovation ← Blurring	.316*** (.114)	.321*** (.124)			.272**(.115)
Exploitative innovation ←Bridging	.345*** (.103)	.327*** (.125)			.259**(.122)
Exploitative innovation ←Blurring	-.106 (.111)	-.100 (.137)			
Exploratory innovation ← Internal knowledge creation experience				.148 (.121)	
Exploratory innovation ← Knowledge co-creation experience				.393***(.151)	.318**(.127)
Exploitative innovation ← Internal knowledge creation experience				.248**(.143)	.144 (.125)
Exploitative innovation ← Knowledge co-creation experience				.287 (.170)	
Bridging ← Internal knowledge creation experience			.329***(.119)		.318***(.113)
Bridging ← Knowledge co-creation experience			.134 (.142)		
Blurring ← Internal knowledge creation experience			.159 (.123)		
Blurring ← Knowledge co-creation experience		.	.240* (.135)		.226*(.126)
Control variables					
Exploratory innovation←KTP_Sector_Mgt		.075 (.179)		.428 (.177)	.316 (.310)
Exploitative innovation ← KTP_Sector_Mgt		-.169 (.149)		.119 (.151)	-.221 (.336)
Bridging ← KTP_Sector_Mgt			.423*** (.364)		.779**(.306)
Blurring ← KTP_Sector_Mgt			.098 (.354)		.106 (.314)
Exploratory innovation← KTP_Sector_Tech		-.026 (.187)		-.095 (.182)	.006 (.364)
Exploitative innovation ← KTP_Sector_Tech		-.090 (.176)		.180 (.178)	-.012 (.377)
Bridging ← KTP_Sector_Tech			.183 (.428)		.351 (.355)
Blurring ← KTP_Sector_Tech			-.289*(.384)		-.741** (.360)
Exploratory innovation←Business_Size		-.027 (.131)		-.186 (.133)	-.073 (.125)
Exploitative innovation ← Business_Size		.205 (.133)		.197 (.124)	.212 (.133)
Bridging ← Business_Size			.088 (.135)		.119 (.126)
Blurring ← Business_Size			-.254**(.140)		-.224*(.124)
Exploratory innovation←University_Ranking		.020 (.143)		-.110 (.160)	.000 (.111)
Exploitative innovation ← University_Ranking		-.034 (.131)		-.015 (.132)	-.027 (.115)
Bridging ← University_Ranking			.112 (.136)		.121 (.108)
Blurring ← University_Ranking			-.311***(.111)		-.274**(.108)
Exploratory innovation←Past_relationship		.179 (.143)		-.065 (.163)	.015 (.135)
Exploitative innovation ← Past_relationship		.036 (.134)		-.092 (.155)	.039 (.121)
Bridging ← Past_relationship			.001 (.166)		.071 (.115)
Blurring ← Past_relationship			-.238* (.156)		-.215 (.134)
Exploratory innovation←Seniority		.116 (.118)		.047 (.117)	.091 (.113)
Exploitative innovation ← Seniority		-.018 (.119)		-.073 (.140)	-.021 (.118)
Bridging ← Seniority			-.159 (.123)		-.153 (.111)
Blurring ← Seniority			-.145 (.116)		-.138 (.114)
X^2 (df)	2.226 (1)	3.257 (1)	2.853 (1)	.744 (1)	14.036 (8)
GFI	.985	.991	.992	.998	.971
RMSEA	.129	.175	.158	.000	.101
RMR	.048	.023	.019	.011	.044
TLI	.576	.102	.412	1.090	.698
IFI	.945	.986	.990	1.001	.973
CFI	.929	.980	.987	1.000	.963
CMIN/DF	2.226	3.257	2.853	1.091	1.755
AGFI	.854	.530	.587	.744	.713
NFI	.905	.979	.985	.996	.939

***$p <= .01$, **$p <= .05$, *$p <= 0.1$. Standard errors in parentheses.

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The analysis suggests that the bridging approach is significantly associated with exploitative innovation (β= .345, p<0.01), and its relationship with exploratory innovation is not significant (β= .058, p>0.1). By contrast, the blurring approach is significantly associated with exploratory innovation (β= .316, p<0.01), and its relationship with exploitative innovation (β= -.106, p>0.1) is not significant (Model 1, Table 4). These findings clearly support H1 and H2. As shown in Model 2 (Table 4), the results hold even after adding control variables, further validating the relationships between the type of boundary spanning approach and the nature of innovation.

The qualitative evidence further supports our quantitative findings, as it provides reasons why the bridging approach is positively associated with exploitative innovation, whilst the blurring approach results in exploratory innovation. It is evident that the use of bridging approach (Table 5), which involved a structured relationship with clear communication channels, facilitated the acquisition of academic knowledge by the firm, which can then build on it to improve its internal processes. It also allowed the partners to closely monitor the progress of the project, so that it could be kept on track to ensure the achievement of its objectives; after the end of the KTP, the firm continued to build on these successful outcomes using its own knowledge resources. In relation to the use of a blurring approach (Table 6), the blurring practices lead to outcomes that went beyond the project and that were of value to multiple other parties. This encouraged the firm to develop further collaborations to integrate knowledge developed during KTP with other external knowledge. They also helped to build trust, increase co-operation, and improve relationship stability, which in turn facilitated further external collaborations.

