The co-production of value in digital, university–industry R&D collaborative projects

Abstract

In the context of R&D collaborations between universities and industry, this study investigates the co-production process and the contextual elements that shape it. We develop a conceptual framework that builds on the service-dominant logic perspective that value propositions emerge from the interaction between co-producing parties and the integration of resources. Specifically, the framework explicates how individual, organizational, and external factors shape the type of interactions and the platforms used, the availability and use of operand and operant resources, and the organizational and individual outcomes sought in R&D collaborative projects. We investigate the interplay among these factors through group interviews with UK industry practitioners and university researchers in the context of digital research projects. The types of interaction, resources, and outcomes sought that characterize successful R&D collaboration are revealed, and the contextual aspects that enable, facilitate, block, or create barriers to successful R&D collaborations are identified. Finally, we propose five practical principles for the successful development of collaborative R&D projects within the university–industry context.

Highlights

- Co-production demands right attitude, social skills, and complementary expertise
- Early wins, regular meetings, and form of IP protection aids trust development

- Discrepancies in modes of operation hinder co-production
- Information needs to be shared in ways that are accessible and relevant to others
- Third-parties can identify projects that gain from collaboration, and link partners

Keywords: Value co-creation, Value proposition co-production, University–industry collaboration, Knowledge exchange, Digital research, R&D collaboration

1. Introduction

The concept of service-dominant logic (SDL) emphasizes the customer's role in co-creating value with the supplier during exchange, rather than as a passive recipient of value at the end of a transaction (Vargo, Maglio, & Akaka, 2008). Value is therefore created through active interactions between the firm and the consumer (Vargo & Lusch, 2008) or, in business-to-business markets, from the integration of resources between two firms to create a valued outcome (Gronroos, 2007).

In this paper, the distinction between value co-creation and value co-production is important. Co-creation occurs when the customer takes the firm's value proposition and integrates it with his or her own resources to generate something, the value of which is subjectively determined by the beneficiary (Vargo & Lusch, 2008). Conversely, co-production involves the purposeful integration of operand and operant resources from the firm and the customer, to develop a value proposition, which can range from the co-conception of goods and service to their co-disposal (Sheth & Uslay, 2007). The distinction between co-creation and co-production is dismissed as unnecessary and unhelpful by authors such as Payne, Storbacka, and Frow (2008), who prefer to use the two terms interchangeably. However, other scholars, such as Etgar (2008), Jacob and Rettinger (2011) and Vargo and Lusch (2008), argue that the distinction is important for the conceptual development of the field. This paper follows the tradition that distinguishes co-creation from co-production, focusing on the latter to center attention on the process of development of the core value proposition.

Co-production takes place in a variety of business-to-consumer and business-to-business exchanges and non-commercial settings (e.g., Alves, 2013; Diaz-Mendez & Gummesson, 2012). It is also present in the form of collaborative R&D initiatives between universities and industry, which are the focus of this paper. Idea generation and creativity are both fundamental to R&D, with the latter being particularly emphasized as an antecedent of innovation (Bozeman, Fay, & Slade, 2013). Both idea generation and creativity are enhanced through interpersonal communication that can be developed within a workplace environment (West, 2002).

This paper makes both theoretical and applied contributions. Theoretically, we develop a conceptual understanding of value co-production by building on the SDL notion of value as an interactive, multi-actor exchange process. We unpack how the social features (e.g., norms, organizational culture), material characteristics (e.g., support, incentive systems), and the attributes of individuals engaged in the co-production of value propositions support or hinder the process. In doing so, we complement and advance conceptual work of Akaka, Vargo, and Lusch (2013), Chandler and Vargo (2011), and others on the interplay between the context and process of value proposition co-production. The applied contribution we make is through the provision of qualitative, empirical evidence that is absent from these earlier articles (Perkmann et al., 2013), which sheds light on the management of R&D collaborations in practice.

This paper addresses the following research question: How do the various contextual layers shape the co-production of value propositions in university–industry R&D collaboration,

in the digital arena? We begin with an outline of the specific context of the study. Then, we draw from literature on the process and role of context in value proposition co-production and on R&D collaboration, which we use as the basis for a research framework for understanding co-production in R&D projects. Next, we discuss the empirical data collection and present our findings, in which we draw from the verbalized experiences of practitioners and academics. Finally, we outline the theoretical implications and present five practical principles for the development of university–industry R&D projects.

