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Abstract
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1 Abstract

Although university-industry collaborations are considered significant contributors to firms' environmental innovations, gaps remain with respect to how firms integrate specialised knowledge provided by university partners. A rising literature on boundary spanning seeks to investigate how firms do this; however, in-depth studies on the individual level are lacking. To develop this understanding, we conducted a longitudinal study of ten industry-based boundary spanners and their activities in research centres. We identify a set of underpinning transferring, translating and transforming activities of boundary spanning that are performed to leverage environmental innovations from research centres. Second, we find a pattern of how these activities are attended to by boundary spanners in the establishing, performance and end stages of research centres, revealing that spanners cannot expect to engage in the highest value-adding activity of transforming without first engaging in transferring and translating activities to successfully integrate the specialised knowledge from university partners required for environmental innovations. Revealing these activities and patterns provides guidance for theory and practice on how to develop environmental innovations in research centres.

2 1 Introduction

There is an increasing social and political awareness of the importance of the development of environmental innovations (EIs) (Díaz-García et al., 2015, del Río et al., 2016), where numerous policy initiatives are aiding firms in this development (Cuerva et al., 2014, Jakobsen et al., 2019). Because EIs often require more specialised knowledge than general innovations, (De Marchi, 2012, De Marchi and Grandinetti, 2013, Cainelli et al., 2015), these policy initiatives often seek to connect firms with external partners (Yarahmadi and Higgins, 2012, De Marchi, 2012, Klewitz and Hansen, 2014). Universities are one such partner that holds specialised knowledge, and research centres are the predominant policy initiative used to increase university-industry collaboration in most developed countries (Ponomariov and Boardman, 2010, Gulbrandsen et al., 2015, Chai and Shih, 2016), particularly for developing EIs (De Marchi, 2012, Soini et al., 2018, Jakobsen et al., 2019).

Although some firms capture value from research centres, firms often find it challenging to integrate external and specialised knowledge to develop EIs (Souto and Rodriguez, 2015, Jones and Corral de Zubielqui, 2017, Álvarez Jaramillo et al., 2019), where knowledge boundaries between firms and university partners often hamper this process (Steinmo, 2015, Miller et al., 2016, Galán-Muros and Plewa, 2016). Thus, the environmental impact of research centres often differs depending on firms' ability to integrate university partners' specialised knowledge (Cuerva et al., 2014). Hence, to materialise successful outcomes of EIs in research centres, firms need to strengthen their knowledge integration abilities (De Marchi and Grandinetti, 2013, Galán-Muros and Plewa, 2016, de Wit-de Vries et al., 2019)– meaning their 'ability to integrate specialised but complementary knowledge' (Tell, 2011, p. 27).

To integrate specialised knowledge from research centres, firms often involve a key individual, termed a *boundary spanner* (Santoro and Chakrabarti, 2002, Nsanzumuhire and Groot, 2020, Velter et al., 2020), to act as the link between the firm and the university partners (Santoro and Chakrabarti, 2002, Knudsen et al., 2017, de Wit-de Vries et al., 2019). The activities of boundary spanners play a significant role in combining firm competence with the specialised but complementary knowledge provided by the university partners (Santoro and Chakrabarti, 2002, Knudsen et al., 2017, Takanashi and Lee, 2018). Hence, this study is concerned with the individual level of university-industry collaboration by exploring boundary spanning activities for knowledge integration in research centres, assessing how these activities enable EIs.

There exists several evidence of boundary spanning outcomes from collaborating with universities, such as innovations, patents and licences (Mansfield, 1991, Ponomariov and Boardman, 2010, Cohen et al., 2002), which are typically based on panel data (e.g., Kobarg et al., 2018, Robin and Schubert, 2013), large-scale surveys (e.g., Cohen et al., 2002, De Marchi and Grandinetti, 2013) or archival patent data (e.g., Kaiser and Kuhn, 2012, Soh and Subramanian, 2014). These studies demonstrate that boundary spanning activities have occurred through which the knowledge of university partners has been integrated into and applied to EIs. However, less is known about the *activities* and *efforts* that led to these outcomes, representing a significant gap in the literature that applies to boundary spanning (Boardman and Bozeman, 2015, Pateli and Lioukas, 2017, Langley et al., 2019, Velter et al., 2020, Corsi et al.), knowledge integration (Perkmann and Walsh, 2007, Alexander et al., 2018, Hayter et al., 2020) and EIs (Hojnik and Ruzzier, 2016, Engert et al., 2016, Hermundsdottir and Aspelund, 2020). Based on these shortcomings, this paper uses insights from organisational and innovation studies to address the following research question: “*How are boundary spanning activities for knowledge integration performed in research centres?*”.

The research question is explored through an inductive, longitudinal case study of ten industry-based boundary spanners involved in the Norwegian Centres for Environment-friendly Energy Research, financed by the Research Council of Norway. These research centres provide a unique setting for studying the boundary spanning activities for knowledge integration, as the centres involve long-term collaboration between a number of universities and firms aiming for EIs.

This paper provides an in-depth understanding of the underlying dynamics of innovation processes in university-industry collaboration in general (Perkmann and Walsh, 2007, Galán-Muros and Plewa, 2016) and EIs in particular (Yarahmadi and Higgins, 2012, De Marchi, 2012, Hermundsdottir and Aspelund, 2020), with two main contributions. First, we identify boundary spanning activities for knowledge integration (Le Dain and Merminod, 2014, Van de Ven and Zahra, 2017, Langley et al., 2019) and propose that boundary spanners should perform transferring, translating and transforming activities (Carlile, 2004) to enable EIs in research centres. Second, our study revealed a pattern of how these key activities are attended to by boundary spanners in the knowledge integration process (Le Dain and Merminod, 2014, Van de

Ven and Zahra, 2017, Hayter et al., 2020), unfolding in the establishing, performance and end stages of a research centre (Skute et al., 2019, Zahra et al., 2020).

This paper is structured as follows. The next section presents the literature from organisational and innovation studies on the role of research centres for EI and boundary spanning activities for knowledge integration. Section 3 presents the methodology used, and empirical findings are discussed in relation to the scholarly literature in Section 4. Section 5 highlights the implications and conclusions from our study.

3 **2 Theoretical Framework**

4

5 ***2.1 The role of research centres for environmental innovations***

Central to the aims of environmental policies is the recognition that it involves taking steps to develop EIs (Díaz-García et al., 2015, del Río et al., 2016, Jakobsen et al., 2019), which can be defined as *“the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organization (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resource use (including energy use) compared to relevant alternatives”* (Kemp and Pearson, 2007, p. 7).

To spur EI, research centres – a *“joint venture between the university, industry and governmental funding organizations, identifying some domain of research where industry and academy can benefit from collaborating”* (Lind et al., 2013) – have become a predominant policy response (Ponomariov and Boardman, 2010, Chai and Shih, 2016, Soini et al., 2018). By linking firms with universities, research centres aim to develop solutions that require scientific and technical input from multiple disciplines and perspectives to address challenges that organisations are unwilling to address alone due to resource requirements and risk (Boardman, 2011).