Table 5. Links between bridging approach and exploitative innovation

Reasons why the bridging approach to boundary spanning is positively associated with exploitative innovation	Representative quotations
1. Bridging practices enable the firm to acquire academic knowledge, which it then builds on to improve its internal processes	*"By the end of the first KTP programme, they found structured meetings very useful. It [the meeting] was much like structured audit mode, but I think it helped the company to make most out of our knowledge [...] actually after the project they [firm] added value by building and implementing a new streamlined business process." [KTP ID 42, Academic partner]* *"It is about creating a consistent language for the business [...] If someone there creates process maps and someone here creates a process map, we are using the same language effectively, so that, they understand what each other are talking about. Then [after the KTP], they [business] integrate this [acquired academic knowledge] to re-engineer the business processes and implement new business systems." [KTP ID 42, Academic partner]*
2. Bridging practices allow collaborators to achieve project objectives smoothly, which can be further developed by the firm after the KTP	*"He[the Associate] knew all the different approval processes that needed to go through, and he came up with the useful process toolkit......like a decision support type matrix, that we...I mean myself, the company and the Associate, agreed to use [in the KTP project] while we were developing new packaging....This was exactly what we aimed to develop and I am aware that the business is further improving it even after the KTP." [KTP ID 7, Academic partner]* ***"That's one very crucial good point about KTP's is that the team, they all keep through regular meetings to see the KTP associate is on track and reaches the project's objectives. Due to this approach [..] [using the output of KTP] we're diversifying into new sectors and improving our products."** [KTP ID 58, Business partner]*

Table 6. Links between blurring approach and exploratory innovation

Reasons why the blurring approach to boundary spanning is associated with exploratory innovation	Representative quotations
1. Blurring practices lead to outcomes that go beyond the project and which allow to develop further collaborations	*"We… the company…the associate and myself support each other. Whenever there were any problems or new ideas, we picked up the phone and talked to each other rather than sending e-mail or waiting for monthly meeting [...].With this informal approach and relationship, we have achieved more than what we set out in the original KTP objectives, such as increasing our profile in the area…also co-writing a peer review journal. We're just starting to talk about whether there's any sort of commercialisation opportunity for the KTP as well. So, further collaboration is expected….. "[KTP ID 27, Academic partner]*
2. Blurring practices help to build trust, increase co-operation, and improve relationship stability, which in turns facilitates further collaborations with external parties	*"The academic, company, associate including support team collaboratively acted as a mediator between the gap in expectation and understanding [...] by recognising change, focusing on positive outcomes and by mentoring and where necessary counselling. [...] So, relationship and trust, which I guess is at the heart of partnership you know, it was formed. This is obviously beyond the mandate written in the contractual agreement. Based on the success of the KTP programme and on the effective partnership developed, a number of further co-operations are being planned. [...]the knowledge developed under the existing KTP programme will be used to provide a platform on which to base a second knowledge transfer project" [KTP ID 38, Academic partner]* *"It comes through the informal setting between us…. talking to or float an idea by – even if it's completely off the wall, you-know, 'what do you think of this?' type thing and we build up new process and business opportunities together. I think, again, that's one of the sort-of added values that establish a trusted relationship between partners…we can then begin to see what the possibilities are. And, as I say, it's enabling that trust in the relationship. I would say, trust and relationship are more of intangible aspects of the KTP project [...] and I think then it really does turn into more than a single collaborative project, extending to future partnership beyond just one project" [KTP ID 62, Academic partner]*

In order to test the other two hypotheses, Models 3 and 4 (Table 4) first introduce internal knowledge creation experience and knowledge co-creation experience as

antecedents of the boundary spanning approaches. Internal knowledge creation experience is significantly positively associated with bridging approach (β= .329, p<0.01) but not with blurring approach (β= .159, p>0.1), while knowledge co-creation experience is significantly positively associated with blurring approach (β= .240, p<0.1), but not with bridging approach (β= .134, p>0.1) (Model 3). Furthermore (Model 4) knowledge co-creation experience is positively associated with exploratory innovation (β= .393, p<0.01) whereas its relationship with exploitative innovation is insignificant (β= .287, p>0.1). Internal knowledge creation experience is positively associated with exploitative innovation (β= .248, p<0.05) whereas its relationship with exploratory innovation is insignificant (β= .148, p>0.1). These findings fulfil the pre-conditions to suggest that boundary spanning approaches act as mediators between the types of experience and the nature of innovation. In order to test this, a mediator analysis was conducted in Model 5 (Table 4), which includes all the relevant variables. The model fit measures confirm the appropriateness of the model.[5]

In Model 5, as a result of the introduction of the bridging approach variable, the relationship between internal knowledge creation experience and exploitative innovation becomes insignificant (β= .144, p>0.1), suggesting a full mediating effect of the bridging approach. The relationships between internal knowledge creation experience and bridging (β= .318, p<0.05) and between bridging and exploitative innovation (β= .259, p<0.1) remain significant. Similarly, by adding the blurring approach variable, the level of significance and coefficient of the influence of the knowledge co-creation experience on exploratory innovation is reduced (from β= .393, p<0.01 to β= .318, p<0.05), although it remains significant, suggesting a partial mediation effect of blurring approach on the relationship between knowledge co-creation experience and exploratory innovation.

