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Being, becoming and brokering: Industrial PhD students' positioning within industrial and academic communities

Maria Cervin-Ellqvist[1]

Abstract

Doctorates conducted in industry-academia collaborations are on the rise, aiming to strengthen industry–academia connections, address real-world problems, and prepare students for industry careers. Students are expected to be brokers between two contexts—while learning brokering and becoming experts in both—yet little is known about what this entails in practice. Drawing on Wenger's communities of practice (CoP) framework and using inductive thematic analysis, this study analysed interviews and community plots from 12 industrial PhD students in STEM to explore how students position themselves within and across academic and industrial communities. Participants experienced academia as stable and structured, whereas industry varied in expectations, support, and integration opportunities. Many had peripheral positions in at least one context, limiting possibilities for knowledge brokering. Brokering relied on students' relational efforts rather than dual affiliations. Clearer expectations, stronger support structures and cultivation of CoPs—particularly in industry—are needed to support students' boundary-spanning roles.

Keywords

doctoral education, knowledge brokering, communities of practice, industry-academia collaboration, collaborative doctorates, professional doctorates

Introduction

Collaboration between industry and academia is increasingly important to solve societal problems (Pertuz et al., 2021)—especially in Science, Technology, Engineering and Mathematics (STEM; Grimm, 2018). In response, collaborative doctorates, such as industrial PhDs (IndPhDs) and professional doctorates, are becoming more common (Compagnucci and Spigarelli, 2024). Specifically, these doctorates introduce a boundary-spanning function and optimally result in research that is both academically sound and applicable in industry, while preparing students for careers not only in academia but also in industry or industry-academia collaborations (Bernhard and Olsson, 2023; Borrell-Damian et al., 2010; Cardoso et al., 2022; O'Carroll et al., 2012; Wallgren, 2007) and lowering the organisational culture shock of entering industry after a traditional PhD (c.f. Skakni et al., 2022). The students themselves are key in these doctorates, and placed at "the intersection between learning, creating, and transferring knowledge to industry and society at large" (Compagnucci and Spigarelli, 2024: 2). Therefore, in evaluating and improving these doctorates as ways of increasing constructive collaboration, it is important to investigate the students' experiences, including challenges and support needs.

However, there seems to be a risk that instead of being fully integrated in their two contexts, these doctoral students find themselves on the peripheries of both industry and academia, where they might not bridge boundaries or become prepared for a range of careers. Indeed, they often feel alone and struggle with the dual but sometimes unclear expectations, ambiguous roles, integrating theory and practice, handling different timeframes in industry and academia, learning the skills needed, and getting sufficient support (Compagnucci and Spigarelli, 2024; Grimm, 2018; Jones, 2018; Tavares et al., 2020; Thune, 2009, 2010; Wallgren, 2007; Wint, 2026). They have to a limited extent been theorised as potential *knowledge brokers* between *communities of practice* (CoPs; Bernhard and Olsson, 2023; Gustavsson et al., 2016; Wallgren and Dahlgren, 2007; and

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in one study discourse communities, Cervin-Ellqvist et al., 2026), i.e. as "experts who interact, communicate, facilitate learning, share, and create knowledge across sectors" (Garcia-Morante et al., 2025: 2). However, it is still unclear to what extent and how they broker knowledge between their two contexts. This paper builds on the notion of these students as brokers and explores expectations, communities, and brokering in collaborative doctorates.

Previous research underscores the complexity of brokering between industry and academia generally (Owens et al., 2020) and to some extent in collaborative doctorates (Compagnucci and Spigarelli, 2024; Jones, 2018). For example, Wallgren (2007) conceptualised IndPhD students as brokers but concluded that they often do not have a brokering role in practice, whereas other studies suggest they do (Assbring and Nuur, 2017; Gustavsson et al., 2016; Thune, 2009). For instance, Bernhard and Olsson (2023) found that most interaction in an IndPhD passes through the student. However, Salminen-Karlsson & Wallgren (2008) argue that these students are often seen as objects physically linking contexts but should instead be seen as boundary subjects—human actors with whom both industrial and academic representatives have an interest in and to whom they relate as future colleagues. Importantly, this view highlights a need to examine the students' relationships with the various social agents—e.g. individuals, groups and CoPs—involved in their doctoral journey to better understand and support the brokering the students presumably engage in.

In this study, I therefore investigate IndPhD students' perspectives on the social agents involved in their doctoral journey—which communities, groups, and individuals they consider significant; the roles these agents play; and the expectations students perceive these in their two contexts. Using a communities of practice lens (Wenger, 1998), this study analyses and theorises IndPhD students' participation in their academic and industrial contexts, whether it is peripheral, their presumed brokering role, and how students themselves shape their participation—resulting in both theoretical and practical implications.

This study examines the students' perspective, guided by the following research questions:

RQ1: What expectations do they, as presumed knowledge brokers, face?

RQ2: What social agents and communities of practice are involved?

RQ3: What are the roles of these social agents and communities?

Empirically, this paper contributes with nuanced insights into the brokering role of IndPhD students, adding to previous understanding of what this role entails in practice. Methodologically, it shows how a visual tool called *community plots* can be particularly useful to capture IndPhD students' perspective. Finally, this paper also contributes theoretically by showing how *knowledge brokering* and *communities of practice* can be used to conceptualise, theorise and increase our understanding of IndPhDs students' realities.

This paper is structured as follows: literature survey, which adds more details regarding both the theories and previous literature; method; results, with sub-sections expectations, key people and communities, and brokering between industry and academia; discussion, which discusses the three research questions and then the broader picture; conclusion, including implications; and finally limitations and future research.

Literature survey

This study draws on Wenger's (1998) communities of practice (CoP), defined as "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (Wenger et al., 2002: 4). CoPs are thus not defined by formal organisational units but rather their function for participants (Wenger, 1998). Furthermore, large organisations are too diverse and diffuse, and the people too distant from each other, to constitute a single CoP, and can instead comprise constellations of practice. Engagement is local, meaning an individual can be part of a constellation (e.g. a company) but interact primarily within a smaller CoP. This theoretical lens is particularly useful in contexts where learning is not formally structured but rather situated, as in a workplace or in the industrial contexts of an IndPhD. In addition to the situatedness, the model builds on learning as social and occurring by participation, similar to how learning in both PhDs and workplaces is often described (Eraut, 2004; Fuller et al., 2005). While there are sometimes academic courses for IndPhDs (Compagnucci and Spigarelli, 2024), these do not always target the knowledge and skills needed or perceived useful for brokering or the industrial context (Cervin-Ellqvist et al., 2026; Sin et al., 2021). Therefore, CoPs are particularly important understand IndPhD students' PhD experiences.

Across CoPs, *knowledge brokers* create and transfer knowledge, facilitating learning and providing a bridge (Wenger, 1998). The students' learning can be theorised as tied to CoPs in each context and brokering as happening between these CoPs. Brokering is a key rationale for IndPhD projects (Wallgren and Dahlgren, 2007) and students commonly report motivations aligned with a brokering role—e.g., bringing academic knowledge into industry and conducting research that is truly relevant to industry (Compagnucci and Spigarelli, 2024). Interestingly, Wenger (1998) suggested that certain individuals seek brokering roles and thrive in them; they "would rather stay

at the boundaries of many practices than move to the core of any practice" (Wenger, 1998: 109). This quote requires unpacking. Slightly rephrased, the assumption is that some people would thrive when being in the *peripheries* of several CoPs and provide a participative connection between these CoPs, through *legitimate* but *peripheral participation*. Peripheries of a CoP here refers to "a region that is neither fully inside nor fully outside, and surrounds the practice with a degree of permeability" (Wenger, 1998: 117), a permeable boundary area rather than a distinct defined boundary. Being in the peripheries entails walking a fine line between being a full member and an intruder not belonging in the CoP, a balance act that is in IndPhDs then presumably conducted in two CoPs at once.