Research centres are particularly important for EI due to their focus on research and development that aims to be “transformative” and “paradigm-shifting”; the research is often characterised as “blue-sky” or as having a “high risk-high yield” (Boardman and Gray, 2010). With a broad and diverse set of collaborative partners, research centres provide firms with the specialised knowledge (Gulbrandsen et al., 2015) required for EIs (De Marchi, 2012, Kobarg et al., 2019). However, firms often find it difficult to implement comprehensive environmental

changes (Jones and Corral de Zubielqui, 2017) and to integrate the specialised knowledge provided from research centres (Souto and Rodriguez, 2015). As such, this study explores the key individuals who are responsible for knowledge integration in research centres, often termed boundary spanners (Perkmann, 2017).

6 ***2.2 Boundary spanning activities for knowledge integration in research centres***

Boundary spanners are individuals functioning as the “link between a unit and its environment” (Haas, 2015, p. 1034), which facilitates and manages the inflow and outflow of knowledge between organisations (Tushman, 1977, Tushman and Scanlan, 1981). Hence, boundary spanners have a twofold function: first, to maintain contact with the external environment and gather information and knowledge from it, and second, to maintain close contact with the internal organisation in an effort to integrate the information and knowledge in a way that is understandable to the colleagues of the boundary spanner (Allen et al., 1979).

Thus, the function of the boundary spanners in research centres implies being the link of the firms towards the university partners, of which firms are critically dependent on (Santoro and Chakrabarti, 2002, Knudsen et al., 2017, Takanashi and Lee, 2018). As such, Santoro and Chakrabarti (2002) find that only five out of 202 firms participating in US research centres involved more than one boundary spanner towards the research centre, which illustrates the importance of the boundary spanner’s skills and activities if firms are to integrate the knowledge into EIs.

Although prior studies have highlighted the importance of firms’ and boundary spanners’ commitment and involvement in university-industry collaboration (e.g., Santoro, 2000, Mora-Valentin et al., 2004, Núñez-Sánchez et al., 2012), less is known about how this commitment should be put in action. Scholars have just recently begun to provide insights into the types of activities that boundary spanners undertake to integrate knowledge in interorganisational collaboration in general (Ter Wal et al., 2017, Monteiro and Birkinshaw, 2017) and from universities in particular (Takanashi and Lee, 2018). From a qualitative case study of Irish research centres, Ryan et al. (2018) asserted that attitudinal behavioural modifications by firms’ boundary spanners enhanced firms’ innovation capabilities over time. Based on a survey of university-industry collaborations, Takanashi and Lee (2018) found that boundary spanners that enhanced

effective communication and trust towards university partners helped align different interests, which in turn had a significant effect on project performance and knowledge development in their firms. A survey by Hamadi et al. (2018) of highly involved university-industry collaboration partners has also contributed insight into the boundary spanning characteristics that are important at different stages of the collaboration, showing that the spanner should build internal support and good relations towards the university partners in initiation stages and engage with his/her expert know-how and communicate, coordinate and supervise in the performance and termination stages.

These findings have generated insights into the value of boundary spanning but remain somewhat abstract and provide limited guidance on how this value could be achieved. Because boundary spanning is often challenging (Bechky, 2003, Kaplan et al., 2017, Velter et al., 2020), several scholars have called for in-depth appreciations of how boundary spanners actually span boundaries in interorganisational collaboration in general (Halevy et al., 2008, Haas, 2015, Tell et al., 2017, Smith, 2016, Langley et al., 2019) and how they manage to integrate knowledge from university partners (Perkmann and Walsh, 2007, Alexander et al., 2018, Hayter et al., 2020). With the aim of uncovering how EIs are enabled by boundary spanning activities for knowledge integration in research centres (Le Dain and Merminod, 2014, Ven and Zahra, 2017, Zahra et al., 2020, Velter et al., 2020), this paper elaborates on three knowledge integration dimensions: *transferring*, *translating* and *transforming* (Carlile, 2004, Van de Ven and Zahra, 2017).

Knowledge transfer – is used to describe the movement of knowledge and is defined as “the process through which one unit (e.g., individual, group, or division) is affected by the experience of another” (Argote and Ingram, 2000, p. 151). Knowledge transfer is based on the premise that knowledge can be easily transferred - without modification - and managed across organisational boundaries (Carlile and Reberich, 2003, Carlile, 2004). Critics of knowledge transfer argue that transferring knowledge is an inefficient approach to integrating knowledge when novelty and innovation are sought and the actors’ knowledge base is specialised, as knowledge is inherently personal and tacit and therefore not easily “transferable” (Polanyi, 1967, Grant, 1996b, Berggren et al., 2011). Knowledge transfer in university-industry collaborations has mainly focused on the transfer of patents, licences and scientific publications from universities to industry partners (Cohen et al., 2002, Perkmann and Walsh, 2007, Hayter et al., 2020).

Knowledge translation – is often used to describe three related processes: (1) identifying differences and dependencies between partners, where university partners generally want to pursue

academic publications, while industry is more inclined towards innovations (Perkmann and Walsh, 2009, Bjerregaard, 2010, Trencher et al., 2013). To handle these differences, two boundary spanning approaches stand out in the literature: (2) creating shared meanings between partners (Kellogg et al., 2006, Carlile, 2004, Bechky, 2003), through close interaction over time (Steinmo, 2015, Bjerregaard, 2010) or by negotiating differing interests and making trade-offs between partners (Carlile, 2004, Boehm and Hogan, 2014, Lander, 2016). Further, as university and industry partners have different knowledge bases (Perkmann, 2017, Brocke and Lippe, 2015, Miller et al., 2016), the boundary spanner often needs to (3) translate external domain-specific knowledge so that employees within the firm may understand it (Cyert and Goodman, 1997, Monteiro and Birkinshaw, 2017, Zahra et al., 2020).

Knowledge transformation – is the process of altering existing and creating new knowledge (Carlile, 2002). As knowledge is inherently tacit (Polanyi, 1967), it is often a challenging process to transfer specialised knowledge from one domain and make it applicable to another domain. The literature often points towards boundary objects, such as tools, machines, numbers, blueprints and prototypes, which can be used to learn about and transform knowledge between two domains (Carlile, 2002). Social interaction is important in the process of transforming knowledge, (Styhre, 2011, Carlile and Reberntisch, 2003), which implies that firms' boundary spanners ought to interact closely with university researchers in research centres to transform and integrate individuals' specialised knowledge bases (Kellogg et al., 2006, Grant, 1996a) solving challenges jointly (Gulbrandsen et al., 2015, Perkmann, 2017). Because the process of transformation requires time, the actors' abilities to integrate their knowledge should improve with each iteration (Carlile and Reberntisch, 2003).

Although these dimensions provide useful conceptual distinctions of boundary spanners' knowledge integration, less is known about their underpinning activities of how transferring, translating and transforming activities actually are carried out (Le Dain and Merminod, 2014, Van de Ven and Zahra, 2017, Hayter et al., 2020). By pursuing an inductive, in-depth case study of boundary spanners involved in research centres with environmental objectives, we thus aim to uncover boundary spanning activities for integrating specialised knowledge from university partners (Le Dain and Merminod, 2014, Van de Ven and Zahra, 2017, Hayter et al., 2020), which is essential for EIs (De Marchi, 2012, Jakobsen et al., 2019).