2. Context

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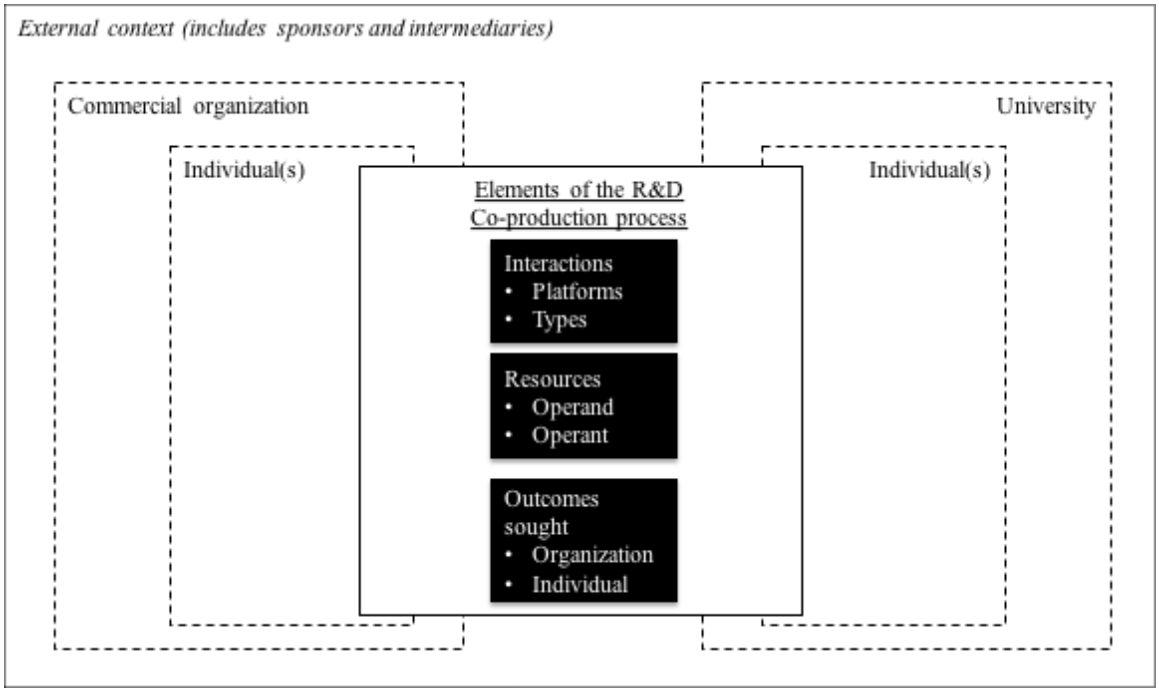
To advance the conceptual development of this field and its relevance for managerial practice (Chang, Chih, Chew, & Pisarski, 2013), we focus on the specific case of R&D projects in the digital arena. Digital research is an area of interest and importance for both industry and university environments (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013). The interdisciplinary nature of research in the field offers multiple streams of

inquiry, from computer science and sociology to marketing and information systems, to benefit from distributed innovation (Yoo, Boland, Lyytinen, & Majchrzak, 2012) and inter-organizational partnerships (Bharadwaj et al., 2013) that transcend established subject or functional silos. Furthermore, while it is clear that universities can transfer knowledge that supports innovation to industry (Pertuzé, Calder, Greitzer, & Lucas, 2010), in the case of digital research, the reverse is also the case; for example, industry has developed new techniques and protocols to collect, manage, analyze, and distribute digital data (Ruppert, Law, & Savage, 2013). This represents a significant departure from the traditional discourse on university–industry R&D collaboration, which tends to describe universities as providers of knowledge and technology and industry as providers of funding, materials, or data (Bozeman et al., 2013; Perkmann et al., 2013).

3. Theoretical background

The starting point for our conceptual framework is the SDL emphasis on process (Vargo & Lusch, 2004). This focus draws attention to the integration of key resources through a series of interactions, to define and deliver a mutually valued outcome (Perks, Gruber, & Edvardsson, 2012; Prahalad & Ramaswamy, 2004). This integration can occur at various levels, each of which frames the derivation and evaluation of value (Akaka et al., 2013): from dyadic interactions between individual actors at one extreme to complex service networks at the other. The sub-sections that follow explore how these contextual layers influence the interactions, resources, and expected outcomes that constitute the co-production of value in R&D collaborative projects. Fig. 1 depicts the conceptual framework we use to shape our study.

Fig. 1. Framework of co-production in university–industry R&D collaboration.



3.1 The constituent elements of the co-production process

The SDL literature suggests that value emerges from the interaction between co-producing parties through purposeful, continued encounters that take place over time (Gronroos, 2011). Engagement platforms play an important role in facilitating this interaction (Ramaswamy & Gouillart, 2010); for example, organizations increasingly use online communities and other web-enabled spaces as platforms to connect with different stakeholders (Ngugi, Johnsen, & Erdelyi, 2010; Vernette & Hamdi-Kidar, 2013). In instances in which online collaboration generates frustration, particularly when there is no sense of community or participants are perceived to be unfairly treated (Gebauer, Füller, & Pezzei, 2013), face-to-face contact can be more conducive to dialogue and intensive interaction (Crowther & Donlan, 2011). Payne et al. (2008) conceptualize the interactions

between parties as a series of touch points that cumulatively produce value propositions and involve various departments at different stages of the relationship. Although these authors base their findings on business-to-consumer interactions, their views about how value propositions are generated are also relevant to co-production between organizations. Lambert and Enz (2012) refer to the need to implement cross-functional business processes that facilitate the sharing of information, encourage engagement, enable progress monitoring, and measure project success. Similarly, Perks et al. (2012) note the existence of multiple, micro-level patterns of behaviors, each producing incremental progress that eventually leads to a significant outcome, and Lempinen and Rajala (2014) explain that it is necessary to clarify roles in the process and understand how these alter over time.

Perkmann et al.'s (2013) review of university–industry relationships identifies a broad range of R&D collaboration formats, ranging from simple, ad-hoc exchanges of advice to formal, ongoing interactions formalized through contracts. In some cases, such as science and technology parks, the collaborating parties co-locate geographically, to facilitate communications, the sharing of service, and networking opportunities (Corsaro, Ramos, Henneberg, & Naude, 2012). A common factor that underpins these different formats is that they all aim to produce knowledge (Bozeman et al., 2013). Cross-disciplinary collaboration (Bharadwaj et al., 2013), which can add complexity to the interactions (Corsaro et al., 2012), is also a common theme.

Resources are a central tenet of SDL. They are integral to the production of value propositions and essential for creating competitive advantage (Vargo & Lusch, 2004).