To further validate this, we computed the direct, indirect and total effects of the structural model, using. the bootstrapping method to assess the level of significance of the mediation effects. As illustrated in Table 7 and Figure 1, there is a significant indirect effect of internal knowledge creation experience on exploitative innovation (.082, p<0.05), without a significant direct effect (.144, p>0.1), further validating the

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[5] X^2(5)= 14.036, p>0.1 (Barrett, 2007),GIF= .971 (>0.95) (Tabachnick and Fidell, 2007); RMSEA = .10 (<0.01), *p*= >0.05 (Byrne, 1998); RMR = .044 (<0.05) (Byrne, 1998; Diamantopoulos and Siguaw, 2000); IFI = .973 (>0.95); CFI=.963 (>0.95) (Tabachnick and Fidell, 2007); CMIN/DF = 1.755 (<2) (Carmines and McIver, 1981).

full mediation of bridging approach. This mediation effect is further supported by the significant relationship between internal knowledge creation experience and bridging approach (.318, p<.01); and the significant relationship between bridging approach and exploitative innovation (.259, p<.1). These findings support H3. We also find a significant indirect effect of knowledge co-creation experience on exploratory innovation (.062, p<0.1), together with a significant direct effect (.318, p<0.05), further validating the partial mediation of blurring approach. This is further supported by the significant relationship between knowledge co-creation experience and blurring approach (.226, p<.05); and the significant relationship between blurring approach and exploratory innovation (.272, p<.05). These findings support H4; we find that the blurring approach partially mediates the relationship between knowledge co-creation experience and exploratory innovation.

Table 7. Direct and indirect effects

Path	Direct	Indirect	Total
Internal knowledge creation experience → Bridging	.318***(.116)	.000	.318 (.116)
Bridging → Exploitative Innovation	.259* (.127)	.000	.259 (.127)
Internal knowledge creation experience → Exploitative Innovation	.144 (.144)	.082**(0.048)	.226 (.141)
Knowledge co-creation experience → Blurring	.226* (.137)	.000	.226 (.137)
Blurring → Exploratory innovation	.272** (.117)	.000	.272 (.117)
Knowledge co-creation experience → Exploratory innovation	.318**(.144)	.062* (.049)	.380 (.148)

***$p <= .01$, **$p <= .05$, *$p <= 0.1$. Standard errors in parentheses.

Figure 1. Mediation effects of bridging and blurring approaches to boundary spanning

***p<0.01 **p<0.05 * p<0.1*

- - - - - - ▶ Indirect relationship

───────▶ Direct relationship
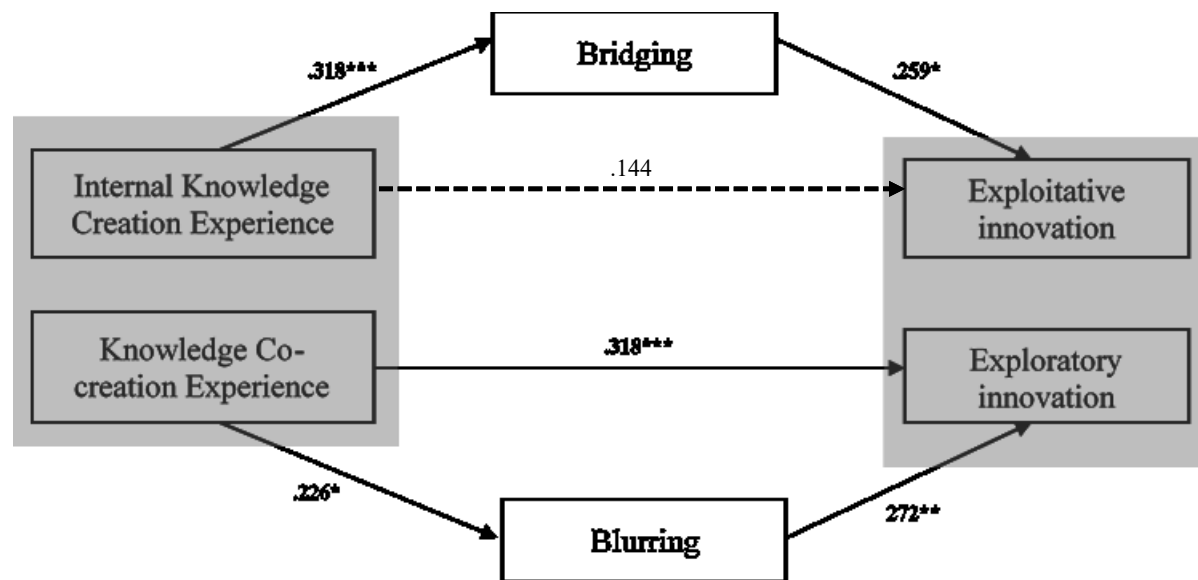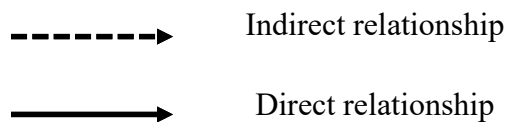
Qualitative evidence further confirms the association between previous experience and choice of boundary spanning approach. Table 8 shows the links between internal knowledge creation experience and the adoption of the bridging approach. Business partners with strong internal research capabilities already possessed routines for research that they did not have to modify when using the bridging approach. They also had structured knowledge sharing practices that they could replicate in their UICs.