7 3 Methodology

7.1 3.1 Research design and cases

We conducted a longitudinal inductive multiple-case study (Langley, 1999, Eisenhardt, 1989, Eisenhardt and Graebner, 2007) of ten industry-based boundary spanners to provide in-depth insight into how their activities for knowledge integration are performed in research centres. Our longitudinal design allows for richer contextual insights and understanding of this phenomenon (Eisenhardt, 1989), while prior studies have rarely investigated it at the individual level (de Witte de Vries et al., 2019). The boundary spanners of this study were working towards university partners in research centres operating from 2009 to 2015 under Norway's public Centres for Environment-friendly Energy Research. These centres seek to develop knowledge and promote EIs in areas such as CO₂ storage, bioenergy, zero-emission buildings, offshore wind energy and solar cells and have yearly budgets ranging from three to four million EUR and are funded by the Research Council of Norway (50%), university partners (25%) and industry partners (25%). Because research centres are a predominant policy response in most developed countries and are financed long-term, they are theoretically and empirically a unique context of university-industry collaboration (Kaiser and Kuhn, 2012, Chai and Shih, 2016, Ponomariov, 2013) that offers opportunities for longitudinal in-depth studies of boundary spanning for knowledge integration.

The theoretical sample (Eisenhardt and Graebner, 2007) of ten boundary spanners was drawn from a larger study by the authors. The analysis of additional boundary spanners ended when saturation was achieved, meeting the purpose of the inquiry (Patton, 2015), which was to explore the boundary spanners' activities relating to knowledge integration. All boundary spanners in this study were considered to be engaged by the university partners and represented firms varying in size and reported outcomes regarding EIs, knowledge and network, according to the official midterm evaluation of the research centres (Research Council of Norway, 2013). We avoided interviewing bias by gaining access to the midterm evaluation after conducting the interviews while retaining the ability to choose contrasting cases from our larger study.

7.2

7.3 3.2 Data collection

The boundary spanners were first interviewed in 2013, with follow-up interviews in 2015 to uncover changes in the activities performed by boundary spanners, in addition to the topics of interest that arose from the analysis of the first-round interviews (Table 1). Three of the interviews

were conducted via telephone. The data set includes additional interviews with 22 firms and 27 centre directors and work area leaders who provided multiple accounts of the same processes (Pentland, 1999), which decreased the risk of impression management bias (Eisenhardt and Graebner, 2007) and increased our contextual understanding. The interview data were triangulated with secondary data sources to understand how boundary spanners perform knowledge integration activities. As requested by the informants, the cases are anonymised for confidentiality, which also implies the contextual details provided in Section 4, ‘Findings and discussion’.

Table 1. Data collection

Firm	1	2	3	4	5	6	7	8	9	10
Size*	Large	Medium	Medium	Small	Large	Small	Large	Large	Large	Small
Role of boundary spanner	Technical director	Technical director	Senior advisor	Technical director	Technical director	Technical director	Technical director	Senior researcher	Senior advisor	Senior engineer
Degree	Ph.D.	M.Sc.	M.Sc.	Ph.D.	Ph.D.	M.Sc.	Ph.D.	Ph.D.	Ph.D.	M.Sc.
Work experience	Research within the university and in industry for several years	Industrial technology development for several years	Research within the university and in industry for several years	Research within the university and in industry for several years	Research within the university and in industry for several years	Industrial technology development for several years	Research within the university and in industry for several years	Industrial research for several years	Research within the university and in industry for several years	Industrial technology development for several years
Interviewed in 2013 and 2015	X	X	X	X	X	X	X	X	X	X
Secondary sources (2009-2015)	Annual reports, evaluation reports, newsletters, press articles, web sites									

* The EU measures of firm sizes are used: large is > 250 employees; medium is 50-250 employees; and small is 10-50 employees.

The interview questions were developed before commencing the interviews to explore the activities performed by boundary spanners towards the research centres and were based on secondary data, such as official annual reports (Yin, 2013). Two interviewers were present at all interviews to minimise bias. A semi-structured interview guide served as a checklist to ensure that all relevant topics were covered regarding the boundary spanners activities, and the interviewers aimed to establish a conversational atmosphere in which the interviewees could speak as freely as possible (Patton, 1990). There were also situations in which we wanted the informants to provide additional details about key activities or unclear statements. In such situations, we asked follow-up questions such as “How did you do that?,” “Why did you do that?,” “Who was involved in that

event?,” and “When did this happen?”. To avoid bias, we avoided the use of theoretical concepts in the interview setting.

7.4 3.3 Data analysis

The interviews were recorded and transcribed verbatim during the data analysis process (Yin, 2013). By reading the interview transcripts multiple times, we searched for broader patterns and insights into how the involvement of boundary spanners developed (Pentland, 1999, Yin, 2013, Eisenhardt et al., 2016). By applying a temporal bracketing strategy (Langley, 1999), three “stages” were identified, i.e., establishing, performance and end stages, which provided a temporal structure for the in-depth analysis. Next, we identified that the boundary spanners' involvement and outcomes from the research centre varied and changed over time. Thus, relevant codes and quotes concerning involvement and outcomes were combined in a matrix over the periods (Miles et al., 2014) and were characterised for each case (Eisenhardt and Graebner, 2007, Pentland, 1999) (see Table 2).

Qualitative analysis software (NVivo 12) was used to facilitate the coding and categorisation identification of the boundary spanning activities performed for the interview data. The coding consisted of data-driven inductive (sub)codes (e.g., suggesting research activities) (Langley, 1999) and included critical characteristics and activities related to the boundary spanners' involvement. Subsequently, we identified similar codes and clustered them in first-order concepts before searching for linkages among the concepts, which led to the development of second-order analytical themes (Nag and Gioia, 2012).

The next step was more deductive and theoretically driven, involving in-depth exploration of the literature on boundary spanning (e.g., Perkmann, 2017, Birkinshaw et al., 2017) and knowledge integration (e.g., Grant, 1996a, Tell et al., 2017). We thus progressed from inductive to abductive research, where the data and existing literature were considered in parallel (Alvesson and Sköldbberg, 2009). In this process, we reviewed the extant literature to identify theoretical concepts that could explain and elaborate our findings (Eisenhardt, 1989), where the knowledge integration dimensions of transferring, translating and transforming (Carlile, 2004, Van de Ven and Zahra, 2017) were found suitable. Hence, in the final step, we assembled the second-order themes into the aggregate dimensions of transferring, translating and transforming knowledge (see Figure 1). In addition, Figure A.1 (in the Appendix) presents the emergent data structure, including the boundary spanners' first-order quotations.

8 **4 Findings and Discussion**

We present our findings and discussion in three sections. First, an overview of the firms' involvement in and environmental outcomes from the research centres is provided. Second, the findings regarding boundary spanning activities for knowledge integration in the research centres are presented and discussed. Third, we present the three stages of boundary spanning activities for knowledge integration in research centres.