The realities these concepts describe are complex, as are often modern organisations, meaning that Wenger's theories cannot capture every facet (Fuller et al., 2005). However, for this paper, the concepts described above are useful to theorise and increase our understanding of IndPhD students' realities.

In previous research, both contextual and individual factors have been found to affect brokering and professional identities of doctoral students (e.g., Compagnucci and Spigarelli, 2024; Thune and Børing, 2015; Wallgren, 2007). These include conditions at the start of the doctorate—such as division of time and recruitment process—the research topic and its relevance in industry and academia, the type of industry and its investment in R&D and innovation, the research school's organisation, and supervision. "Industry" here refers to companies and other non-academic organisations, including NGOs and governmental agencies, similar to how it is used by O'Carroll et al. (2012). This term works comparatively well in STEM, and thus in this study, but perhaps less well in other disciplines (c.f. Compagnuggi and Spigarelli, 2023, on outreach and collaborative activities in social sciences and humanities). More to the point, research on collaborative doctorates has primarily focused on the roles of academic and industrial supervisors (Roolaht, 2015; Salminen-Karlsson and Wallgren, 2008; Tavares et al., 2020; Yang and Jeffrey, 2021), and to a limited extent managers in industry (Abu Sa'a & Yström, 2024). For example, the role of academic supervisors seems to be fairly similar to in traditional PhDs, but Thune (2010) also describe them as those who develop the PhD projects and training in collaboration with industry, and as often having extensive experience of collaboration with industry and thus being able to "handle some of the most controversial aspects of collaborative research" (p. 479). Furthermore, Buchholz et al. (2026) found that professors' professional engagement outside of academia was beneficial for knowledge exchange between industry and academia, suggesting it could be beneficial with for brokering in IndPhDs if supervisors have previous on ongoing engagements in industry. Other studies have concluded that roles and responsibilities—especially in industry—are often unclear and indeed vary depending on previous academic and industrial experience (Roolaht, 2015; Salminen-Karlsson and Wallgren, 2008; Tavares et al., 2020; Wint, 2026). In a recent study conducted in the UK, Wint (2026) concludes that roles and responsibilities need to be clarified to ensure the doctoral student receives adequate guidance, support, and training.

Studies on traditional PhDs have underscored the importance of additional social agents, such as PhD student peers, other colleagues, research groups, and international research communities (Jacobsen et al., 2025; Sala-Bubaré and Castelló, 2017; Solli and Muir, 2021), and the "necessity for maintaining, brokering and supporting a range of relationships" (Owens et al., 2020: 107) as well as agency in the PhD and the post-PhD career (Castelló et al., 2026). For collaborative doctoral students, the complexity is amplified (Yang and Jeffrey, 2021)—perhaps especially for IndPhD students since they are employed in industry, affiliated to a university, and have to fulfil the same academic requirements as traditional PhD students (Grimm, 2018; in contrast to professional doctorates, see Jones, 2018). Consequently, research needs to expand beyond supervisors and examine the roles of and students' relationships to other social agents—providing a comprehensive understanding of who are "the players in the game" (Compagnucci and Spigarelli, 2024: 22; see also Wint, 2026) and what roles they have for IndPhDs students' experiences and boundary-spanning functions.

Method

This study draws on interviews with 12 IndPhDs from two large Swedish STEM universities. Informed consent was obtained and the study follows the Swedish Research Council's (2024) ethical requirements and guidelines for good research practice.

Setting and participants

First, it is important to clarify the national context, given that the setup of IndPhDs varies slightly across countries and even institutions, including differences in employment, funding agreements and organisation in doctoral schools (Compagnucci and Spigarelli, 2024). In Sweden, IndPhD students have the same formal academic requirements as other PhDs, are employed in industry, and typically do the PhD during work hours (see e.g., Compagnucci and Spigarelli, 2024; Kot and Hende, 2012). Regarding doctoral schools, IndPhDs are sometimes organised into schools with other IndPhDs (as in Gustavsson et al., 2016; Wallgren, 2007) and sometimes integrated into doctoral schools with predominantly traditional PhDs. The latter was the case for all participants in this study. The two STEM universities are large, well renowned and have

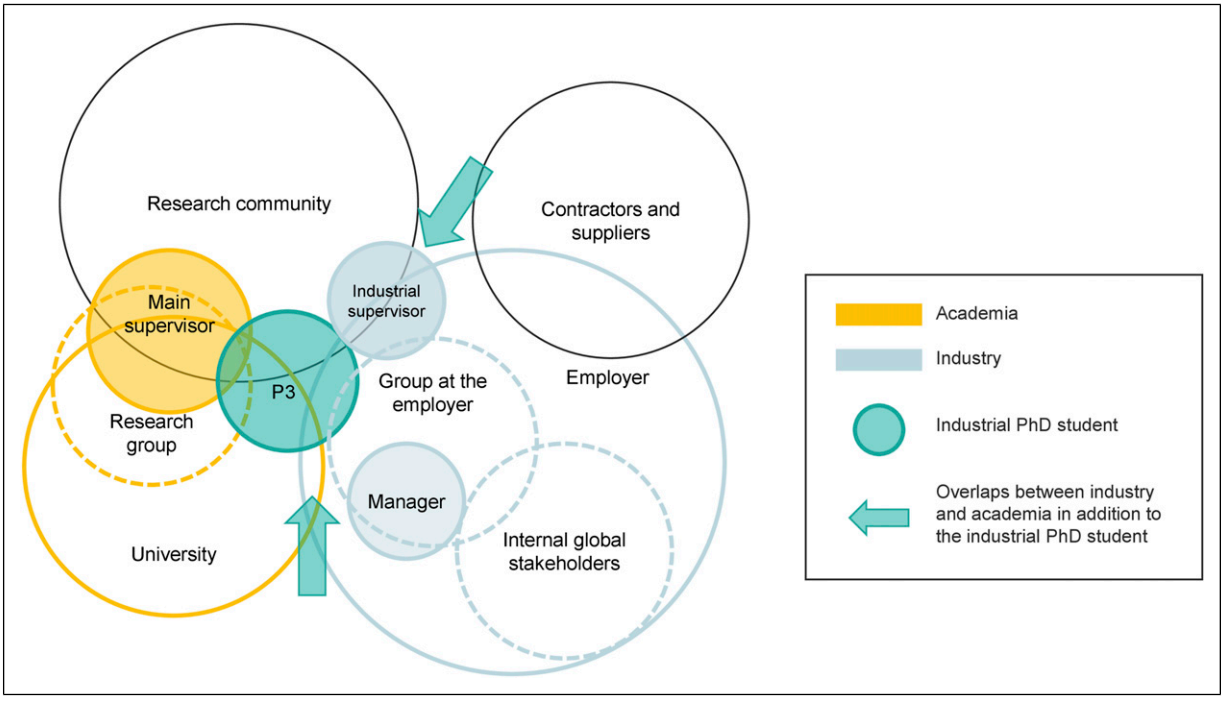

Figure 1. Example of a community plot, namely P3's plot.

comparatively many IndPhD students affiliated to them (around 10 to 15% of their PhD students).

This study is part of a larger research project (see Cervin-Ellqvist et al., 2026). The 12 participants had volunteered for interviews in an earlier phase of the project (Cervin-Ellqvist, 2026), and were selected through purposive sampling (Robinson, 2014) to capture a range of perspectives on the IndPhD. The selection criteria included age, gender, research field, employer, time elapsed between their most recent degree and the start of their PhD, language background, and reported challenges in the previous study (e.g., difficulties in communicating research across academic and industrial contexts). Participants were about 25 to 50 years old; the time between their most recent degree and the start of their PhD varied between zero and about 20 years. All 12 IndPhD projects in this study were standalone and not part of larger research projects. Most projects began with a broad scope and were refined over time based on personal relevance. Two participants had less autonomy, having entered predefined projects through job applications and where the topic had been set before their involvement. Further participant characteristics are summarised in Appendix A, at a group level to maintain anonymity despite the detailed data regarding individuals involved in each participant's PhD journey that is presented in this paper. Participants' field of research is for the same reason not included, but all participants were affiliated to STEM universities, and this was reflected in their fields of research.