These resources are classified into two types: operand and operant (Madhavaram & Hunt, 2008). Operand resources are typically tangible and static (Edvardsson, Tronvoll, & Gruber, 2011) and require their use to generate value (Vargo & Lusch, 2011). Examples include raw materials or physical products over which the collaborating parties "have allocative capabilities" (Arnould, Price, & Malshe, 2006). In contrast, operant resources are processional and dynamic (Edvardsson et al., 2011) and are able to act on operand resources as well as on other operant resources (Arnould et al., 2006). They include organizational competencies, capabilities and routines, the skills and knowledge of individual employees, and relationships with key stakeholders (Edvardsson et al., 2011). In R&D collaboration, human capital is a key resource (Bozeman et al., 2013). Although the exchange of data and materials is a necessary requirement for innovation projects (Perkmann et al., 2013) and funding must be in place for such an exchange to happen, a distinguishing feature of these R&D collaborations is that all parties provide some form of knowledge (Bozeman et al., 2013). This reflects the centrality of creative ideas to all innovation activity (Janssen, Vliert, & West, 2004).

Consequently, the human capital required for R&D collaborations needs to have particular characteristics. Collaborating partners need to bring knowledge that is new and complementary to the organization (Chesbrough, 2003). The scope of the knowledge base is also crucial, with some evidence indicating that initiatives based on narrow knowledge bases are the most likely to succeed (Un, Cuervo-Cazurra, & Asakawa, 2010). Individuals with several skills who are able to play multiple roles are particularly desirable (Rese,

Gemunden, & Baier, 2013), as are those with strong social and communication skills (Diaz-Mendez & Gummesson, 2012).

The final constituent in the successful co-production of value propositions relies on both parties benefiting from the collaboration and having their expectations met (Pinnington & Scanlon, 2009). Economic and financial gains, such as price reductions or savings in production costs, are among the prime benefits that organizations seek (Ulaga, 2003). Functional benefits, such as product features that delight customers (Mattsson, 2010), or reductions in the time and effort required to acquire the product (Saarijarvi, 2012) are also sought. The individuals engaged in the co-production process of the value propositions may also seek economic and functional benefits in their own right, such as improving their personal knowledge of the market or strengthening their capacity to solve problems (Ulaga, 2003). In addition, individuals may pursue emotional benefits, such as feeling empowered by being actively involved in the construction of value (Verhoef et al., 2009), and symbolic benefits, such as being able to express themselves through their engagement in the co-creation process (Rintamäki, Kuusela, & Mitronen, 2007).

Several benefits from R&D collaborations may also come from the institutional level. For industry, the primary benefit sought is access to leading-edge (rather than applied) research (Lambert & Enz, 2012). Universities are under two pressures: a growing need to demonstrate the impact of academic research and a financial imperative to identify alternative funding sources (Du et al., 2014; Edmondson et al., 2012). Yet research evidence of the motivations and working methods of individuals engaged in R&D

collaborations is limited (Walshe & Davies, 2013). The only work we could identify suggests that some individuals may feel "positively charged [by] ideals of creating 'an exciting future'" and by engaging in activities they believe support this future (Lawrence, Suddaby, & Leca, 2011, p. 30).

3.2 The contextual aspects of co-production of value propositions

The interactions, resources, and potential outcomes that make up the co-production of value propositions are likely to vary according to the context in which co-production takes place (Edvardsson et al., 2011). The conceptualization of value as subjectively determined and produced (i.e., value in context rather than value in use) draws attention to the context in which the co-producing partners interact (Vargo & Lusch, 2011). Drawing on Chandler and Vargo (2011), we consider context in terms of a set of actors and the unique reciprocal links between them, such that different sub-sets of actors and their connections constitute different contexts. These contexts range from the single actor level to dyads, triads, complex networks, and service ecosystems (Akaka et al., 2013; Corsaro et al., 2012). With regard to R&D collaboration, Bozeman et al. (2013) identify three layers, each of which we consider in turn and integrate into our research framework: individual collaborators (the individual level), the organizational home of the collaborators (the organization level), and the policy and market context that surrounds them (the external level).

First, by virtue of their positions and roles in the project (Edvardsson et al., 2011), individual collaborators act as "resource integrators" (Vargo & Lusch, 2008). Individual participation in R&D collaborations often results from previous personal contacts or

interactions between the parties (Edvardsson et al., 2011). The likelihood of participation and future collaborative behavior are both influenced by the individual's previous experience with such projects (D'Este & Patel, 2007). In addition to their specific project role, individual collaborators act as boundary spanners among the project, the organization that hosts or employs them, and the wider context, such as the industry or academic discipline to which they belong (Corsaro et al., 2012). Evidence suggests that the behaviors and expectations of these individuals are shaped by their organizational home, by virtue of social norms and organizational values (Edvardsson et al., 2011). The nature of organizational support and the available incentive systems can also influence R&D collaborations between university and industry (Perkmann et al., 2013). Sometimes the impact of these factors is negative. For example, Audretsch et al. (2002) find instances in which university administration was committed to R&D partnerships with industry, but bureaucracy sabotaged those goals.

Second, in cases in which the different organizational homes have congruent values and norms, collaboration is less likely to be successful (Akaka et al., 2013; Solomon, Surprenant, Czepiel, & Gutman, 1985). At face value, this argument lends support to co-production between academic and industry institutions, the social contexts for which are largely incongruent. However, the conflicting pressures, which are a consequence of these differences, such as whether relevant resources can readily be accessed (Un et al., 2010) or the results of an R&D project can be published (David, 2004), can create barriers to progress. Because universities traditionally have a broad knowledge base (Henard & McFadyen, 2006), they are able to act as knowledge brokers between firms in different

industries. Furthermore, in their role as educators, they have established mechanisms to transmit and facilitate access to that knowledge base (Agrawal & Henderson, 2002). In contrast, industry players often have a narrow knowledge base that is limited to their own markets (Du et al., 2014), and their mind-sets may resist giving others access to their resources (Un et al., 2010). Although evidence indicates that the most successful collaboration projects are those that adopt a relatively loose and informal management style (Kitchener, 2002), achieving this informality of approach is not necessarily straightforward. For example, a lack of stability and autonomy on the university side can hinder collaboration with industry (Un et al., 2010), and clashes between academic and managerial logic can undermine the success of collaboration attempts (Edmondson et al., 2012).