4.1 Generating environmental outcomes from the research centres

All the activities in the research centres aim to generate environmental outcomes, in which the boundary spanners in this study are involved to a different extent. The firms that the boundary spanners represent also experience different environmental outcomes from the research centre. Not surprisingly, the most involved boundary spanners (6-10) contributed higher levels of environmental outcomes of the research results in both periods (Table 2) compared with less involved spanners (1-5), confirming that involvement and commitment are important premises for successful university-industry collaboration (Santoro, 2000, Mora-Valentin et al., 2004, Núñez-Sánchez et al., 2012).

Table 2. Generating environmental outcomes from the research centres

Establishing and performance stage (2009-2013)			End stage (2014-2015)	
Firm	Involvement*	Outcomes**	Involvement*	Outcomes*
1	Low: <i>"I struggle to be involved in the research activities and at the same time handle a very operative organisation."</i>	Low: <i>"The research is not relevant." "We don't have much benefit from the results coming out [from the research centre]."</i>	Some: <i>"We have become better at involvement and engagement." "We are now involved early in the process of discussing how to frame applications for spin-off research."</i>	Some: <i>"In sum, there have been positive developments.... However, I cannot recall any big knowledge leaps in the last two years."</i>
2	Low: <i>"We were not actively involved in setting the research agenda.... It was at the bottom of our priority list."</i>	Low: <i>"Frankly, we haven't gotten any results... the output is marginal."</i>	Some: <i>"We decided to collaborate more with them [the university partners.]" "We have taken more initiative and given suggestions for research activities."</i>	Some: <i>"There have been some relevant test results." "The [university] researchers are now much closer to the 'real' process than two to three years ago."</i>
3	Some: <i>"I have discussed the research development [with the university partners] ...but I could have been more involved."</i>	Some: <i>"There are no definite results that I could use from the centre... but my network is broadened, which is valuable.... However, we have some interesting results from a spin-off research project."</i>	Some: <i>"I would have wanted to dedicate more time to the collaboration." "We have involved ourselves more heavily in spin-off research."</i>	Some: <i>"We did some tests, but with no useful results.... We did not follow up as closely as we should have." "We see some definite results in the spin-off project."</i>
4	Some: <i>"It could have been a closer collaboration." "We have suggested research activities."</i>	Some: <i>"Some measurement campaigns in our facility have been relevant." "We hoped to get more output."</i>	Low: <i>"I'm not sure what activities go on in the research centre; it's not a big part of my daily work."</i>	Low: <i>"There have not been many results."</i>
5	Some: <i>"I have given input to the research agenda, but we are</i>	Some:	Some: <i>We are still too few people; each person follow-up projects worth 1-2</i>	Some: <i>"We have increased our knowledge base and networks</i>

	<i>rather passively following up the centre... we are very few persons [within this area in firm]."</i>	<i>"We have a spin-off project with the research partners granting some interesting results."</i>	<i>billion NOK... there is a bigger problem to contribute personnel towards the centre than money."</i>	<i>from participating in the centre."</i>
6	Some: <i>"We have been somewhat involved in setting the research agenda... and we present our technology at seminars and meetings."</i>	Some <i>"Network is our main output so far. We have been approached both by firms and researchers, which we would not have encountered otherwise."</i>	High: <i>"We have been active towards the centre... using the centre to test and develop our technology."</i>	High: <i>"We have got quite exciting results. [The technology] worked surprisingly well, or very well."</i>
7	High: <i>"We have participated in all relevant meetings and seminars and stated what is interesting for us."</i>	High: <i>"We have greatly benefitted from one spin-off research project." "That [research area] is really interesting for us."</i>	High: <i>"We have continuously provided input about the research focus of the centre." "We are involved in a range of spin-off research projects with the university partners."</i>	High: <i>"We have gained knowledge and a very good understanding about the industry. We are now ensured that our [commercial] focus is right."</i>
8	High: <i>"We have been involved in setting the research agenda." "I often call and talk to the university partners."</i>	High: <i>"What we know now, compared to four years ago, is 'two different worlds'. "...knowledge gaps that we had... there have been suggestions on how to solve them."</i>	High: <i>"We have had much contact." "We invited both university and industry partners to [their facility] discuss expectations for the research centre's last years."</i>	High: <i>"There have been many useful results." "We have come much further than we would have done without them [university partners]."</i>
9	High: <i>"We are very involved." "We have demonstrated new knowledge, and we give instructions on what we believe is important for the university partners to focus on."</i>	High: <i>"We would not have succeeded if we hadn't participated in the research centre." "Many have said that this is impossible... but we show that it is actually possible."</i>	High: <i>"We are now mainly involved in spin-off research." "We have become better at handpicking projects where we get direct output, where we dedicate resources and contribute actively."</i>	High: <i>"We have developed methods and concepts together [with the university partners], and this gives greater legitimacy."</i>
10	High: <i>"We have influenced the research activities."</i>	High: <i>"The research that is going on is really interesting for us."</i>	High: <i>"We work very closely with the university partners."</i>	High:

<p><i>“It is formal and informal interactions weekly.”</i></p>	<p><i>“We are at the university at least three times a week.”</i></p>	<p><i>“We need the knowledge generated in the research centre to optimise our [product].”</i></p> <p><i>“We got very good results.”</i></p>
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* Based on illustrative quotes from the boundary spanners in this study.

**Based on illustrative quotes from the boundary spanners in this study and answers in the midterm evaluation related to how the centre's activities have benefitted the firms regarding innovations, knowledge and networks.