Data collection

The interview guide was developed based on a previous study and existing literature, both in English and Swedish. It was piloted with a PhD student in a similar setup to the IndPhDs. This paper draws on selected parts of the interviews, focusing on the IndPhD project and setup, research communication practices and support, communities, and overall reflections on the IndPhD experience (e.g., perceived gaps between academia and industry). The section on communities forms the core of the data for this paper, supplemented by insights from the beginning and end of the interviews to provide a richer understanding of the participants' journeys. The English interview guide is included in Appendix B.

In the interviews, an instrument called community plot was used. It was originally designed by Sala-Bubaré and Castelló (2017). An anonymised example from participant 3 is shown in Figure 1.

Participants were provided with 10 circles of different sizes (digitally or on paper), with additional circles and size adjustments available if needed. Each circle was used to represent one person, group, or community that had played a role in the PhD, and the participants were asked to name them and place them so that they represented how the different social agents were connected to each other and the participant. Participants were also asked to explain the composition and asked follow-up questions regarding for example the role of different actors, which circle was the

most important, and if the plot would have looked different at different times in their PhD

The resulting plot is a "visual representation of the relationships between the interviewee and the most significant groups and individuals in his/her doctoral experience" (Sala-Bubaré and Castelló, 2017: 19–20). The instrument was designed to capture PhD students' interpretation of their research network and how they position themselves in it. While originally designed for traditional PhDs, this instrument is very suitable to explore these questions also for IndPhDs, where the dual contexts provide even more complexity as to who is involved and how. In another study, Solli and Muir (2021) used community plots in interviews with PhD students with a professional background, focusing on their PhD overall and specifically on writing. While different in scope and aim, that study speaks to the potential of using the community plots to uncover what IndPhD students' networks look like in and across industry and academia.

Data analysis

All interviews were recorded and transcribed. Community plots were saved digitally and anonymized during analysis (e.g., replacing company names with "employer"). The transcribed data was first curated in a large table to be able to compare data, for example on the inclusion/exclusion and roles of certain social actors across participants. Given the exploratory nature of the study, inductive thematic analysis was then used to identify categories and themes across participants (roughly following the steps laid out by Braun and Clarke, 2006, with adaptations to accommodate for the number of participants and nature of the data). Both the transcribed data and the community plots were used.

After familiarisation with the data, the data was curated into categories in an Excel file. The categories included different aspects of the PhD (e.g. how it was initiated, perceived expectations and interest in industry and academia, and if participants perceived a gap between industry and academia) and the different social agents described by the participants (e.g. supervisors in academia and industry, managers, other PhD students, and colleagues in the two contexts). There was variation in which social agents were included, but the absence of certain actors in the plots and transcripts was also treated as meaningful data, indicating that the participant did not perceive the absent actor as playing a role in their PhD

Thereafter, themes were identified within each category. A summary was then written for each participant and category, i.e. for the identified social agents and other aspects of the PhD included and the summaries were analysed qualitatively and theorised drawing on concepts of brokering and communities of practice (CoPs), returning to the plots and transcripts when needed to check interpretations.

Results

Participants' community plots and reflections around their plots revealed considerable variation in how participants experienced and navigated their academic and industrial contexts. The findings are organised around expectations, key social agents and communities, barriers to participation, and the brokering role of IndPhD students. While the plots informed the thematic analysis, only selected examples are shown; all plots are included in Appendix C.

Expectations

Participants consistently described academia as a stable and predictable context, while industrial contexts showed large variation among participants and over time for individual participants—in terms of support, engagement, and organisational structures. P2 described the difference:

> "while at my employer it always felt like all things are changing all the time, I kind of could really build with the group [at the university] because in a way, this was the only constant." (P2)

The expectations from academia were perceived as clear, including completing coursework, publishing papers, presenting at conferences, and writing a thesis (P1, P2, P4, P5, P6, P8, P10, P12). They centred around ensuring "that the academic quality is enough" (P1) and meeting explicit requirements such as "I need to do four publications in order to get my PhD" (P10).

Expectations from industry were less clear and formalised. Some participants (e.g., P2, P7, P10, P12) perceived informal interest from colleagues, who had been "very active in it all" (P7), but no explicit requirements. Many still tried to shape their research to ensure relevance for the employer (including P3, P5 and P9). As P2 explained, contributing in industry "wasn't an outspoken requirement, but rather something that always was underlying", and P9 summarised the situation by stating that "it is up to me in a way to kind of shape my research… [and figure out] how can I do things that I can transfer my knowledge to the team and to the company". Rather focusing on outcomes during the PhD, P1 and P3 explained that industry saw the PhD as competence development:

> "the most important is the education and that you finish and come back." (P1)

> "we really have said that it is my future role that is the most important output and the kind of assignments I get afterwards." (P3)

Limited understanding of research within industry sometimes led to mismatched expectations, including

assumptions that research would result in concrete or consultancy-like outcomes. P8 described this as "a dissonance between the picture of what research is and can do versus what it is" and elaborated that "some can confuse it with consultant assignments, that there will be a concrete output". Overall, many participants expressed uncertainty about industrial expectations and either implicitly or explicitly how they as PhD students did not fit well into the employing organisation. P8 was perhaps the most explicit and described feeling like an "odd bird" at their employer.

Despite sometimes unclear expectations, participants felt that both academia and industry recognised the IndPhD as a research education, not demanding "ground-breaking new research" (P4). The lack of industrial expectations also created autonomy in shaping the project, a freedom mirrored in academia through mutual trust. As P9 put it, about academia, "they let me do whatever I wanted… I've never been told: 'Yeah, 'you have to do this'". Furthermore, some participants noted that the brokering activities—such as facilitating networks or collaborations—could lower academic expectations for traditional outputs. P3 explained that their group "sees that I have a more important function than just research, and might then overlook that… [the IndPhD student] is not as effective at writing papers but they make a lot of other things happen."

Finally, unclear expectations and a lack of understanding in industry could have consequences for salary progression—potentially also creating motivation to contribute—and a feeling of being peripheral in industry:

> "depending on how I contribute to the group, I can escalate that ladder as well. So, there is this kind of motivation that, okay, if you contribute [you get a better salary]" (P5)

> "you as a PhD somehow become this person that is not of interest for them, that cannot contribute" (P9)

Key People and Communities

The most important social agents in academia were mainly supervisors, managers and colleagues, as presented below.

Supervisors. Academic supervisors—especially main supervisors—were consistently among the most central social agents in participants' academic communities. They gave appreciated guidance, support for research, and help to navigate the academic world. As P4 described, they were "guides through this world, which is a special world", and P4 concluded that without the academic supervisors they "had been lost". This role evolved over time in a constructive way, and P5 described that "as time was passing, I feel like I'm more independent and they recognize that".

Half of the participants had one or more academic co-supervisors (P1, P2, P4, P5, P8, P11). These often contributed with complementary knowledge and perspectives, as for P5:

> "adding [yet another co-supervisor] was kind of like trying to create… more entropy. It was a nice way to start discussing and also challenging a lot of us" (P5)

Industrial supervision showed more variation. Some industrial supervisors had a more traditional supervisor role as discussion partners (e.g. P2, P3, P10), guides (e.g. P2) and co-authors (e.g. P1, P6), while others had no role other than formally (e.g. P12). Four participants had switched industrial supervisor at least once (P1, P2, P6, and P7) while two did not have one (P4 and P11). Participants appreciated the importance of the industrial supervisors knowledge of the employer, for example having a role to "help find a direction and look into what may be relevant research areas then that are both publishable and interesting for the company" or (as P3, P7, P8, and P9) emphasized the role in "marketing research as a concept" (P3) at the employer along with help with "visibility, and… putting me in contact with people" (P9).