Table 9 links previous knowledge co-creation experience and the adoption of the blurring approach. Having knowledge co-creation experience led the collaborators to adopt those same informal practices that had worked well in previous collaborations. It also facilitated the development of direct, peer-to-peer relationships, which led to an ongoing, non-hierarchical and open flow of communication.

Table 8. Links between internal knowledge creation experience and the adoption of a bridging approach to boundary spanning

Reasons why the experience of internal knowledge creation is associated with the adoption of the bridging approach to boundary spanning	Representative quotations
1. Organization that engage in internal knowledge creation have specific routines for research, which they don't have to change when using bridging approach since this approach provides separate structured practices for the KTP	*".....the company that I first worked with on the KTP programme, they have got all…….they were already operating in a structured and systematic way, they had sort of codified research, saying here is a model and the basis of this model is based on this. You know, like you do in academic research…… So, there presented an opportunity, we could codify it, we wanted to come up with the model, and built the sort of academic credibility behind it through KTP. During the KTP programme, we carried on…built on the structured and codified practice…We adopted specific structures for the KTP. Therefore, the business did not have to change the practices adopted for their internal research activities…Some new insights came up, as a result, that contributed to the knowledge performance and a couple of joint papers came out of it."* [KTP ID 40, Academic partner]
2. Organization that engage in internal knowledge creation already have knowledge sharing practices that they can replicate in their UICs	*"We… sort of have… practice and structure in mind in terms of meetings, document and information sharing and working out how to structure solutions from different parties. So, we follow the same practice when working in this KTP project to create the new solution and measurement tool……the collaboration with university worked well, I think….We were writing up an academic peer-reviewed paper about this new solution ....."* [KTP ID 67, Business partner]

Table 9. Links between knowledge co-creation experience and blurring approach

Reasons why the experience of knowledge co creation is associated with the adoption of the blurring approach to boundary spanning	Representative quotations
1. Having knowledge co-creation experience is likely to lead the collaborators to adopt those same informal practices that had worked well in previous collaborations	*"After our first collaboration with X [a university partner] we were left with a kind of basketful of ideas of where to take it next. [...] When working with Y [new KTP academic partner] it kind of got the point where it didn't have to be quite as frequently because it was rolling along and there was a lot of email communication in the second year of it. In the one that we're doing right now it's much more fluid"* [KTP ID 57, Business partner]
2. Knowledge co-creation experience facilitates the development of direct, peer-to-peer relationships, which lead to an ongoing, non-hierarchical and open flow of communication	*"I have got very good close ties with the university and you heard me talking about our most recent collaboration with the university, which is on communication and bar coding's in particular. So, it has been a very good connection. Okay, so the one area is that it bought us as a small company, an SME, into close contact with the university. It allowed us to get to know the individuals within the university and now I think we could call many of the people at the university friends and it has become that close. [...] because it was a smaller company there was ease of access to key decision-makers which there wouldn't necessarily be within bigger companies. And what that meant was I was able to [...] directly talk to the key decision-makers within the company to get those ideas implemented or at least trialled....."* [KTP ID 23, Associate]

To further validate our model, we ran two robustness checks, shown in the Appendix.

In the first robustness check (Table A3), we ran the SEM model with alternative variables to capture bridging and blurring approaches, *Bridging_F* and *Blurring_F*, constructed using factor analysis. To construct these variables, we ran a PCA with varimax rotation on the four variables *Structure*, *Communication*, *Commitment* and *Empowerment*. This technique identifies two significant components (eigenvalues>1), which together explain 68.4% of the variance (Kaiser-Meyer-Olkin measure of sampling adequacy 0.573; Cronbach's Alpha 0.5). The two significant components

align well with the two approaches to boundary spanning: component 1 correlates strongly with commitment and empowerment of associate, while component 2 correlates strongly with structuring of the relationship and clear definition of communication processes. We then combined the *Structure* and *Communication* variables using factor analysis, to create a new variable named *Bridging_F*, which has an acceptable level of unidimensionality (Factor loading- .770, .770 Eigenvalues 1.184, 59.22%). Similarly, by combining the *Commitment* and *Empowerment variables*, we created the variable named *Blurring_F*, which also has an acceptable level of unidimensionality (Factor loading .789, .789; Eigenvalues 1.245, 62.23%). We ran the SEM using the *Bridging_F* and *Blurring_F* variables, obtaining similar results (Table A3).