In Review

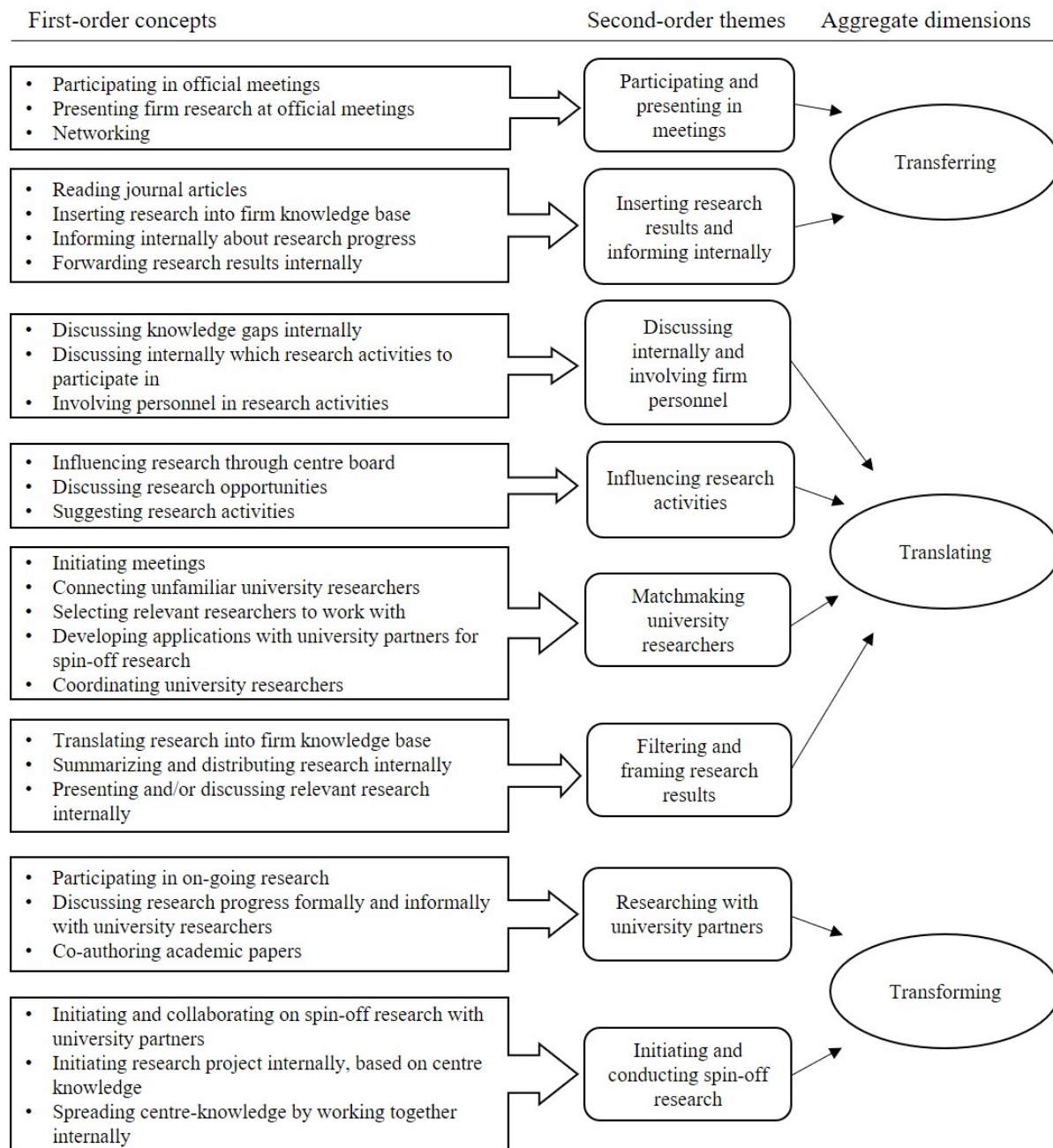
However, as we know little about the underpinning activities of *how* firms should be involved to achieve outcomes from collaborating with university partners (Boardman and Bozeman, 2015, Pateli and Lioukas, 2017, de Wit-de Vries et al., 2019), this study aims to uncover the boundary spanning activities for integrating specialised knowledge from university partners needed to spur EIs. The following discussion is therefore based on and compares the most involved boundary spanners (6-10) and the less involved boundary spanners (1-5).

4.2 Boundary spanning activities for environmental innovations in research centres

Overall, we find that the boundary spanners in this study perform a diverse set of transferring, translating and transforming activities (Carlile, 2004) during collaboration within the research centre (see Figure 1).

In Review

Fig. 1 Data structure – Boundary spanning activities for knowledge integration in research centres



4.2.1 Knowledge transfer

We identify two knowledge transfer activities that boundary spanners perform in which the knowledge is more or less easily transferred (Carlile and Reberich, 2003, Carlile, 2004) between the university and firm partners without requiring much resources from the boundary spanner.

(1) Participating and presenting in meetings

All the boundary spanners in this study participated and presented at official meetings and seminars arranged by the university partners. Such events are important for the boundary spanners to obtain an overview of current and potential research activities and present their firm, its R&D activities, and firm data and cases that could potentially be worked on by the research centre. Moreover, these meetings were important arenas for establishing and strengthening social relations between the partners, which is found to be a prerequisite for further collaboration (Steinmo and Rasmussen, 2016), as exemplified by the boundary spanner of firm 10: *“We have presented our R&D activities at the conferences. This has resulted in greater interest in what we are doing...and we have used these conferences to talk with possible future [university and industry] partners.”* The group of highly involved boundary spanners (6-10) more actively participated in these conferences and used their time in the spotlight to network and present firm research, whereas the less involved boundary spanners (1-5) often participated as passive receivers: *“... [these conferences’] attendance is to keep myself oriented, it is often interesting to listen to [the university researchers] ... but it is not always relevant for our business”* (BS4).

(2) Inserting research results and informing internally

In line with Hoffmann et al. (2017), we find that publications and reports are often finalised by the university researchers at the end stage and made available to the firm partners. However, few boundary spanners in this study managed to simply “transfer” the research results obtained from their university partners into applicable knowledge (Berggren et al., 2011, Hayter et al., 2020), as exemplified by Boundary spanner 1: *“I often get an email about new publications and updates... I have sometimes forwarded relevant knowledge to other employees, but they probably don’t read it... I’m not sure they have the time or capacity”*. As such, the research results were not framed in an understandable language for internal use.

One exception is boundary spanner 8, who was able to insert the research results directly into their internal knowledge base: *“The research centre serves as a ‘filter’ that filters research results for us...that has been a big advantage for us.... We can then just insert this knowledge into our models.”* Hence, the knowledge bases of the university and industry partners may be so specialised (Perkmann, 2017, Rajalo and Vadi, 2017) that a pure process of knowledge transfer may be unable to address the differences and dependencies among all actors (Polanyi, 1967, Grant,

1996b, Berggren et al., 2011) and requires filtering and framing of research results for internal use (as discussed below).

4.2.2 Knowledge translation

We identify four activities of knowledge translating that boundary spanners perform to involve relevant firm and university expertise, to make the specialised knowledge provided by the research centre more understandable to internal firm employees and to handle institutional differences between university and industry partners (Perkmann and Walsh, 2009, Bjerregaard, 2010).

(1) Discussing internally and involving firm personnel

To translate specialised knowledge from the research centre, we find that all of the highly involved (6-10) and some of the less involved boundary spanners (1-5) initiate internal discussions regarding the centre's developments: *"We are now [end stage] discussing [internally] what knowledge gaps we have and what we want the research centre to focus on"* (BS3). Furthermore, some of the highly involved boundary spanners (6-10) benefitted from identifying and involving other firm personnel with relevant expertise in the research activities. Boundary spanner 8, for example, identified relevant meetings for other firm employees to participate in: *"The technical insights of the research results come in the technical subject meetings, and at a meeting two weeks ago, I brought with me 'the others' [who work in that subject area]"* (BS8).

However, the less involved boundary spanners tended to operate single-handedly towards the research centre and struggled to involve other firm personnel: *"We are an operative organisation, we focus on operations... I'm therefore solely following up the research centre"* (BS1). One of the centre managers commented on this issue: *"The challenge is that they [boundary spanners] often don't have inhouse expertise that they can communicate with... that matches what happens in this research centre."*, of which another less involved boundary spanner agreed: *"I have to few internal resources [personnel] in the organisation that I can use towards the research centre, which hampers our ability to follow up the centre as good as we would like"* (BS5). Hence, these findings are in line with and extend the findings by Santoro and Chakrabarti (2002), illustrating the difficulty of involving internal personnel in operative organisations.