Managers. Managerial support varied widely and was often disrupted by reorganisations. Switching managers (experienced by P2, P3, P5, P6, and P8) resulted in a need to re-establish relationships and re-explain their work. For P6, the new manager became more important while or P2's new manger became more peripheral. Importantly for IndPhD students as paid employees, P3 noted:

> "When revising the salaries… I need an understanding from my manager… which then is a bit of a struggle when you then have to start over with a new relationship" (P3)

Managers acted either as enablers—being supportive (P1, P4, P5, P6, P7, P9 and P12), providing funds (P4, P5, P8, P10 and P12) and supporting visibility (P3, P5, and P9)—or barriers when they lacked understanding of IndPhDs or prioritised cost-savings (P5). P5's experience illustrated this variation: the first manager "knows the topics and was also kind of contributing to the discussion", the second was "always looking for saving [money]," and the third "supports and understands" and helped with visibility.

Managers with PhD experience (P5, P6, P9, and P11) took on different roles but were generally among the more understanding. One of these, P6's manager, had a strategic role in leading a group with only IndPhD students, articulating a vision for high-quality, industry-relevant research, and in doing so creating a community for IndPhD students. P6 explained that this manager "saw the industrial PhD students more as a research program for [the employer] and already from the beginning had a vision about… research being of high quality,… research that is also relevant to [the employer]".

Colleagues and other groups. In academia, colleagues, including other PhD students, were identified as important discussion partners (P1, P2, P3, P4, P7, P11, P12), also providing opportunities to vent and informal guidance. Several participants emphasized the value of shared understanding and common goals within their academic communities, for discussions and a sense of collective purpose, in contrast to in industry. For example, P3 described it as "very useful mentally to just get to talk with likeminded people", and P7 similarly appreciated to have "people in the next room or so, they've been very good to bounce ideas off". In other words, academia was, at least to some participants, a space for mutual support and shared identity.

In industry, some participants found communities in among colleagues (e.g. P1, P6, and P7)—especially when they had prior employment in the organisation (e.g., P1, P11, P12). For example, P7 valued colleagues' practical insights, which helped validate or contextualise their research. As P7 explained, colleagues "have come with input and ideas" and could then also confirm if suggested solutions aligned with what they "can see also in practice, because they have practical experience of these problems". Other participants did not seem to be part of a community in industry. P10, employed at a very small organisation, therefore commented that "this for me is not an industrial experience".

In both industry (e.g. P6, P7, P10) and academia (e.g., P2), connections to other IndPhD students were mentioned as positive; they seemed to foster a sense of belonging and helped participants navigating the dual context. In one case, a participant (P6) was part of initiating a a reorganisation creating a dedicated IndPhD group at the employer, which became the participant's primary community across contexts, even for academic matters. Similarly, P9's main community across contexts was a research group consisting also of another IndPhD and both of their academic and industrial supervisors. P6 explained:

> "I think we have gained a lot from being a group of PhD students where we can talk to each other and help each other… and particularly this feeling of belonging to a group [*Swedish: grupptillhörighet*]" (P6)

Many participants (P1, P3, P5, P6, P9, P10, and P12) also engaged with broader research communities, often accessed through supervisors, conferences, collaborations, or specific other universities (e.g. P7). Similarly, P3 and P5 mentioned a more widespread network in industry. Local social agents—supervisors, managers, and close colleagues—were described as far more influential than the university or employer as whole institutions, though the employing organisation was mentioned more often than the academic institution—unsurprisingly as the employer funded the PhD

Barriers to integration and participation. Several participants described barriers to feeling fully integrated in either industry, academia, or both contexts. Some viewed academia as necessary but peripheral in their PhD journey (P5, P6, P9), while others felt like outsiders (P4, P10, P11). For P10, working remotely created a sense of disconnection, and P10 concluded that "if I was a full time PhD student just being there, it would be more of a group feeling, [while now] I'm just a small part of it". P11 described more explicit exclusion—IndPhD students "never got to join the Christmas parties or the division meetings" and had to "work extra to get hold of key cards" or even finding a free desk to use. For P5, P6 and P9, other communities had come to take the role of academia—a competence centre connected to their topic, a small research group including another IndPhD student and their respective supervisors, and a group of IndPhD students at the employer respectively—creating less of a need for inclusion and a community within academia.

In industry, integration and a sense of community was hindered by limited time spent on non-PhD tasks at the employer (in most cases 20% or less), organisational changes, limited understanding of research among colleagues, and sometimes limited openness to new technology (e.g. P2, P6, and P12). P1 noted that "jumping in on a project on 5%, there's no reason [to do that]". Participants often tried to affect their industrial context and, in some cases (e.g. P2, P6), actively reshaped it to improve alignment and belonging. P2 described requesting a move to a different group where they could contribute more and, afterwards, feeling "a lot more connected now again to my workplace." Finally, while no major issues were reported regarding the funding from the employer, many participants expressed a desire for more support and sustained interest and from their employers—at an organisational an individual level:

> "I would have liked to see more engagement from the employer side… have a more colourful role… then maybe it's also about which individuals are involved… Even though I've been a bit dissatisfied since the beginning with their role, they've faded out more into the background over the years" (P8)

These results highlight how structural and social barriers can shape IndPhD students' sense of belonging. They also suggest that full integration into academic communities may be more accessible to traditional PhD students, and into industrial communities for those who are regular employees, though exceptions exist—such as P12 who felt fully included in supportive communities in both contexts. In addition, it may be easier to find or build supportive communities when there are other brokers between the contexts.

Brokering between industry and academia

According to the participants visualisations and descriptions, seven of them were the only broker between their

employer and university context (P2, P3, P4, P7, P8, P10, and P11). The remaining participants (P1, P5, P6, P9, and P12) mentioned additional brokers or links—such as a competence centre (P5), a collaborative project (P12), and a joint research group (P9)—which contributed to knowledge brokering.

Industrial supervisors with research experience (e.g., P1, P3, P5, P6, P10) were generally perceived as more engaged, regardless of if they acted as brokers. Similarly, participants appreciated when academic supervisors had connections to industry (e.g. P1, P3 and P9). P11 explained:

> "I chose my [academic] supervisors because they had been in practice… before they became academics… I would have completely sick of it and ran out the door and never come back if it had been someone too hardcore academic." (P11)

These findings suggests that other brokering functions or people with cross-context experiences can help reduce friction for IndPhD students, and facilitate the collaboration.

Most participants perceived a cultural or epistemological gap between academia and industry, often linked to differing priorities or time horizons. P5 described the gap as "very, very big" and elaborated that in academia "your higher goal is to develop the science", while companies wonder "How can we get profit from this?". P5 also sided with academia and concluded that it would be "little bit corrupted" if academia focused on profit. Other participants highlighted the complexity of navigating two institutional logics. P10 likened it to being "always between two seats".

However, most participants also mentioned positive aspects of their position, regardless of if they felt included in both contexts or not, especially valuing the dual perspectives, practical relevance and access to data. For instance, P12 appreciated "a more concrete connection to the real world" and getting to see "the actual outcomes" and "the long-term positive effects of what you do".

Although many experienced challenges in relation to brokering, critiqued industry's lack of understanding of research, and pointed out industry as the problem in the collaboration—e.g. P8 stating that "it is in industry there are shortcomings in my project"—most wanted to remain connected to both industry and academia after graduation. Interestingly, they leaned towards industry if forced to choose and wanted to continue acting as brokers if possible. P1 explained wanting to return to industry while ideally keeping "some percentage" in academia "to keep the connection in a clear way". On the other hand, P9 noted that IndPhD students could " feel sort of obliged ethically to stay with [the employer]", but for most participants it seemed like a genuine wish aligned with participants motivation to do the PhD.