In the second robustness check, we tested hypotheses H1, H2, H3 and H4 using a regression framework instead of SEM, using the binary variables *Bridging* and *Blurring* (Tables A4-A6). In Table A4, we show that bridging has a full mediation effect between internal knowledge creation experience and exploitative innovation. In Table A5, we show that blurring has a partial mediation effect between knowledge co-creation experience and exploratory innovation. In Table A6 we consider the full model, with the bivariate probit setting to account for the possibility of multiple, not mutually exclusive outcomes. Also in this model, we confirm *Bridging*'s mediation between internal knowledge creation experience and exploitative innovation, and *Blurring*'s mediation between knowledge co-creation experience and exploratory innovation.[6]

5. Conclusions

This study makes an original contribution by investigating how the adoption of two distinct, although complementary, approaches to boundary spanning in UICs – bridging and blurring – influences how a firm collaborating with universities engages in long-term exploratory and exploitative innovation. In doing so, we look at boundary spanning approaches as mediators between collaborator' prior experience and the engagement in innovation after the UIC. This extends current knowledge

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[6] We also tested hypotheses H1, H2, H3 and H4 using a regression framework and the independent variables *Bridging_F* and *Blurring_F*. The results (available from the authors upon request) confirm our previous findings.

about the outcomes of UICs (so far mainly limited to short-term innovation outputs), the features of boundary spanning individuals and teams, and the relationship between collaborators' experience and innovation.

We find that adopting a bridging approach, with a degree of structuring of interactions and communication modes, facilitates the acquisition of academic knowledge, which the firm is then likely to continue to develop internally after the end of the UIC; moreover, it facilitates the achievement of project objectives, which relate to a business challenge that the firm is likely to continue to address with internal resources. Hence, it increases the likelihood that the UIC will result in subsequent exploitative innovation. At the same time, the collaborators' internal knowledge creation experience facilitates the adoption of the bridging approach, which therefore mediates between internal knowledge creation experience and exploitative innovation. While previous literature had established a link between internal knowledge creation experience and exploitative innovation, the mediating role of bridging practices had not been identified.

We also find that adopting a blurring approach that involves a blurring of hierarchies with peer engagement at all levels, informal communication channels, and strong commitment to the collaboration, facilitates the achievement of knowledge outcomes beyond the initial project objectives, which are likely to be of interest to a broader community outside the UIC; this facilitates further collaborations with external partners, amenable to exploratory innovation. Hence, it increases the likelihood that the UIC will result in subsequent exploratory innovation. At the same time, the collaborators' prior knowledge co-creation experience leads to the adoption of the blurring approach, which therefore mediates between knowledge co-creation and exploratory innovation. While previous literature had established a link between knowledge co-creation experience and exploratory innovation, the mediating role of blurring practices had not been identified.

Our findings offer management and policy implications. In relation to the former, firms and universities should be aware that adopting a bridging approach improves their prospects of engaging in long-term exploitative innovation, while adopting a blurring approach improves their likelihood of further exploratory innovation. Hence, firms should carefully consider how they organise boundary spanning practices within their UIC in view of their long-term innovation objectives. Moreover, their likelihood

of adoption of one or the other boundary spanning approach is contingent on their prior experience in knowledge development. If collaborators wishing to adopt a bridging approach lack internal knowledge creation experience, they might lack internal routines for performing research and structured processes for knowledge sharing that they can replicate in the UIC. Where the collaborators lack such routines, they might need some training in how to appropriately to structure collaborative relationships. If collaborators wishing to adopt a blurring approach lack prior experience of knowledge co-creation, they may be unfamiliar with informal collaboration practices, and lack the trust and open mindedness towards external partners that facilitate the adoption of more open, peer-to-peer relationships. Where the collaborators lack such experience, they might need to be offered greater opportunities and training to build capabilities to have a close working relationship with external partners.

Our findings provide some policy implications for the management of UIC schemes. Training, coaching and support should be put in place to encourage participants to adopt the appropriate boundary spanning practices in order to increase their UIC's long-term innovation outcomes. Training and support might differ according to the prior experience of the partners, in order to help them implement the boundary spanning practices for which they lack appropriate experience. Even applicants to these schemes could receive training and support in order to better understand how to select the most appropriate partners and implement the most appropriate boundary spanning approaches in their UICs to achieve specific outcomes. Finally, when evaluating proposal application and assessing performance and impacts, it would be important to consider the potential and achievement of long-term exploitative and exploratory innovation.

This study has some limitations due to the reliance on a relatively small number of UICs. Arguably, this is necessary to obtain data, since detailed micro-level data about the management and long-term innovation outcomes of UICs are rarely public and need to be collected from individual projects through interviews. Despite the small sample, the hypotheses are robustly tested, validating our conceptual framework. Future research in different UIC contexts could test the generalisability of our findings. Also, further research could further investigate what are antecedents of the successful adoption of different approaches to boundary spanning, opening up a line

of research into boundary spanning practices in UICs. This goes beyond the focus on boundary spanners as actors with specific characteristics, and considers the opportunities for partners to develop boundary spanning capabilities. Future research could also examine how the dynamic combination of bridging and blurring approaches can be used to achieve both exploitative and exploration innovation, leading to ambidexterity.