The third and final contextual layer is the ecosystem in which these organizations and actors are embedded (Akaka et al., 2013) and to which they are connected by value propositions (Vargo et al., 2008). This ecosystem influences R&D collaborations in several ways. For example, national policies and the allocation of funding shape the collaborations that take place (Perkmann et al., 2013); national attitudes to innovation can indirectly influence the level and rate of innovation (Janssen et al., 2004); and societal values, such as those related to climate change or the importance of quality, help determine how innovation is focused or collaboration partners selected (Ngugi et al., 2010). The ecosystem also includes project sponsors, which can impose organizational forms or incentive systems that directly influence the effort invested in a project (Raasch & Hippel, 2013), and

intermediaries, who can facilitate communication and interaction between the partners (Bansal et al., 2012).

4. Research design

Because the co-production of value propositions is manifested through interactions between actors, our empirical investigation adopted a social-constructionist approach. Social constructionism, which focuses on understanding the social processes by which phenomena assume their form (Denzin & Lincoln, 2012), is a suitable lens for examining business problems (Peters, Pressey, Vanharanta, & Johnston, 2013) and for studying co-production in particular (Corsaro et al., 2012; Edvardsson et al., 2011). Such an approach is necessary to provide the in-depth insights missing from other studies examining co-production between universities and industry (e.g., Du et al., 2014; Un et al., 2010). In line with Lambert and Enz (2012), we focused on the individuals who engage in collaborative initiatives, rather than the organizational level. Moreover, following Huikkola et al. (2013), our investigation included both sides of the R&D relationship—namely, research participants from both industry and universities.

Echoing previous research in small business (Yoo et al., 2012) and knowledge transfer (Paraskevas & Saunders, 2012), our sampling approach used diverse but expert participants. We build on the findings of Perkmann et al. (2013), who suggest that disciplinary affiliation strongly influences academics' engagement with industry partners. Participants were drawn from a heterogeneous group of UK professionals, encompassing academics from established and new universities, computer scientists, owners of small and

medium-sized businesses, senior-level managers from large firms, managers from public sector organizations, and managers of technology transfer and business development functions within universities. To ensure their suitability, all participants had R&D experience within the field of digital research. Accessing a spread of experiences in R&D collaborations enabled us to achieve a rich and holistic picture of the co-production of value propositions in university–industry relationships.

We collected data through group interviews, a recommended approach for studying interactions between research participants (Frey & Fontana, 1991) using the social constructivist perspective. In accordance with guidance from Barbour (2007), 36 individuals were interviewed in six groups, each of which comprised roughly equal numbers of industry and university participants. Using mixed groups minimizes the chances that participants might be working with hidden assumptions (Rose, Spinks, & Canhoto, 2014), thus making the implicit explicit. Group discussion also encourages a level of interaction and emergent discussion that is valuable for subsequent social constructionist-based analysis (Potter, 1996). The group interviews focused on participants' experiences of successful R&D collaboration in digital research. The interviews proceeded with an exploration of three topics. First, participants were asked to identify the outcomes that they sought from collaboration. The second stage involved a discussion of the types of interactions that best support R&D collaboration, including the form, frequency, and role of technology. Third, the operant and operand resources required for successful R&D collaboration were explored. Each group interview followed the systematic process that Esin, Fathi, and Squire (2015, chapter 14) endorse for surfacing the

contextual elements in the process. Whenever a participant referred to the impact of factors such as organizational rules or ways of working, the group moderator directly questioned other participants about whether they had similar experiences.

The interviews were filmed, and contemporaneous notes were recorded in notebooks and on flipcharts, enabling participants to confirm that their contributions had been understood (Mero-Jaffe, 2011). The video recordings were transcribed and anonymized, to protect the privacy of the participants and the strategic interests of their organizations. We analyzed the interview notes, transcripts, and flipcharts using thematic analysis (Bryman, 2012; Denzin & Lincoln, 2012). Two researchers separately coded the transcripts, while a third sampled the combined coding to check consistency and saturation of pattern matching and to ensure internal validity (Boyatziz, 1998; Fereday & Muir-Cochrane, 2008). The coding process followed Krippendorff's (2004) systematic approach. Following initial classification according to participant type, two stages of data categorization followed: (1) we interrogated the data inductively to identify emerging themes, and (2) we classified the data into the component elements of the co-creation process—namely, "interaction," "resources," and "outcome sought"—according to the contextual level—namely, "individual," "organization," and "external" (see Table 1).

Table 1
Example of coding process of the group interview extracts

Inputs	**Type of participant**	**Stage 1**	**Stage 2: Process components**	**Stage 2: Context levels**
Verbatim quotes	*Labels:* • *Academic* • *Practitioner*	*Inductive labels*	*Labels:* • *Interaction* • *Resources*	*Labels:* • *Individual* • *Organization*

			• *Outcome sought*	• *External*
"There should be an allowance or an expectation of the unexpected (the counter-intuitive). Because if you give people space to think, people will come out with all sorts of ideas." (Participant 13)	Academic	Time to think; Space to think; Acceptance; Creativity; Employer;	Resources	Organization

During the next stage, we noted the patterns and repetitions in the data and, following the process outlined in Miles and Huberman (1994), distilled these into emergent categories. We followed all three elements of Potter's (1996) criteria for social constructionist analysis: the emergent categories must be credible and internally valid, the information should be corroborated by other participants, and active voice should be encouraged.

5. Results

We describe the key findings from the interviews in the following sub-sections and provide a summary in Table 2.