Reflecting on the overall experience, participants highlighted both challenges and unique opportunities. P3 argued that "industrial PhD students are the perfect people to understand the connection in the gap", i.e. bridge the gap by contributing to increasing competence and understanding in industry as well as conduct relevant research and "understand why things might be difficult to implement in practice". In other words, compared to doing a traditional PhD, most participants were despite challenges happy with doing an IndPhD and saw the value of IndPhDs, as summarised by P8:

> "It's rather nice for the most part I think, I like it… You get a fantastic exposure to two very different worlds really, and get to see the pros and cons with both… And that you get to see industry as a part of a larger system, innovation and as part of a bigger system of knowledge generation and such. And then that you build a fantastic network… and that I think is a big and good opportunity." (P8)

Discussion

This study explored IndPhD students' perspectives on the social agents involved in their doctoral journey—which communities, groups, and individuals they consider significant (RQ2); the roles these agents play (RQ3); and the expectations IndPhD students perceive that these agents have on the IndPhD student (RQ1). The aim was to add to the understanding of what IndPhD students' brokering role entails in practice and what is needed to support this role, ultimately to ensure that IndPhDs can provide constructive connections between industry and academia. By combining a community of practice lens (Wenger, 1998) with community plots, this study reveals a complex landscape of participation, brokering, and boundary navigation between two rather different contexts.

Regarding RQ1, participants consistently perceived academia as a stable context with clear expectations. In contrast, the industrial context was characterised by variability in expectations, support, and organisational structures, which seems to be typical for this kind of doctorates regardless of national context (Compagnucci and Spigarelli, 2024). For example, while funding of the PhD was secure, many participants encountered ambiguity regarding what industry actually expected from funding the PhD-research, competence development, or something else? This is somewhat in line with Thune's (2010) finding that organisational commitment is a challenge, often resulting in that the collaborations break down over time. While Thune argue that projects without much collaboration can still be successful, the findings relating to RQ2 and 3 in this paper instead suggest that maintained organisational commitment, with clear expectations also from industry, is an enabler for ensuring knowledge brokering actually happens in industrial PhDs.

Regarding RQs 2 and 3, i.e. who was involved and what roles they played, academic supervisors played central roles in shaping students' experiences, while the role and engagement of industrial supervisors varied (see also Roolaht,

2015; Salminen-Karlsson and Wallgren, 2008; Tavares et al., 2020). Academic supervisors were described as guides and mentors, similar to their typical roles in traditional PhDs (e.g. Jacobsen et al., 2025). Note that in this study, only 2 participants had applied to an industrial PhD post with a rather fixed project. For the other 10, 2 had applied to an Industrial PhD position with more open project and the rest had an even larger role in the initiation of the project, in 3 cases even initiating the project themselves. This is in contrast to Thune's (2010) description of the academic supervisor as the person developing relevant industrial PhD projects. Managers also emerged as key figures, with their role in creating barriers or as enablers, complementing Abu'u Sa'a and & Yström's (2024) recent study showing in what ways managers can act as enablers in industrial PhDs. For example, managers' understanding of research and willingness to support visibility and resources was important for IndPhD students' experiences of the industrial context. For both supervisors and managers, experience or ongoing engagement in the other context, for example in industry for academic supervisors, or of collaborations across contexts was clearly appreciated by participants (c.f. Buchholz et al., 2026, on how professors' professional engagement across context is beneficial for knowledge exchange). Furthermore, when other IndPhD student were mentioned, participants spoke about them in an appreciative manner and described them as important in an industrial and/or academic CoP. This suggests that it is beneficial for IndPhD students to have people with experience across contexts and especially IndPhD peers as part of their CoP in industry or academia (similar to traditional PhD students, see Jacobsen et al., 2025): peers who understand what it means to work across contexts and to do an IndPhD, with its benefits and challenges both in connection to the project itself and the social dimensions of the IndPhD journey.

Regarding the study's aim to add to the understanding of IndPhD students' brokering role, the results provide nuanced insights into the brokering role of IndPhD students, adding to previous understanding of what this role entails in practice (e.g. Assbring and Nuur, 2017; Bernhard and Olsson, 2023; Gustavsson et al., 2016; Wallgren, 2007). While some participants perceived themselves as the only link between their academic and industrial contexts, others described additional helpful brokering structures. Most perceived a gap between the two contexts, often describing industry as less familiar with academic research processes and timelines and, interestingly, lacking interest. Despite this, many students actively shaped their research to align with industrial interests, demonstrating agency in their brokering role (c.f. Castelló et al., 2026 on the importance of student's agency and purpose in modern doctoral education) —i.e. acting as boundary subjects rather than objects (Salminen-Karlsson and Wallgren, 2008). This also corroborates Wint's (2026) conclusions in a recent UK study, stating that the industrial PhD students themselves should not be seen as recipients of training but agents shaping the research and learning environment, and ties it together with knowledge brokering and CoPs.

On a similar note, it is also clear how brokering does not happen automatically by just having an IndPhD connected to two contexts (e.g. Wallgren, 2007). Similarly to traditional PhDs (Owens et al., 2020) the broker needs to form relationships and participate in the two contexts, in some sort of CoPs, for meaningful brokering to happen.

Regarding CoPs, the nature of the IndPhD students' participation in academia and industry varied across participants, contexts, and time, with peripheral participation in at least one context being common. It was clear that the industrial and academic organisations were seen as distinct *constellations of practice* (Wenger, 1998), with differing goals, ways of operating, timelines, and epistemologies—somewhat similar to Skakni et al.'s (2022) description of PhD holders perceiving industry and academia as being two entities with different organisational cultures. They were however not perceived as CoPs due to a lack of interaction, learning, and/or a shared interest. This is in line with Wenger's (1998) definition of a need for locality of engagement in CoPs, which large organisations are simply too large, diverse and diffuse to achieve. These findings do not necessarily contradict Thune's (2010) description of mature and often institutionalised collaborations between industry and academia; the findings rather underscore that while there may be collaborations at an organisational level, i.e. a constellations of practice level, collaboration and brokering between CoPs is needed to ensure brokering between CoPs. Furthermore, there were examples of sustained *peripheral participation* over time in both contexts, and in academia also one case where participation did not feel entirely *legitimate* to a participant. However, academia in most cases offered a clear pathway for participation—first *legitimate peripheral participation* as a newcomer and then moving further into a CoP over time with increasing expertise. The academic supervisor(s) and colleagues at the university (including other PhD students) often, but not in all cases, rather clearly constituted an academic CoP.

In industry, on the other hand, there was often a lack of structures and/or shared understanding necessary to support IndPhD students' integration into CoPs. Thus, while their participation in industry, as employees, was formally legitimate, it was sometimes very peripheral or even increasingly peripheral over time. There was also not always possible to identify a clear CoP in industry—for the author and in practice for participants who struggled to find a place for themselves and their research. However, sometimes colleagues, other IndPhD students, industrial supervisors, and/or managers were part of what could be seen as an industrial CoP. Crucially, those who had a clear CoP in industry, or a CoP that bridged industry and academia at least epistemologically, expressed clear appreciation of this group of people. This suggests it is beneficial for IndPhD students to

be part of a CoP both in academia and industry, but that inclusion in industry may require more deliberate support.

From a broker perspective, it is interesting to underscore the challenges perceived by IndPhDs, such as lack of a clear industrial CoP, feeling not included in academia, and feeling lonely in their IndPhD journey (see also e.g. Bernhard and Olsson, 2023). The notion of IndPhDs as brokers here presents a paradox in that new IndPhDs *are* newcomers and learners in both of their contexts (c.f. Yang and Jeffrey, 2021) and *are becoming* brokers between industry and academia, but also *becoming* experts in each of the contexts, all at once. While as brokers, according to Wenger (1998), they should stay close to the peripheries, as newcomers they can be theorised as entering through *peripheral* but *legitimate participation*, on their route to move further into the CoPs as they increase their expertise (see also Sala-Bubaré and Castelló, 2017). In this study, the participants who felt that they became more connected to industry over time were mainly those who had actively, on their own initiative, tried to shape their industrial context or their role in it. When lacking an industrial CoP, these participants found or created a CoP to place themselves in—where they could move from the peripheries into a CoP that they deemed to be a constructive environment for them as researchers, learners, employees, and brokers. This paradox of simultaneous *being*, *becoming* and *brokering* may provide an explanation for the mixed results in previous research (Compagnucci and Spigarelli, 2024; Wallgren, 2007) regarding whether IndPhD students and similar professional doctoral students actually act as brokers between industry and academia. Brokering between an academic and an industrial CoP becomes a catch 22 when there is no clear industrial CoP to broker with. Moreover, it is not surprising that academia becomes the most important context during the IndPhD: academia often provides a CoP, clear expectations, and even requirements to fulfil, but all three are missing in industry.