(2) Influencing research activities

Based on the involvement and views of several firm employees, the most involved boundary spanners (6-10) were very active in influencing research activities: *“We [the firm] had a lot of specific knowledge gaps that we suggested as possible research activities that were discussed with other firms and university partners. Now, something is solved, and some aspects are still ‘works in progress’ that we expect to give valuable insights”* (BS8). Such involvement was also acknowledged by the centre managers: *“... ‘Professional discussions’ are a really effective way of influencing because, there, you [boundary spanner] can present your ideas to the university partner, which then could reply with his research suggestions, and you could have a match.”* Boundary spanner 10 confirmed this view: *“We have influenced the research activities... so the research is of interest to us...and to them [the university partners] ... we have compromised on a range of research areas.”*

The less involved boundary spanners (1-5) were somewhat active in influencing and suggesting research activities but often failed to suggest activities that were relevant for the researchers and seldom followed up on their suggestions. One exception is boundary spanners 1 and 2, who, in the end stage, acknowledged that they had to be involved more in these activities if the research results were to be useful for their firms: *“We now [end stage] discuss the work plan [with the university partners], what is planned, what is important for us and how the resources can be dedicated”* (BS1). Consequently, the research centre’s activities became more relevant for these firms: *“It is now more thought through what they [the university partners] should do research on, and it ‘works’ These results can be used to improve the industry’s facilities”* (BS1).

These quotes illustrate how the highly involved boundary spanners actively discussed research questions with their university partners and considered both parties’ interests (Perkmann and Walsh, 2007, Bjerregaard, 2010). Although some scholars have emphasised the importance of creating shared meanings between partners in the process of translating knowledge (e.g., Carlile, 2004, Bechky, 2003), our findings are consistent with research results that suggest that shared meanings are not essential because partners can reach agreement about common activities despite having opposing meanings (Kellogg et al., 2006, Lander, 2016). The findings also demonstrate the importance of commitment and involvement by boundary spanners over time (Santoro, 2000, Mora-Valentin et al., 2004, Núñez-Sánchez et al., 2012) and illustrate how the boundary spanning process may be carried out towards university partners over time.

Another observation relates to boundary spanner 4, who had little involvement with the research centre: *“I just had a meeting with the university researchers about future research activities... but I wasn’t really prepared.”* This statement exemplifies a missed translation opportunity where the university partners wanted input on research activities but the boundary spanner did not have any ideas to present, which hampered the knowledge integration process (Carlile and Reberich, 2003, Carlile, 2004). Hence, we confirm and extend Jarvenpaa and Valikangas (2016) by suggesting that firms that are involved in and dedicate resources to a research centre over time are better able to influence the research agenda.

(3) Matchmaking of university researchers

We found that the boundary spanners of this study managed to connect and coordinate actors in the research centre (matchmaking) (Monteiro and Birkinshaw, 2017) in three ways that benefitted both the firms and university partners. First, some of the boundary spanners conducted, quite surprisingly, matchmaking activities that mainly benefitted the university researchers. These boundary spanners managed to identify and connect unfamiliar university researchers they believed had the potential to create valuable research results: *“We connected some researchers. They worked on similar research questions, but from different angles... I do not think that [university researcher collaboration] would have happened without us suggesting that they should talk together”* (BS2).

Second, some boundary spanners identified key persons in their firms and connected those persons with university researchers who needed and obtained access to unique firm data that later were used for research purposes: *“We helped the centre management [with data access]... and put them in contact with the right decision makers in our firm”* (BS3). Third, the highly involved boundary spanners (6-10) got to know the university researchers well, which enabled them to select university researchers with relevant knowledge according to their specific firm need: *“I hand-picked resources from [the research centre], and when I needed competence in [subject area a, b or c], I drew on interdisciplinary knowledge from other work areas. That worked very well... it would be difficult without this kind of active coordination”* (BS9). Hence, our findings nuance the findings that successful industry partners often have social proximity towards university partners (Steinmo and Rasmussen, 2016, Lauvås and Steinmo, 2019), illustrating that boundary spanners are able to draw upon and select university researchers for their spin-off research projects.

(4) Filtering and framing of research results

Many of the boundary spanners in this study were actively involved in filtering, which involves assessing and selecting relevant research from a range of research results, and framing, which involves converting the “language” of the research results into an understandable and useful form. Filtering and framing was performed by the boundary spanners by mainly discussing relevant research results internally and by translating the research results into the knowledge base of the firm: “*We have an internal system with documentation and knowledge... Sometimes you can just cut and paste, and sometimes you need to translate the results to become relevant for the firm. In that process, we use research results combined with our internal [firm] knowledge*” (BS8). This quote illustrates that the activity of translating research results is a more active form of knowledge integration and demands greater effort from the boundary spanners than transferring activities (Carlile, 2004). The findings further illustrate and support scholars (e.g., Carlile, 2004, Van de Ven and Zahra, 2017) claiming that a more nuanced set of knowledge integration dimensions is needed (transferring, translating and transformation) compared to the knowledge transfer literature that mostly has treated it as a one-dimensional aspect (e.g., Argote and Ingram, 2000).

The filtering and framing of research results also generated new possibilities for spin-off research projects: “*We now [end stage of the research centre] have much better internal coordination... the research projects and reports are collected and categorised, which we can later discuss and collaborate on internally*” (BS1). Our findings thus add nuance to prior research that seldom has scrutinised how firms are to benefit from university-industry collaborations (Cohen et al., 2002, Bekkers and Bodas Freitas, 2008), showing that filtering and framing are necessary to obtain the value of academic publications in such collaborations.

4.2.2 Knowledge transformation

We identified two activities boundary spanners perform to create new knowledge based on the university and industry partners’ specialised knowledge bases (Carlile, 2002).

(1) Conducting research together with university partners

Our data show the importance of conducting research together with university partners for the creation of new knowledge (Grant, 1996b, Styhre, 2011); boundary spanners participated in ongoing research and discussed research progress formally (e.g., meetings and workshops) and

informally (e.g., phone calls) with university researchers. Boundary spanners 6-10 were closely involved in these activities: “*We work very closely with [the university partner]. We are here [at the university] at least three times a week, so we have a close dialogue*” (BS10), and “*the research with the university partners are really important for the firm*” (BS6). Boundary spanner 9 explicated the importance of conducting research together and illustrated how their industrial processes are used as “boundary objects” to transform knowledge (Carlile, 2002): “*It has been great to get the [university partners] to research and document the ‘processes’ thoroughly. We have previously searched in academic papers... but that was of low quality... now we have accomplished that in collaboration with [the university partner]*” (BS9).

The other boundary spanners (1-5) had little involvement in these activities, which hampered knowledge transformation: “*I don’t have time to work on, or follow up, the research subjects*” (BS4). Our findings are thus in line with findings illustrating that formal collaborations are more important for firms than passively receiving or acquiring publications and patents (Meyer-Krahmer and Schmoch, 1998, Monjon and Waelbroeck, 2003) and further illustrate how conducting research together with university partners enables industry partners to work with research that is relevant both for their firm and the university partner.

(2) Initiating and conducting spin-off research projects

Our findings show that the transformation of knowledge is a long-term process and requires additional research activities to reach its potential. As such, the most involved boundary spanners (6-10) initiated spin-off research projects based on knowledge produced in the research centre, focusing more on firm-specific issues:

“Much effort goes into spin-off projects that are connected to the research centre, which has been central, especially on subject X. Within subject Y, it has been crucial.... I find that we learn a lot by working together. Until now, there has been little knowledge in our area, but we are getting there in collaboration with it [the university] ...we do things that nobody else has done before” (BS8).