5.1 Key aspects of interactions, and the context that shapes them

The participants considered building momentum critical to the successful collaboration between universities and industry. Interviewees achieved this momentum by moving quickly beyond generic ideas to determining specific goals, identifying needs, and agreeing to the critical points in the project. However, this pragmatism needed to be balanced with

a working environment that allowed new ideas to be fully considered, including those that might challenge conventional practice. For example:

> *There is a big, big, big gap between having the ideas and actively developing a research project…. We need to identify practical, doable, achievable research projects. It has to be brought down to specifics…. Identifying the specifics of each project is a must.* (Participant 26, Academic)

> *When you get these people together, they will have lots of ideas. Some of them [are] crackpot. Some of them will go nowhere. Probably the majority will go nowhere. But there might be an idea that looks crackpot and but actually turns into the next big thing. You need to think about how you allow that to happen without dismissing things at such an early stage [so] that they do not get developed.* (Participant 13, Academic)

A favored approach for balancing the need for pragmatism and innovative thinking was to encourage creativity within well-specified boundaries. For example:

> *You need to keep the big problem in the background, then the specific problems are like models of the bigger picture. Our outputs are these very specific things that help with the big problem.* (Participant 7, Academic)

Trust was another key factor. As trust could not be imposed externally, partners needed to have time to get to know each other, for the relationship to develop and to find the best way of working together. Interviewees commented that it was advantageous to meet regularly, to exchange information, or work together on specific aspects of the project. Views on the extent to which technology could facilitate such contact also differed. Some participants believed that communication via broadband and web conferencing supported joint working between individuals, while others were more skeptical about the benefits of online communication:

> *Trust is fundamental to the way we work … but we can work remotely and do not need to meet in person for trust to develop. We can use technology. That is the nature of trust in the digital environment*. (Participant 4, Practitioner)

> *Developing trust is essential for us. But what is the best way to do that? Do we need to meet face to face? Yes. And this [cost is accounted for] in the project.* (Participant 1, Practitioner)

> *Some people think that broadband connectivity is a necessity to be able to work together. But you can do it without connectivity and without the technology that is now emerging. People have always innovated and done great things without broadband.* (Participant 29, Practitioner)

Interviewees also mentioned the importance for partners to develop simple mechanisms and processes that improved communication and allowed rapid information exchange. This process included establishing clear roles in the teams and investing time early on to understand each other's terminology. All participants had experienced projects in which a misunderstanding of the expectations or interests of partners had hindered progress. For example:

> *We sometimes think that we are talking about the same thing and we are not. At [a previous initiative], we didn't get beyond the language and the meaning of terms, which you have to if you are going to have real collaboration.* (Participant 8, Academic)

Project success requires that individuals have a shared purpose, understand each other's motivations, and believe in each other's commitment and abilities. In addition, participants deemed working together on small projects before embarking on larger initiatives crucial for developing trust:

> *There are stages in this. Maybe start with requirement to produce something and realize that people are reliable and deliver and are interested. Small projects are the way to get going.* (Participant 2, Practitioner)

Individuals needed to approach collaboration with a long-term view. Some projects were unsuccessful, and exploratory meetings did not always lead to a joint project. Even so, the

participants considered such contacts a useful basis for establishing connections and generating future collaboration: “Past successes and failures feed into how you shape and develop and generate new ideas and opportunities” (Participant 13, Academic).

Individual preferences affected how and with whom participants worked. For example, a preference for face-to-face contact meant that some participants favored working with institutions that were geographically local, even if they did not have the highest reputation in the field: “You’ll do business within 2 hours' car drive” (Participant 3, Practitioner).

Project interactions were often shaped by organizational context. The requirement for legal departments to formalize arrangements early in the process could get in the way of developing a relationship. Other legal barriers designed to protect the organization’s intellectual property (IP) created delays and an environment of suspicion that discouraged many researchers from pursuing collaborative initiatives. Both participant types shared a similar frustration, as encapsulated in the following quote: “The biggest barrier to innovation is IP offices!” (Participant 3, Practitioner). Different ways of working could also influence the development of work flows and timescales. For example:

> *Practitioners have this drive to take the idea and run quickly with it, to see if it works. But for academics there is this need for incubation and maturation of the ideas that are put forward*. (Participant 13, Academic)

R&D projects are often sponsored by third parties, which play a defining role. On the one hand, the interviewees regarded institutional bodies such as InnovateUK (formerly the Technology Strategy Board), pan-institutional research initiatives such as those funded by the European Commission, and think-tank organizations as a positive factor in bringing together different types of researchers and institutions. On the other hand, most sponsors require regular progress reports and financial statements, which can be a time-consuming and distracting "administrative nightmare" (Participant 18, Academic).

5.2 Key resources, and the context that shapes them

The participants identified a range of necessary resources. For example, they viewed funding as the basic enabler of R&D projects, though the sources used and the difficulties faced varied. While universities rely mainly on highly competitive external sources, industry participants typically seek internal financial support for collaborative projects, a process that is rarely straightforward.

Successful projects also require a range of different skills, ranging from the ability to contribute good ideas to the need for particular advanced technical skills. Therefore, participants deemed the ability to assemble teams of people with different and complementary skills essential:

> *You need to have the knowledge of where the industry is going and the courage of taking a viewpoint. And we need people able to interpret data, but also people able*

to tell a story about that data. It is really difficult to find people that can – or, indeed, want to – do both. It is almost bipolar skills. (Participant 1, Practitioner)

We don't say, "I can't do that because we haven't got the [technical] skills or the data." In the world we are in now we just say: "Let's go and find a partner." We connect and find the knowledge. (Participant 3, Practitioner)

Partners needed to have a genuine interest in interacting with others and to believe that they would benefit from the partnership. They needed to be enthusiastic about new ways of solving problems and curious about innovation. Being open-minded and willing to learn from the other party were also important, as these participants explained:

It takes a certain type of person. Someone who is going to be open and transparent with you. Someone who has a stake and commitment to deliver. (Participant 3, Practitioner)

I am a bit of a magpie. I like shiny things. Anything that is new, that is interesting. And that I can make money from for my business. (Participant 2, Practitioner)

You don't form a partnership by approaching it from a position of power, but from curiosity. It is not about celebrities. (Participant 6, Academic)

Participants also stressed the need to be realistic about the difficulties of working in a collaborative environment, as different ways of working and varying priorities and expectations could all cause tension:

> *Collaboration is quite hard, even with the person next to you in the office. Collaboration is very difficult across disciplines and across sectors. We need to go in with the assumption that it's a difficult enterprise.* (Participant 8, Academic)

Reflecting on the kind of organizational context that supports R&D, all participants believed that having the necessary space and time to think and develop their ideas was crucial. Some mentioned Google as an example of good practice, in which employees are encouraged to invest 20% of their time pursuing innovative projects. In addition to having sufficient time, participants considered an environment that encourages experimentation and risk taking important:

> *There should be an allowance or an expectation of the unexpected, the counter-intuitive. Because if you give people space to think, people will come out with all sorts of ideas.* (Participant 13, Academic)

Moreover, the process of academic research, which must usually be scheduled around teaching requirements and administrative commitments, was not always compatible with industry timelines. The requirement for numerous institutional approvals compounded

these difficulties, putting academic partners out of step with industry's emphasis on speed and action:

> *One of the main challenges [is] the differences in timescales. For [businesses] it is very fast paced, very fast moving and the decisions are needed yesterday, almost. [We need to] make sure that businesses and academia coincide at the right point so that they can really capitalize on the knowledge*. (Participant 17, Practitioner)

Even the best-intentioned, well-supported, and most determined researchers faced major difficulties in gaining access to or developing a good understanding of each other's work. Academics may ignore high-quality, industry-based research because it lacks quality signals that are deemed equivalent to the academic peer-review system. In turn, academic work tends to be published in journals that may not be freely accessible to managers. Instead of routinely reading academic journals, these managers were more likely to use free resources available on the Internet:

> *It's actually quite difficult. How do we find out, if I am working in this area, that you are working in that area?* (Participant 7, Academic)

> *Businesses head to the Internet to find answers. Academics need to be on Twitter… and blog, and be on SlideShare and write one-page summaries to make research available to businesses.* (Participant 2, Practitioner)

The main way third parties' resources contribute to R&D collaboration is through research funding. Funding in the United Kingdom has traditionally come from research councils, though increasingly, researchers are seeking financial support from commercial partners, which, in its own right, is improving the significance of these collaborations.

5.3 Key outcomes sought, and the context that shapes them

The group interviews identified a range of potential functional and emotional benefits for individuals involved in R&D collaboration, as well as a series of possible financial and functional benefits for their employers. Surprisingly, each party had a poor understanding of what the other would value. The industry participants, for example, believed that universities are motivated by the opportunity to see how industry works, to validate theoretical concepts and source teaching materials. For academics, however, the ability to demonstrate the policy and practical impacts of their research was a primary concern. In recent years, the impact of research on non-academic audiences has emerged in the United Kingdom as a key performance metric for government and the major research funding bodies. Collaboration with industry was considered an effective way to create such impact, allowing academics to identify research priorities and develop their ideas in collaboration with the potential beneficiaries of their work. Including these stakeholders early is particularly beneficial in digital research projects because it enables a simultaneous understanding of the technology, its users, and the social implications that arise. For example:

> *How can you research [these topics] if you don't approach it from multiple disciplines and multiple perspectives? The best research in this area is problem focused, not discipline focused.* (Participant 8, Academic)

The academic participants perceived industry partners as motivated by the desire to gain access to specialist academic expertise. They expressed concerns that in some cases, commercial organizations use the partnerships to gain access to know-how at little or no cost. Yet industry participants claimed that their aims were to obtain some sort of operational advantage that could be translated into additional profit or other tangible measures of success:

> *A commercial organization is going to look at deriving some kind of commercial advantage and profit. It says, "Yes, we have succeeded." And the third sector organizations, too, are saying, "If we derive this outcome, we have succeeded."* (Participant 12, Practitioner)

> *There is this old thinking that academia is a service to businesses.* (Participant 6, Academic)

In terms of the benefits derived by participants in collaborative projects, both parties mentioned the opportunity to obtain a different perspective on a particular problem. All participants believed that it was beneficial to bring academics and practitioners together, because they had different expertise and approached problems in different ways. While the

academics noted that they benefited from the practical insights that practitioners could offer, the industry participants valued the broad knowledge base of the academics and appreciated their ability to approach questions in an abstract way:

> *In universities, you are focused on research problems. You do not have non-research objectives. The business partner brings that.* (Participant 7, Academic)

> *We don't know what we don't know and that's where it is useful to have partnerships with universities because they think laterally and not about solving specific problems.* (Participant 3, Practitioner)

Both sets of participants had experienced frustration in bringing new ideas to fruition within their own workplace settings. For academics, the time pressures imposed by teaching and committee work sometimes hindered their ability to achieve project goals, while practitioners could find research ideas thwarted if they were deemed to threaten an existing revenue stream or did not offer immediate competitive advantage. An additional complication was that external sponsors placed demands of their own on projects, perhaps driven by a focus on particular functional outcomes. For example:

> *The funding drives the topics because the sponsor wants something specific. Often, it is focused on the technology or the economic aspects, whereas the big problems are broader than that.* (Participant 14, Practitioner)

Table 2
Results from group interviews: key process and context factors in R&D collaboration