Conclusion

This study contributes to a deeper understanding of the relational and structural dimensions of IndPhDs, highlighting the complexity of navigating dual contexts and the importance of various social agents in shaping IndPhD students' experiences. Through a community of practice (Wenger, 1998) lens, the study reveals how IndPhD students engage with, participate in, and broker between their academic and industrial contexts, adding complexity and depth to the picture painted by previous research. Overall, the findings suggest that IndPhD students should be seen as boundary subjects rather than passive links (Salminen-Karlsson and Wallgren, 2008) and are often very motivated to have brokering role (c.f. Wenger 1998: 109, on people enjoying brokering roles). However, there is a need for stronger support structures, as called for in previous research (Compagnucci and Spigarelli, 2024; Grimm, 2018; Wint, 2026; Yang and Jeffrey, 2021)—particularly in industry—and more intentional efforts to foster meaningful participation and collaboration across industry and academia. Importantly, this study points to the importance of including a brokering perspective in such support and ensuring the IndPhD student becomes a member in CoPs in both industry and academia to facilitate brokering and make the students feel supported rather than lonely in their IndPhD journey. It also showcases the usefulness of a CoP and brokering lens (Wegner, 1998) in examining collaborative doctorates, and of combining this lens with community plots (Sala-Bubaré and Castelló, 2017). Drawing on this lens and method, among other things, enables to problematise what it means to be a newcomer and learner but simultaneously becoming an expert in two contexts (or optimally CoPs) at once. In doing so, this study questions if brokering from the peripheries is a desirable and constructive situation for IndPhD students.

Finally, it is important to point out that despite the problems described, almost all participants wished to remain connected to both contexts after the PhD and retain a brokering role (similar to career outcomes described by Assbring and Nuur, 2017; Casano, 2015). This is in itself promising for IndPhDs as an avenue to educate brokers with skills needed in academia, industry and industry-academia collaborations (Cardoso et al., 2022) and through these brokers increase industry-academia collaboration.

Implications

This study highlights the need for stronger and more deliberate support structures for IndPhD students to improve both their experiences and the collaboration between academia and industry (see also Cervin-Ellqvist, 2026 for more detailed recommendations).

Based on the findings and previous research, my recommendations for universities, employers, and policymakers are to:

- Acknowledge the complexity of the IndPhD role and that IndPhD students are not only PhD students but also boundary subjects navigating two distinct contexts. This dual role requires tailored support and recognition.
- Establish clear structures and expectations among the stakeholders, including a common understanding of the goals, expectations, and responsibilities involved in the IndPhD project, already from the start of the project.
- Support brokering as a skill by providing mentoring, training, and opportunities for peer support to help IndPhD students develop the relational and communicative competencies needed to broker effectively between academia and industry.

Foster inclusive communities of practice and actively work to integrate IndPhD students into both academic and industrial CoPs, addressing barriers related to organisational culture, communication, and epistemological differences—particularly in the industrial context but also in academia ensuring IndPhD students are not less included than traditional PhD students.

Require joint planning and follow-up, extending beyond academic requirements to include the industrial context, the brokering role and the overall situation as experienced by the student.

Limitations and future research

The main limitation of this study perhaps lies in the general issue of studying doctorates in collaboration between industry and academia: there is considerable variation across countries as well as within countries, making generalisations difficult (Compagnucci and Spigarelli, 2024; Jones, 2018). However, the findings of this study provide further pieces of a larger picture of what doing an IndPhD entails, as experienced by the students, and what can be done to further improve such PhDs—and ensure it responds both to the push for collaboration and the push to modernise doctoral education and prepare students for careers in industry (O'Carroll et al., 2012). To address this limitation, future research could replicate the study in other contexts, such as in other disciplines, at smaller and regional universities, and in other national contexts. For example, this study focused on STEM universities, where collaboration between industry and academia is often described as particularly important (Compagnucci and Spigarelli, 2023; Grimm, 2018; Hadgraft and Kolmos, 2020). There are similar doctorates also in other disciplines, such as in medicine and in social sciences (e.g. in educational sciences), where the "industrial" context presumably differ from what is typical in STEM and other dynamics, expectations, and challenges may come into play (see e.g. Compagnucci and Spigarelli, 2023 on differences in outreach to and collaborations with society in social sciences and humanities compared to in STEM). Future research could also further develop the community plots as an instrument to visualise also other stakeholders'—e.g. supervisors and managers—perception of who the social agents involved are and what their roles are, or what their roles should optimally be, complementing this study and previous research from said stakeholders' perspective (e.g. Bernhard and Olsson, 2020). Furthermore, while this study has aspects of longitudinally in asking what has changed over time, longitudinal research collecting data throughout IndPhDs and following up after graduation would be valuable to further understand how IndPhD students' participation in CoPs in their two contexts evolve over time and what career choices they make after graduation (c.f. Sundström et al., 2026). Finally, further exploration of IndPhD students' brokering and how brokering as a skill develops, is supported, and is valued would contribute to a deeper understanding of the boundary-spanning role of IndPhD students and how to best support it.

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Ethical considerations

The study follows the Swedish Research Council's (2024) ethical requirements and guidelines for good research practice. According to these official guidelines and Swedish legislation, no ethics approval is required for this type of study. Participants provided written informed consent for participation in the study, including the data collection and publications.

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Data Availability Statement

Due to privacy concerns, access to the interview transcripts supporting this study is restricted. Anonymised versions of all participants' community plots are included in Appendix C.

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Appendix

Appendix A

Further participant characteristics can be found in Table A1.

Table A1. Participant characteristics.

Characteristic	Number of participants
Previous experience	
Straight from master's degree to PhD	4
Industry experience between master's degree and PhD	8
Gender	
Men	8
Women	4
Employer	
Large company (>250 employees)	6
Small or midsized company (<250 employees)	2
Governmental agency	2
Interview language	
Swedish	8
English	4
Initiation of PhD	
PhD student's initiative based on question relevant to organisation	3
Application to IndPhD position (or position with such possibility)	4
Offered IndPhD opportunity by employer (often after having expressed research interest)	5
Stage of the PhD at the time of the interview	
About 50% remaining	3
20-30% remaining	4
Close to completion	2
Finished	3
Division of time (percentage PhD/percentage at employer or duties at the university)	
100/0 (in practice, as reported by participants)	3
80/20, with up to 10% teaching at the university	6
50/50	2
Other setup (PhD during spare time)	1

Appendix B

The interviews were conducted in either Swedish or English based on participants' preferences. The English version of the interview guide is included below.

Interview guide

Introduction. This project aims to increase knowledge about industrial PhD students communication of research, but also about the PhD students experiences of being industrial PhD students in a broader sense. The idea is that this can be used

to improve doctoral education for industrial PhD students (if needed).

First, I've prepared some questions regarding how come you decided to become an industrial PhD student, your project, and expectations on your project from different stakeholders.

Then I have some questions regarding the people who are involved in your project and PhD-ing in one way or the other, and in connection to this part of the interview I'll ask you to do a "communities plot" exercise, to help you describe your network.

Thereafter we'll move on to questions more specifically about your communication of research, followed by a few questions regarding potential challenges and opportunities with being an industrial PhD student. Finally, we will talk about your thoughts regarding the time after your PhD, i.e., the future.

(1) Do you have any questions before we get started?
(2) Is it okay if I record?