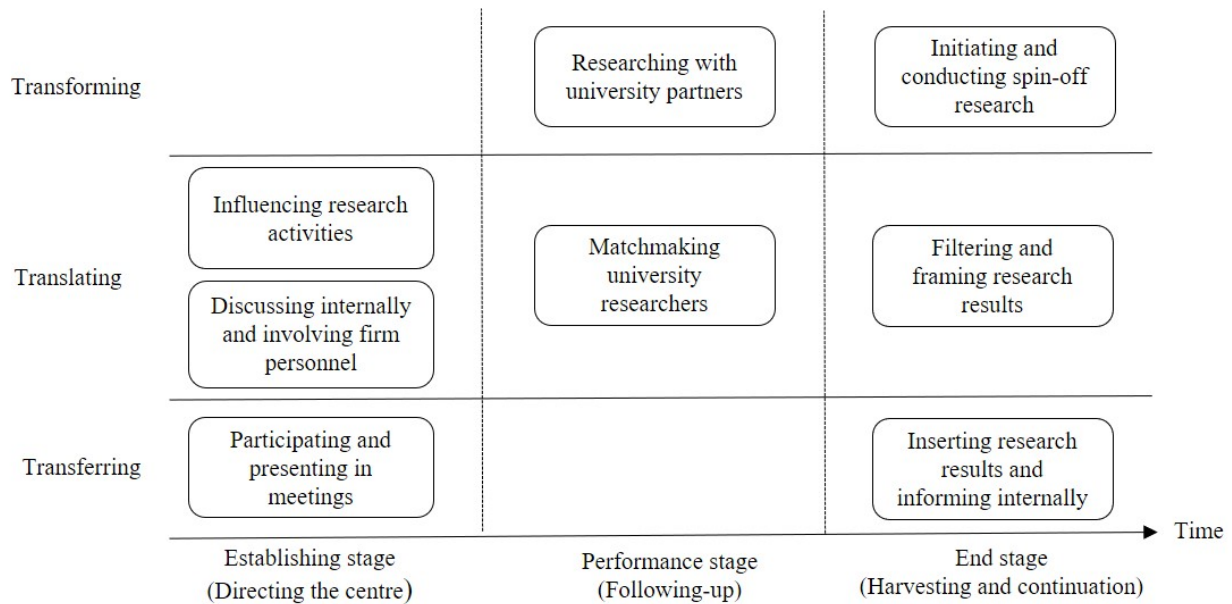
Our findings further illustrate that the research centres functioned as the knowledge base, of which the highly involved boundary spanners were able to use as a basis for more applied spin-

off research projects: *“It has been done a large amount of basic research, that we now are harvesting, creating a lot of interesting applied results through the spin-off project”* (BS7). Some of these boundary spanners also initiated new research projects internally in their firms: *“We try to integrate knowledge [from the centre] within the enterprise by working together on projects”* (BS9). Hence, some of the boundary spanners spread and integrated tacit knowledge from the centre internally by working together with other employees within the firm (Styhre, 2011). In this matter, the boundary spanners acknowledged the importance of working closely together to integrate tacit knowledge (Polanyi, 1967): *“It is not enough to write down something and then have someone to read it; there is a difference between reading and doing”* (BS9). Hence, our findings contribute to illustrating how research projects are further developed into new projects, both internally and with university partners, which has received limited focus in the innovation literature (Dimos and Pugh, 2016).

4.3 Building blocks of boundary spanning activities in research centres

Finally, with the aim of guiding boundary spanners in the EI process of combining specialised knowledge from university partners (De Marchi, 2012b, Jakobsen et al., 2019), we illustrate more precisely how firms can take actions when collaborating with university partners (Perkmann and Salter, 2012). As such, Figure 2 reveals a pattern on how the boundary spanning activities were mainly attended to in three stages of a research centre, of which prior literature seldom has distinguished (Skute et al., 2019).

Fig. 2 Building blocks of boundary spanning activities in research centres*



* Each of the activities was performed by the boundary spanners in all three stages but were mainly attended to during the specific stage under which they are presented in Figure 2.

In the (1) establishing stage (before initiation and during the first year of the centre), we identify three key activities that enable the boundary spanner to direct the research focus of the centre, which acted as the foundation for other activities in later stages. We suggest that firms that *participate and present* at official meetings and seminars and *discuss and involve* internally are more likely to create a larger pool of research possibilities and achieve momentum regarding their research interests, thus enabling the boundary spanner to *influence research activities*.

By influencing and suggesting research activities, the boundary spanner ought to conduct *research together with the university partners* within the research centre during the (2) performance stage (during the collaboration). This stage entails follow-up research activities where the boundary spanners may participate in ongoing research and discuss research progress formally and informally with university researchers. During this process, we suggest that the boundary spanner invest time in getting to know the partners in terms of competence and research expertise, which lays the foundations for *matchmaking university researchers* for new research projects.

Hence, at the (3) end stage (during the last year(s) of the centre), we suggest that the boundary spanner “harvest” on the matchmaking activities by selecting relevant university researchers with whom to initiate overlapping *spin-off research projects* based on the knowledge

developed in the research centre. Furthermore, when research results from the research centre become available, we suggest that the boundary spanner *insert research* into the knowledge base of the firm and *inform internally* about the results. However, due to the nature of academic research, the boundary spanner often needs to conduct *filtering and framing* of the research results to ensure that the results are relevant and understandable for internal firm applications.

Revealing this pattern shows that boundary spanners cannot expect to engage in the highest value-adding activity of transforming (Monteiro and Birkinshaw, 2017, Grant, 1996b) in research centres, without first engaging in transferring and translating activities, to successfully integrate specialised knowledge from university partners required for EIs.

9 5. Conclusion and implications

This paper enhances our understanding of how EIs are developed in research centres by exploring the boundary spanning activities for integrating specialised knowledge from university partners.

Numerous studies have shown the importance of firm involvement for innovation outcomes when collaborating with universities (Santoro, 2000, Núñez-Sánchez et al., 2012, Lauvås and Steinmo, 2019), whereas few have focused on *how* firms should be involved in these collaborations to realise EIs (Boardman and Bozeman, 2015, Pateli and Lioukas, 2017, de Wit-de Vries et al., 2019). We add to these shortcomings and contribute to the debate on the dynamic relationship between EI partners (Yarahmadi and Higgins, 2012, De Marchi, 2012, Jakobsen et al., 2019) by exploring activities performed by ten industry-based boundary spanners involved in research centres, which are the key enablers for integrating specialised knowledge from university partners. As such, we provide two key contributions.

First, we propose that boundary spanners should perform transferring, translating and transforming activities to leverage EIs (Carlile, 2004, De Marchi and Grandinetti, 2013) and identify a set of underpinning activities for knowledge integration (Le Dain and Merminod, 2014, Van de Ven and Zahra, 2017). On a theoretical note, this articulation aids the literature, which has paid little attention to but called for more research on the dimensions of knowledge integration (Carlile, 2004, Le Dain and Merminod, 2014, Van de Ven and Zahra, 2017). Second, we illustrate how firms can take actions when collaborating with university partners (Perkmann and Salter, 2012) by revealing a pattern of how boundary spanning activities may be attended to in the establishing, performance and end stages of a research centre (Skute et al., 2019). As such, we

extend Carlile (2004) by showing that boundary spanners cannot expect to engage in the highest value-adding activity of transforming (Monteiro and Birkinshaw, 2017, Grant, 1996b) without first engaging in transferring and translating activities.