		ELEMENTS		
		Interaction	**Resources**	**Outcome sought**
		Build momentum, by identifying specific goals, needs, and critical points; Trust cannot be imposed externally, and partners need time to develop it; Create work flows that improve communication and information exchange.	Funding as the basic enabler of collaboration; Range of technical, creative, and communication skills is necessary; Participants need to have positive attitudes toward collaboration.	Individuals may derive functional and emotional benefits; Organizations may derive financial and functional benefits. Poor understanding exists of what the other party values.
CONTEXT	**Individual**	Shared purpose and understanding among team members; Regular (face-to-face) interaction; Experience of working together in small projects before embarking on larger ones; Consider the long-term potential of collaborative initiatives; Individual preferences affect partnerships and approaches to collaboration.	Need to assemble teams with complementary skills; Need to be enthusiastic about new ways of solving problems and about innovation; Participants need to be open-minded; Need for realistic expectations about challenges of working together.	Individuals value different perspective of partners; Individuals seek partners who can offer complementary approaches to research.
	Organization	Legal departments can create delays and barriers; Practitioners and academics have very different ways of working.	Offer space and time to think and develop new ideas; Environment that supports experimentation and risk taking; Acknowledge impact on project of other ongoing activities in the organization; Academics and practitioners work against very different timescales; Difficulties in learning about and gaining access to each other's work.	Conflicting demands on researcher's time hinders progress; Project's goal may sometimes clash with other organizational goals.
	External	Third parties can assist with the development of networks; Project sponsors' requirements can create administrative burdens.	Key source of funding.	Sponsors' push for cross-disciplinary research influences type of work done; Sponsors' focus on functional outcomes may limit scope of project.

6. Discussion

6.1. Implications

This paper investigates the contextual layers that shape the co-production of value propositions in university–industry R&D collaboration in the digital arena. Through an SDL lens, we examined the interactions, resources, and outcomes sought that characterize the co-production process in R&D projects and considered the effects of the individual, organization, and external contexts on project success. Our findings shed light on the types of interaction, resources, and valued outcomes that characterize successful R&D collaboration. First, in line with Hoffman, Kopalle, and Novak (2010), we found that successful collaboration requires highly committed individuals, with similar attitudes and complementary skills. We also showed that individuals came together for specific projects, each playing a particular role and interacting in ways that enable creative and pragmatic balance. The incremental development of mutual trust required regular meetings between partners, though participants' views varied in relation to the need for geographic proximity. In line with previous work, it was the practitioner interviewees, rather than the academics, who emphasized the value of geographic proximity between partners (e.g., Antonelli, 2000; Huikkola et al., 2013; Siegel, Westhead, & Wright, 2003). Although this emphasis on location may seem surprising in the context of digital research, our findings are consistent with previous research that shows that while academics routinely engage in international collaborations, industry tends to favor partners that are geographically close (see Bozeman et al., 2013). Of note, these findings contradict UK government policy, which focuses collaborative funding on a small number of universities with a reputation for research excellence (see Edmondson et al., 2012).

Both academic and practitioner partners were readily able to identify benefits in the co-production of value propositions, confirming the assertion that sustainable co-production derives from perceptions of worth (Pinnington & Scanlon, 2009). Both parties understood and were able to articulate from their own viewpoint the potential benefits to be gained from collaborating (Ulaga, 2003). Each, however, was less clear about the benefits desired by the other. Despite each party having a poor understanding of what the other would value, acknowledging this lack of understanding is an important first step toward recognizing differences in each side's view of what constitutes the value proposition to be co-created. Reflecting Kitchener's (2002) comments about the differences between managerial and academic logic, industry tended to focus on short-term outcomes, while universities emphasized the long-term. In line with Un et al.'s (2010) study, the participants also recognized that benefits could be generated from the unequal knowledge distribution within and between universities and industry. The complementarity of knowledge sources was marked as important, with both knowledge breadth and depth deemed necessary to co-produce value propositions in R&D collaborations. The ability to communicate the project between the collaborating parties was another area that participants emphasized, thus endorsing Diaz-Mendez and Gummesson's (2012) argument about the value of generic skills in creating value through co-creation.

Through our analysis, we revealed the positive and negative influences of several contextual elements on R&D projects (see Table 3). For example, through the provision of funding and by facilitating collaboration in multidisciplinary projects and networks,

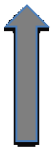
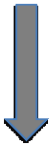
external parties can act as key enablers that have both a positive and determining effect on R&D. However, the emphasis they put on administrative requirements and functional outcomes are potential hurdles to collaboration. Those playing the role of individual "resource integrators" (Vargo & Lusch, 2004) were deemed to have only positive effects on the collaboration. However, the fact that the interviews focused on stories that individuals who had participated in the projects considered successful is a source of potential bias. The combination of different types of knowledge and skills (Ahuja, 2000) was regarded as particularly important by those we interviewed, corroborating previous findings on the impact of relationship building on valuable collaboration outcomes (Vernette & Hamdi-Kidar, 2013). Moreover, informal styles of management, which gave individuals participants autonomy over decisions, were viewed as more conducive to positive outcomes (Du et al., 2014).

We found that the role of organizations within collaborations was more complex. While support for R&D in principle and in practice is an enabler of collaboration, such ventures are often successful despite the management arrangements in place. The existence of highly formalized and systemized approaches to manage collaborations was a constraining factor. In line with Bruneel, D'Este, and Salter's (2010) study, the university administrative systems for IP were a particular hindrance to the process of co-producing value propositions. A further difficulty was in accessing knowledge produced by universities. Although universities' role in society is to produce and disseminate knowledge to identified audiences, and despite the high motivation of academics by this endeavor (Un et al., 2010),

the form and channels by which academic research is disseminated does not support serendipitous discovery.

Table 3.