Part 1: About becoming an industrial PhD student and the PhD project

(1) How come you became an industrial PhD student?
(2) Describe your project in short
    (a) How did you choose your topic? Was the project/topic your idea, or did you apply to an existing project with an already decided topic?
    (b) Are you a part of a larger project or is your project a stand alone project?
    (c) What are you up to now and how is it going?
    (d) What expectations are there regarding research outputs? What do different stakeholders expect from your project? How is the interest for your project from different stakeholders?
(3) Is there anything you would like to add to this part?

Part 2: Your network and the "communities plot". Now I'd like to ask you to make an illustration of which groups, communities, and individuals have been important to you in your PhDing, not just focusing on communication of research but on all parts of your PhDing.

Show two example of illustrations.

Give the interviewee 10 circles in different sizes to use, with the following instructions:

Each circle represents a group/community/individual that is important to you in your PhDing. The size of the circle represents the size of the group/community. Use as many or few circles as you need to illustrate the relationships between these groups/communities/individuals and your relationship to them. Name the groups/communities/individuals (use words that describe their role rather than names, e.g. the university rather than Chalmers) which each circle represents.

(This exercise is adapted from Sala-Bubaré and Castello, 2017, p.5, with additional help from background material to Solli and Muir, 2021)

(1) When you look at your communities plot, which circle do you think is the most important for your PhDing? How and why?
(2) Has your role in relation to these groups changed over time? Why do you think it has changed?
(3) Would the plot have looked different in the beginning of your time as a PhD student? Has it changed with time during your time as a PhD student? Was there for example any group that was important in the beginning but has become less important later, or the opposite?
(4) In the exercise we have looked at groups, communities and individuals. Are there any individuals you would like to highlight as especially important in your PhDing? How are they important?
    (a) What about supervisors and your manager, what roles do they have?
    (b) If you need to discuss something, who do you turn to?
(5) Is there anything you would like to add to this part?

Part 3: Communicating research

(1) In the questionnaire, you replied that you communicate to the following audiences___, in the following genres___. Could you describe the communication in these genres?
    (a) Do you communicate different parts of your research to different audiences?
    (b) What communication do you find the easier and the most difficult? Why?
(2) Could you describe how it works when you communicate to different audiences, i.e. your process and how you adapt to different audiences? For example:
    (a) What do you think about when you plan/start/prepare for writing an article or report, give a presentation, or communicate your research in other ways?
    (b) If you receive/ask for feedback, when do you do that and from whom?
    (c) Do you evaluate your communication somehow? How?
    (d) How is your research/communication received by your different audiences?
(3) How, where and when have you learned to communicate your research?
    (a) Is there someone/something who has had a major influence on your learning process, positively or negatively?
    (b) How do you think it has worked to learn to communicate the way you have learned?
    (c) If you look back on your development so far, is there something you wish you had done differently?
    (d) What opportunities or challenges do you see with being an industrial PhD student when it

comes to communicating research and learning this? E.g. if you think something is difficult or if you think you learn something in particular precisely by being an industrial PhD student?

(4) Is there any help, support, or similar you that could have helped you to become even better at communicating your research?

(5) Is there anything you would like to add to this part?

Part 4: Final part about challenges, opportunities and the future

(1) Do you see any particular challenges and/or opportunities with being an industrial PhD student, in a broader perspective than only regarding communication of research?

(2) In the questionnaire, some participants wrote about a "gap" between industry and academia; that the two worlds do not always understand each other's focus or what's important to the other. Is this in line with your experience, or what do you think about it?

(3) Is there anything you think that industry or academia could do to make it easier for you as an industrial PhD student, or that would result in you or them getting more out of your time as a PhD student?

(4) Looking ahead, do you see yourself in industry or academia? Why?

(a) Have your thoughts about this changed during you time as a PhD student? How? Why?

Is there anything else you would like to add that I have not asked about, or something you would like to clarify?

Appendix C

This appendix includes the community plots (c.f. Sala-Bubaré and Castelló, 2017) for all 12 participants. Note that while interesting in themselves, they cannot be interpreted on their own, without participants explanations and elaborations. For example, what an overlap mean varies from being an actual overlap between contexts in practice to a participant running out of space to explain their network visually. An explanation of the different parts of the plots is shown in Figure C1, and the plots for participants in Figures C2(a)–(l).

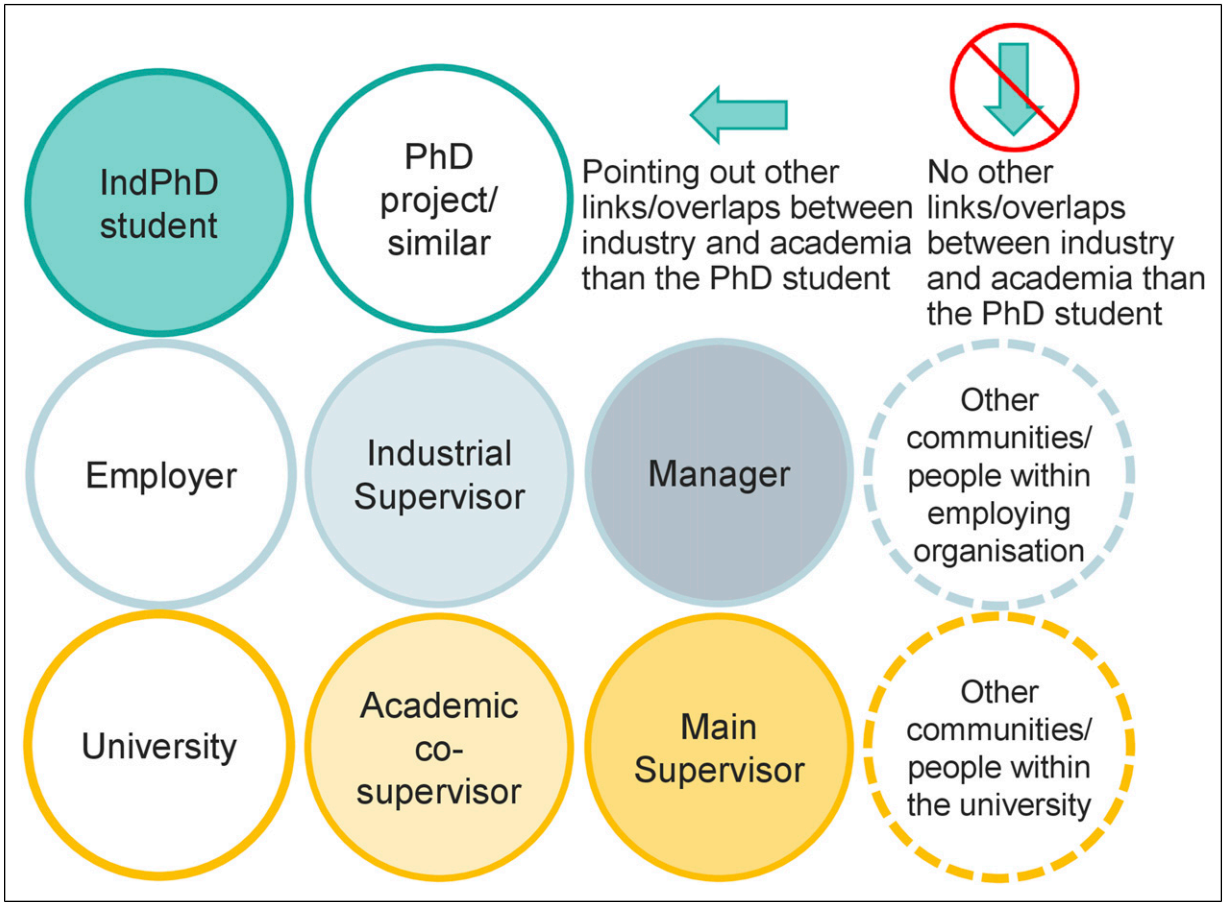

Figure C1. Explanation of the different parts of the community plots. The markers for additional overlaps between industry and academia have been added by the researcher based on the participants' oral explanations.