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Boundary spanning in university-industry collaborations

Appendix

Table A1. List of KTP projects used in the analysis

KTP identification number	n people interviewed	UIC collaborative knowledge field	University department area of specialty	Business sector area of focus
1	1	Design	Engineering	Manufacturing
2	1	Management	Business	Services
3	1	Management	Business	Manufacturing
4	1	Management	Science	Services
5	1	Biology_chemistry_medicine	Science	Manufacturing
6	1	Design	Engineering	Manufacturing
7	1	Environment	Business	Manufacturing
8	1	Management	Business	Services
9	1	Management	Business	Services
10	1	ICT	Engineering	Construction
11	1	Management	Engineering	Construction
12	1	Management	Business	Services
13	1	Engineering	Engineering	Services
14	1	Management	Business	Public administration
15	2	Management	Business	Services
16	1	Management	Business	Wholesale trade
17	1	Management	Medicine	Services
18	1	Services	Social_science	Services
19	4	Services	Social_science	Services
20	2	Management	Business	Services
21	2	ICT	Science	Wholesale trade
22	2	Design	Engineering	Manufacturing
23	3	Management	Business	Manufacturing
24	2	Management	Business	Services
25	2	Management	Social_science	Services
26	1	Design	Social_science	Manufacturing
27	1	ICT	Business	Services
28	1	Management	Medicine	Services
29	2	ICT	Business	Services
30	2	Management	Business	Services
31	1	Management	Medicine	Services
32	1	Management	Social_science	Services
33	2	ICT	Science	Wholesale trade
34	2	Engineering	Science	Manufacturing
35	1	Services	Business	Services
36	2	ICT	Engineering	Services
37	2	Management	Business	Wholesale trade
38	2	Management	Business	Services
39	2	Management	Business	Services
40	1	Management	Business	Manufacturing
41	1	Management	Engineering	Construction
42	2	Engineering	Engineering	Manufacturing
43	1	Engineering	Engineering	Manufacturing
44	1	Biology_chemistry_medicine	Science	Manufacturing
45	1	Design	Engineering	Manufacturing
46	2	Management	Business	Retail trade
47	2	Biology_chemistry_medicine	Science	Services
48	2	Environment	Engineering	Public administration
49	2	Engineering	Engineering	Services
50	2	Management	Social_science	Services
51	2	Biology_chemistry_medicine	Medicine	Services
52	2	ICT	Engineering	Services
53	1	Biology_chemistry_medicine	Engineering	Mining
54	3	Biology_chemistry_medicine	Science	Manufacturing
55	3	Environment	Engineering	Services
56	3	Services	Social_science	Services
57	2	Environment	Social_science	Public administration
58	2	Environment	Science	Services
59	1	Management	Business	Services
60	1	Management	Business	Manufacturing
61	2	Environment	Engineering	Services
62	1	Engineering	Science	Services
63	1	Engineering	Engineering	Services
64	1	Engineering	Engineering	Other software

				publishing
65	2	Management	Business	Retail trade
66	2	Management	Business	Services
67	1	Engineering	Engineering	Construction
68	1	Engineering	Engineering	Services
69	2	Management	Engineering	Utilities
70	3	Management	Science	Services
71	1	Management	Business	Services
72	2	Management	Arts	Services
73	1	Management	Engineering	Services
74	1	Management	Engineering	Services
75	1	Management	Business	Services

Note to Table A1: The column sum of the number of people interviewed is greater than 95 because some individuals appear more than once (that is, in their interviews they discussed more than one KTP) while some KTPs were discussed by more than one interviewee.

Table A2. Correlation matrix

	Exploitative innovation	Exploratory innovation	Bridging	Blurring	Internal knowledge creation experience	Knowledge co-creation experience	Past-relationship	Collaborator's seniority	University ranking	Firm size	Science KTP	Technology KTP
Exploitative innovation	1.000											
Exploratory innovation	0.161	1.000										
Bridging	0.322***	0.125	1.000									
Blurring	-0.033	0.328***	0.213*	1.000								
Internal knowledge creation	0.293**	0.117	0.360***	0.074	1.000							
Knowledge co-creation	0.238**	0.35***	0.075	0.123	0.087	1.000						
Past-relationship	0.038	0.213*	0.011	-0.002	0.143	0.547***	1.000					
Collaborators seniority	-0.109	0.117	-0.117	-0.163	0.013	0.124	0.228**	1.000				
University ranking	0.016	-0.005	0.196*	-0.23***	0.212**	0.010	-0.035	0.242**	1.000			
Firm size	0.291**	-0.069	0.248**	-0.028	0.307***	0.044	-0.130	-0.294**	-0.056	1.000		
Science KTP	0.099	0.044	-0.117	0.082	0.253**	0.332***	0.353***	-0.066	-0.093	0.105	1.000	
Technology KTP	-0.075	-0.219*	-0.251**	-0.273**	-0.243**	-0.144	-0.255**	-0.001	-0.135	-0.219*	-0.281**	1.000
Management KTP	-0.004	0.168	0.315***	0.189	0.036	-0.113	-0.027	0.049	0.192*	0.123	-0.479***	-0.708***

***$p <= .01$, **$p <= .05$, *$p <= 0.1$.

Table A3. SEM model using bridging and blurring variables derived from factor analysis