In sum, by studying the key individuals for enabling EIs in research centres, namely, boundary spanners, we have provided key evidence on how these individuals perform activities to integrate specialised knowledge from university partners (Le Dain and Merminod, 2014, Van de Ven and Zahra, 2017, Langley et al., 2019) for EIs (De Marchi, 2012, Jakobsen et al., 2019, Hermundsdottir and Aspelund, 2020).

9.1 5.1 Implications

Studying the boundary spanning activities for knowledge integration in research centres is necessary not only to fulfil our academic need for knowledge. It is also vital for firms that are seeking to leverage EIs based on specialised knowledge. Hence, our findings have important implications for industry partners involved in research centres aiming to realise EIs and for policy makers who fund such collaborations. As firm involvement is an important premise for successful collaboration with university partners (Santoro, 2000, Mora-Valentin et al., 2004, Núñez-Sánchez et al., 2012), our study provides insights into the processual elements of *how* firms can be involved and take action to participate in useful collaborations (Perkmann and Salter, 2012). Our findings demonstrate a range of boundary spanning activities for knowledge integration (Tell, 2011, Foss et al., 2010, Perkmann and Walsh, 2007) and offer guidance for boundary spanners on how to perform these activities in the three stages of a research centre: establishing, performance and end stage. By this, we contribute important insights to the literature on EI, which has called for insights into how these innovations develop (Engert et al., 2016, Hermundsdottir and Aspelund, 2020).

Prior research has found that many firms that engage in collaboration with university partners exhibit low involvement (Santoro and Chakrabarti, 2002). However, our findings imply that firms should provide resources and time to their boundary spanners in all stages of a research centre to achieve the highest levels of environmental outcomes from research centres. Our findings also imply that formalising university-industry collaborations through a research centre does not automatically lead to increased firm involvement (Thune and Gulbrandsen, 2011, Thune and Gulbrandsen, 2014). Hence, university partners should be motivated to involve industry partners early on and during collaboration to perform the activities needed for EIs.

Our findings show the role of research centres for EIs, as they are long-term financed and involve a range of diverse firm and university partners that hold different specialised knowledge. Policy makers should therefore both facilitate for and be patient with boundary spanning activities. Hence, policy makers could stimulate and facilitate the boundary spanning activities found in this study to foster EIs. However, patience is necessary because it takes time for boundary spanners to become involved in the activities required to integrate the specialised knowledge needed for such innovations.

9.2 5.2 Limitations and future research

This study has limitations that provide opportunities for future research. First, this study is limited to the boundary spanning activities performed by individuals in firms that engage towards university partners and does not concern individuals who represent the university side of the collaboration. The latter have been found to be important actors for knowledge integration in large-scale university-industry collaborations (Knudsen et al., 2017). Future research could therefore demonstrate the “two-way” interaction process of university-industry collaborations (Meyer-Krahmer and Schmoch, 1998, Berggren et al., 2011) by capturing the university side as well. Second, our sample of ten industry-based boundary spanners offers depth at the cost of breadth; thus, our findings should be tested in large-scale surveys. Additionally, the knowledge integration activities addressed in Figure 1 combined with the insights from Figure 2 could be used in quantitative studies as indicators of industry involvement, similar to Bozeman and Gaughan (2007), who explored the involvement of academic researchers.

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Appendix

Fig. A.1 - Data structure: Representative quotations

Representative Quotations

“We participate in the annual meetings. Since we are a partner in the centre, it is much easier internally to say that there is a meeting coming up.”
“I meet [researcher], who is the researcher that I see the most, about three or four times a year [at meetings and conferences]. Then, we usually have informal meetings for a quarter hour or so or more formal meetings for an hour or two.
“We attend conferences and such and present our research results publicly.”
“We have presented our R&D activities at the conferences. This has resulted in higher interest for what we are doing...and we have used these conferences to talk with future possible [university and industry] partners.”

“I don’t read all of them [journal articles], maybe less than half of the journal articles. I only skim those that are of interest.”
“The research centre serves as a ‘filter’ that filters research results for us...that has been a big advantage for us.... We can then just insert this knowledge into our models.”
“I sometimes use it [the intranet] to gather things [research results and memos].”
“If there is something [interesting], then I usually send it out [internally on email].”

Representative Quotations

“We have gained a wider participation from our value chain.... We have become more focused on dedicating people to follow up internally.”
“The technical insights from the research results come in the technical subject meetings, and at a meeting two weeks ago, I brought ‘the others’ [who work in that subject area].”
“We have one project [in the centre] on [product X] where we have taken samples from our [product]... then, the process engineers are engaged.”
“If I am unable to attend [a meeting with university partners], I send somebody there to represent us... afterwards, we have a debriefing where we talk about what was discussed.”

“We give instructions on what we believe is important that [the research centre] do research on.”
“We had some discussions [with the university partners], and they agreed that the purpose [of the research centre] was not reflected in the research plan, so it was improved.”
“In the research centre board, we have discussed and defined the main deliveries. This discussion has worked out.”
“We sit down and go through the work schedule with the university partners, tell them what is important to us, ask them to specify what is planned: ‘Yes, but what about that work area then? What can we do there?’.”

“We connected some researchers. I do not think that would have happened without us suggesting that they should talk together.”
“By participating in the centre, we maintain and extend a network in case we need to get in touch and discuss later.”
“Since I know the people [at the university], I also know who is best in different areas. Thus, I call these people and have a closer collaboration with them.”
“I am a sort of link between the researchers and the internal personnel; I can help introduce, attend the first meeting, or just write a few e-mails.”

“We get the report, and then we take time internally to review it critically before it is accepted within the company and becomes a part of the knowledge base.”
“Ideally, I shorten an article and email it to those who might have interest in it... or it could be as simple as some test results that state that something cannot be used. Then, it is also important and easy to write a line about it.”
“I regularly present what has been achieved in the research centre internally...in such a way that we [firm] can also take it further.”

“We have contact daily [with the university partners] when it is necessary.... A lot has to be discussed in the research projects...”
“We have a continuous dialogue [with the university partners] ... about results, and what will be the next step.”
“On [that paper], there has been proper collaboration...we would probably not have written it if was not for them [the university partner] and the research centre.”

“We are part of a separate project with [university partners] as a part of the research centre ‘umbrella’ where we have shared data.... And it works very well... they [university partners] have gotten some knowledge about our firm, and they see the benefit of it and get insight into datasets differently than before. Therefore, there is mutual interest and benefit.”
“Much effort goes into spin-off projects that are connected to the research centre, which has been central, especially on subject X. Within subject Y, it has been crucial.... I find that we learn a lot by working together. Until now, there has been little knowledge in our area, but we are getting there in collaboration with it [the university] ...we do things that nobody else has done before.”
“We try to integrate knowledge within the enterprise by working together on projects. It is not enough to write down something and then have someone to read it; there is a difference between reading and doing.”

In Review