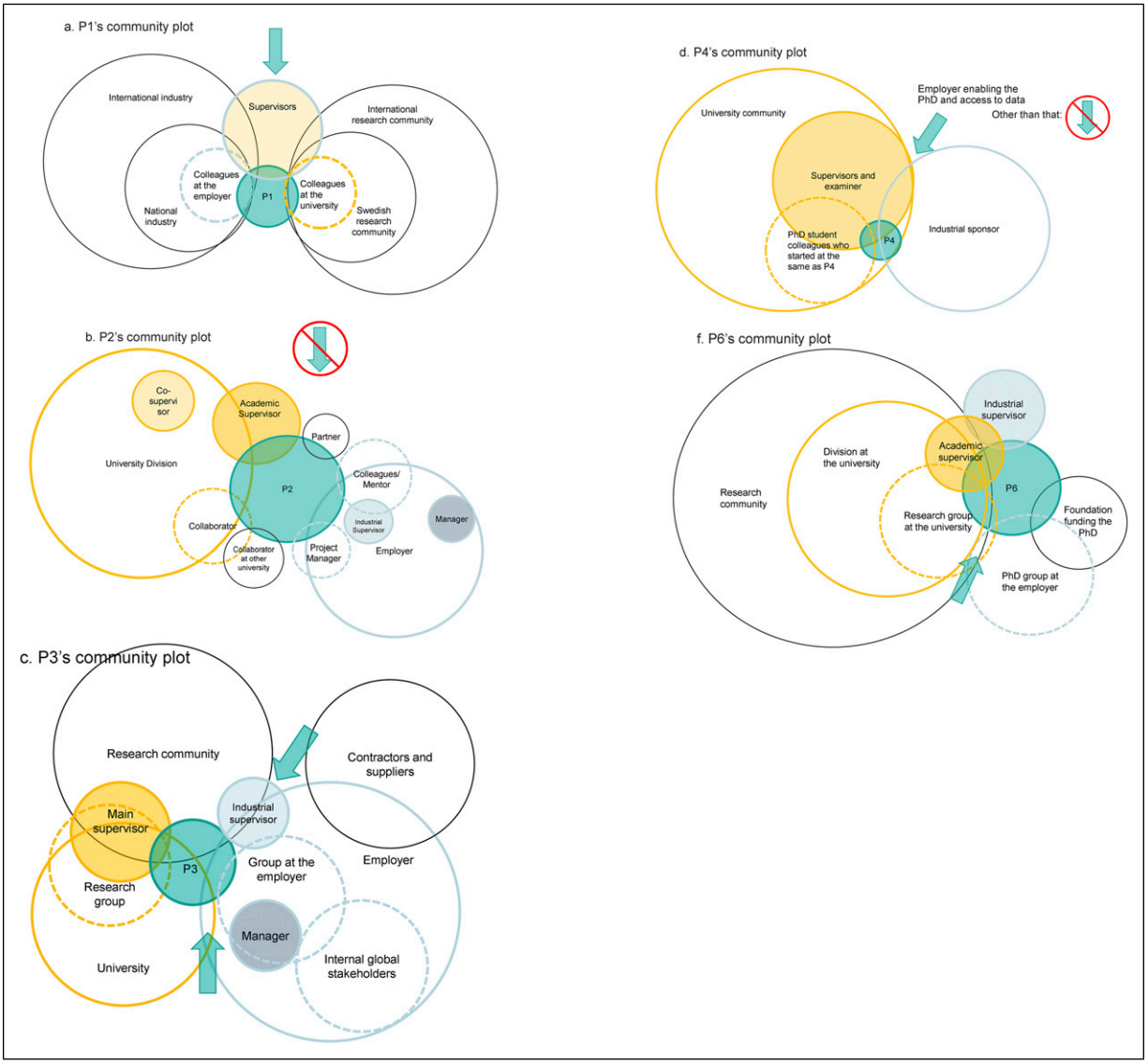

Figure C2. (a)–(l) All participants' community plots.

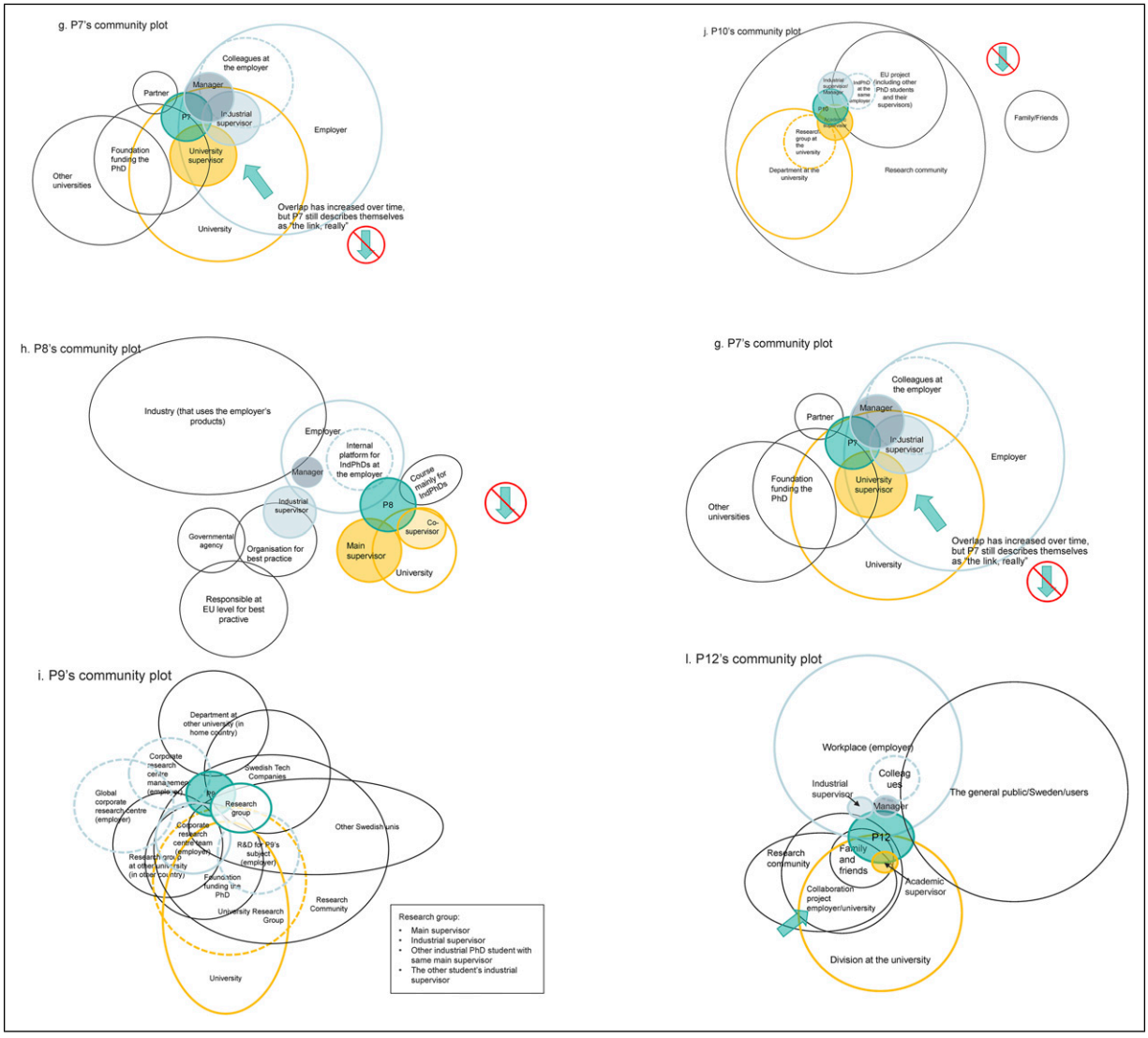

Figure C2. Continued.