	Model 1	Model 2	Model 3	Model 4	Model 5
Exploratory innovation←Bridging_F	.024 (.119)	. 003 (.127)			
Exploratory innovation ← Blurring _F	.331 ***(.119)	.305** (.121)			.235**(.111)
Exploitative innovation ←Bridging_F	.344*** (.120)	.309** (.127)			.249**(.121)
Exploitative innovation ←Blurring _F	-.070 (.120)	-.040 (.122)			
Exploratory innovation ← Internal knowledge creation experience				.148 (.121)	
Exploratory innovation ← Knowledge co-creation experience				.393***(.151)	.305**(.130)
Exploitative innovation ← Internal knowledge creation experience				.248**(.143)	.149 (.125)
Exploitative innovation ← Knowledge co-creation experience				.287 (.170)	
Bridging_F ← Internal knowledge creation experience			.326*** (.112)		.308***(.115)
Bridging_F ← Knowledge co-creation experience			.233* (.121)		
Blurring_F ← Internal knowledge creation experience			.170 (.120)		
Blurring_F ← Knowledge co-creation experience		.	.333***(.130)		.318**(.131)
Control variables					
Exploratory innovation←KTP_Sector_Mgt		.212 (.326)		.428 (.177)	.340 (.312)
Exploitative innovation ← KTP_Sector_Mgt		-.300 (.328)		.119 (.151)	-.187 (.333)
Bridging_F ← KTP_Sector_Mgt			.784**(.309)		.672**(.310)
Blurring_F ← KTP_Sector_Mgt			.116 (.330)		.021 (.327)
Exploratory innovation← KTP_Sector_Tech		-.104 (.376)		-.095 (.182)	-.060 (.363)
Exploitative innovation ← KTP_Sector_Tech		-.082 (.378)		.180 (.178)	.040 (.375)
Bridging_F ← KTP_Sector_Tech			.237 (.354)		.156 (.360)
Blurring_F ← KTP_Sector_Tech			-.463 (.378)		-.580 (.374)
Exploratory innovation←Business_Size		-.040 (.131)		-.186 (.133)	-.091 (.125)
Exploitative innovation ← Business_Size		.261** (.132)		.197 (.124)	.226*(.133)
Bridging_F ← Business_Size			.030 (.126)		.068 (.128)
Blurring_F ← Business_Size			-.244* (.135)		-.184 (.130)
Exploratory innovation←University_Ranking		-.017 (.114)		-.110 (.160)	-.040 (.109)
Exploitative innovation ← University_Ranking		.016 (.115)		-.015 (.132)	-.006 (.114)
Bridging_F ← University_Ranking			.025 (107)		.041 (.110)
Blurring_F ← University_Ranking			-.188 (.115)		-.148 (.113)
Exploratory innovation←Past_relationship		.146 (.122)		-.065 (.163)	-.009 (.134)
Exploitative innovation ← Past_relationship		.036 (.123)		-.092 (.155)	.029 (.122)
Bridging_F ← Past_relationship			-.008 (.130)		.114 (.116)
Blurring_F ← Past_relationship			-.171 (.139)		-.147 (.140)
Exploratory innovation←Seniority		.094 (.119)		.047 (.117)	.075 (.113)
Exploitative innovation ← Seniority		.004 (.120)		-.073 (.140)	-.010 (.119)
Bridging_F ← Seniority			-.213*(.110)		-.202* (.112)
Blurring_F ← Seniority			-.099 (.117)		-.092 (.119)
X^2 (df)	1.643 (1)	2.558 (1)	9.425 (1)	.744 (1)	21.182 (8)
GFI	.989	.993	.977	.998	.957
RMSEA	.093	.145	.337	.000	.149
RMR	.041	.020	.035	.011	.058
TLI	.848	.361	-1.652	1.090	.332
IFI	.979	.990	.955	1.001	.940
CFI	.975	.986	.941	1.000	.919
CMIN/DF	1.643	2.558	9.425	1.091	2.648
AGFI	.891	.629	-.285	.744	.584
NFI	.948	.983	.950	.996	.907

***$p <= .01$, **$p <= .05$, *$p <= 0.1$. Standard errors in parentheses.

Table A4. Mediation effect of *Bridging* between internal knowledge creation experience and exploitative innovation

VARIABLES	(1) exploitative innovation	(2) Bridging	(3) exploitative innovation
Internal knowledge creation experience	0.515*	0.770***	0.354
	(0.285)	(0.290)	(0.306)
Bridging			0.854**
			(0.418)
Past_relationship	0.204	0.203	0.165
	(0.398)	(0.359)	(0.423)
Collaborators' seniority	-0.230	-0.379	-0.114
	(0.263)	(0.258)	(0.280)
University_Ranking	0.002	0.086	-0.028
	(0.080)	(0.075)	(0.084)
Firm_Size	0.423*	0.170	0.388*
	(0.229)	(0.203)	(0.236)
KTP_Sector_Science	0.103	-1.197**	0.377
	(0.577)	(0.494)	(0.619)
KTP_Sector_Tech	0.154	-0.693*	0.336
	(0.397)	(0.395)	(0.415)
Constant	-0.799	-0.903	-0.983
	(0.692)	(0.658)	(0.708)
Observations	75	75	75

***$p <= .01$, **$p <= .05$, *$p <= 0.1$. Standard errors in parentheses.

The test on the significance of the mediation effect returns a mediation effect (ACME) that is significant with $p<0.10$. The indirect effect represents 35% of the total effect.

Note to Table A4: *Internal knowledge creation experience* has a positive effect on *Exploitative innovation* (model 1). When we test for the mediator effect of *Bridging*, we see that *Internal knowledge creation experience* positively influences *Bridging* (model 2) and that once *Bridging* is added to the regression on *Exploitative Innovation* (model 3), the effect of *Internal knowledge creation experience* on *Exploitative Innovation* disappears, while *Bridging* has a positive effect.

Table A5. Mediation effect of *Blurring* between knowledge co-creation experience and exploratory innovation

VARIABLES	(1) exploratory innovation	(2) Blurring	(3) exploratory innovation
Knowledge co-creation experience	0.778***	0.505*	0.686**
	(0.283)	(0.288)	(0.295)
Blurring			0.805**
			(0.366)
Past_relationship	-0.109	-0.734	0.020
	(0.423)	(0.448)	(0.451)
Collaborators' seniority	0.103	-0.288	0.210
	(0.248)	(0.256)	(0.262)
University_Ranking	-0.044	-0.194**	0.002
	(0.072)	(0.082)	(0.077)
Firm_Size	-0.203	-0.393*	-0.110
	(0.195)	(0.211)	(0.202)
KTP_Sector_Science	-0.509	-0.166	-0.452
	(0.486)	(0.487)	(0.505)
KTP_Sector_Tech	-0.755**	-1.338***	-0.431
	(0.377)	(0.429)	(0.409)
Constant	0.234	2.049***	-0.729
	(0.658)	(0.780)	(0.797)
Observations	75	75	75

***$p <= .01$, **$p <= .05$, *$p <= 0.1$. Standard errors in parentheses.

The test on the significance of the mediation effect with bootstrapped errors returns a mediation effect (ACME) that is significant with $p<0.12$. The indirect effect represents 17% of the total effect

Note to Table A5: *Knowledge co-creation experience* has a positive effect on *Exploratory innovation* (model 1). When we test for the mediator effect of *Blurring*, we see that *Knowledge co-creation experience* positively influences *Blurring* (model 2) and that once *Blurring* is added to the regression on *Exploratory Innovation* (model 3), the effect *of Knowledge co-creation experience* on *Exploratory Innovation* is reduced (but remains significant), while *Blurring* has a positive effect.

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Table A6. Mediation effects of *Bridging* and *Blurring* in a bivariate probit setting

VARIABLES	(1) exploitative_innovation	(2) exploratory_innovation	(3) Bridging	(4) Blurring	(5) exploitative_innovation	(6) exploratory_innovation
Internal knowledge creation experience	0.590**	0.326	0.843***	0.377	0.510	0.239
	(0.297)	(0.271)	(0.300)	(0.277)	(0.334)	(0.295)
Knowledge co-creation experience	0.593*	0.817***	0.383	0.539*	0.654**	0.718**
	(0.308)	(0.289)	(0.301)	(0.294)	(0.326)	(0.301)
Bridging					1.000**	-0.026
					(0.451)	(0.376)
Blurring					-0.734	0.742*
					(0.465)	(0.379)
Past_relationship	-0.185	-0.153	-0.080	-0.813*	-0.392	-0.018
	(0.501)	(0.428)	(0.436)	(0.454)	(0.548)	(0.454)
Collaborators' seniority	-0.303	0.079	-0.440*	-0.326	-0.244	0.157
	(0.275)	(0.251)	(0.266)	(0.258)	(0.299)	(0.266)
University_Ranking	0.010	-0.062	0.084	-0.223***	-0.073	-0.011
	(0.084)	(0.074)	(0.076)	(0.086)	(0.099)	(0.080)
Firm_Size	0.339	-0.292	0.120	-0.499**	0.283	-0.179
	(0.234)	(0.208)	(0.208)	(0.227)	(0.255)	(0.218)
KTP_Sector_Science	-0.235	-0.627	-1.365***	-0.316	0.186	-0.552
	(0.608)	(0.499)	(0.517)	(0.509)	(0.718)	(0.534)
KTP_Sector_Tech	0.052	-0.717*	-0.788*	-1.335***	-0.007	-0.436
	(0.406)	(0.377)	(0.409)	(0.432)	(0.452)	(0.412)
Constant	-0.991	0.183	-1.024	2.051***	-0.573	-0.664
	(0.709)	(0.660)	(0.666)	(0.794)	(0.844)	(0.796)
Observations	75	75	75	75	75	75

***$p <= .01$, **$p <= .05$, *$p <= 0.1$. Standard errors in parentheses.

<u>Note to Table A6:</u> *Internal knowledge creation experience* has a positive effect on *Exploitative innovation* (model 1). When we test for the mediator effect of *Bridging*, we see that *Internal knowledge creation experience* positively influences *Bridging* (model 3) and that once *Bridging* is added to the regression on *Exploitative Innovation* (model 5), the effect of *Internal knowledge creation experience* on *Exploitative Innovation* is reduced, while *Bridging* has a positive effect. At the same time, *Knowledge co-creation* has a positive effect on *Exploratory innovation* (model 2). When we test for the mediator effect of *Blurring*, we see that *Knowledge co-creation experience* positively influences *Blurring* (model 4) and that once *Blurring* is added to the regression on *Exploratory Innovation* (model 6), the effect of *Knowledge co-creation experience* on *Exploratory Innovation* is reduced, while *Blurring* has a positive effect.