Effect of contextual elements on university–industry R&D collaboration

	Determining Factors	Influencing Factors	
Positive Effect	**ENABLERS**	**FACILITATORS**	
	Shared purpose and understanding; Complementary skills; Interest in innovation; Open minded; Realistic expectations.	Regular (face to face) interaction; Experience of working together; Long-term view; Individual preferences; Offering different perspectives; Seeking complementary approaches;	Individual Layer
	Offer space and time to think; Risk taking environment.	N/A	Organization Layer
	Key source of funding	Development of networks; Push for cross-discipline research.	External Layer
Negative Effect	**BLOCKS**	**HURDLES**	
	N/A	N/A	Individual Layer
	Conflict with other goals; Different timescales; Poor awareness of, and accessibility to, each other's work; Ways of working.	Role of legal departments; Conflicting demands on time; Interaction with other activities in the organization.	Organization Layer
	N/A	Administrative burdens; Focus on functional outcomes.	External Layer

From these findings, we propose five practical principles for the development of R&D projects between universities and industry. The first principle is that organizations and individuals seeking co-production initiatives should share information in ways that are accessible and relevant to the other party. For universities, this includes sharing research-based information through open, non-paid channels (e.g., open access publishing), establishing a strong Internet presence, and being visible on social media channels, to

enable industry to locate relevant material and expertise. Taking these steps is a practical way to build on the culture of sharing research, as Un et al. (2010) describe.

The second principle reflects the reality that each organization, discipline, or department has its own terminology and ways of working. Given the implicit nature of these features, individuals may struggle to articulate or even identify them (Garfinkel, 1974). Such difficulty is particularly likely in innovative projects (Perks et al., 2012). Project managers should encourage activities that identify these discrepancies in modes of operation and invest in establishing a common language—for example, by producing simple "terms of reference" early in a project. Project participants need to be encouraged to "let go" (Spiller et al., 2015, p. 563) of their discipline-specific theories and methods and instead should embrace the opportunity to expand their perspectives and experiences.

The third principle is that third-party brokers can assist in linking potential partners and in identifying research foci that benefit from integrating academic and practitioner perspectives. This principle connects with Bansal et al. (2012), who recommend that research collaboration should make use of intermediary organizations as facilitators or translators between industry- and university-based researchers. The profiles of third-party brokers could be raised by professional institutes, as many commercial organizations belong to these bodies. Although the bodies we identify herein are UK and European Union centric, equivalent examples exist in other countries, such as the National Science Foundation in the United States.

The fourth principle is that trust is essential for the success of collaborative projects. Huikkola et al. (2013) discuss the importance of trust in the context of co-production, emphasizing the need for platforms and mechanisms that support joint learning and the exploration, rather than exploitation, of resources. The development of trust should be supported by engineering small wins (Perks et al., 2012), ensuring that teams meet regularly, and giving careful consideration to the form of IP protection.

The fifth principle is that individuals are the cornerstone of successful co-production. The teams that are assembled should include individuals with a common and positive attitude toward collaboration and innovation, strong social and communication skills, and complementary technical expertise. As Rese et al. (2013) advise, smaller teams make for better interaction and information sharing. Given the value that individuals contribute to R&D collaboration, consideration of how best to incentivize participation, whether through practical means, such as the provision of sabbaticals and financial incentives, or by highlighting the symbolic and emotional benefits, is necessary.

6.2. Limitations and future research directions

This research provides insights into what is known about the mechanisms of the co-production of value propositions in university–industry collaboration. However, several factors limit the study's generalizability and have implications for future research. First, the study focused on a single interdisciplinary area. Second, the participants were all involved in university–industry collaborations, which may have influenced their views. Third, the geographic location of the study, which was conducted within a 50-mile radius

of a major university city that also contains technology spin-off businesses, may have influenced the findings. Fourth, the study did not explicitly seek, nor did participants offer information about, the actual individual benefits derived from participating in R&D collaborations. It is possible that the use of group interviews to gather data made it socially undesirable for participants to discuss personal benefits resulting from the commercialization of IP, such as financial gain or career advancement. Given that we set out to learn from success, the questions that we posed deliberately emphasized the co-production of value propositions. We asked no explicit questions about alternative outcomes, such as value destruction or the failure of the university–industry collaboration. A possible consequence of such questioning is a tendency to focus on the positive elements of the co-production process. We acknowledge that this issue is a potential source of bias that should be considered in the design of future research.

Future research directions are required to further deepen understanding of the co-production of value propositions in R&D collaborations. These directions involve the conditions under which university–industry partnerships operate, the processes that are followed, and the tensions that arise as a result. Given that opinion remains divided as to the importance of face-to-face versus remote working relationships, it would be worthwhile to clarify the origins of these views—whether this dichotomy depends on the stage of relationship formation or is focused on individual-preferred working practices and the extent to which these need to be changed. Furthermore, while other studies have emphasized the benefits of co-production to the individual (e.g., Rintamäki et al., 2007; Verhoef et al., 2009), our data neither confirmed nor contradicted this point. Further

research is therefore warranted to determine the extent to which identifiable individual benefits arise from participating in these collaborations. Such evidence could be invaluable in encouraging future participation in R&D co-production initiatives, whether in digital research or in other fields. Moreover, further exploration of the different tensions that university and industry partners face could lead to the creation of strategies to manage them more effectively. For firms, these pressures revolve around the need to solve specific business problems, such as extending a product portfolio, developing new product technologies, or improving process efficiencies. From the academic perspective, tensions are associated with the drive to develop a broad-based program of research and generate data. A consequence of these different stances may be that industry is initially more focused on the transactional aspects of the collaborations while universities are satisfied with the relational benefits generated. This tension, the origins of which are in the differing factors that drive each group, is worthy of further investigation. A longitudinal case study approach that tracks the progress of particular collaboration could offer invaluable insights into how these tensions emerge, are managed, and play out over time.

The value of university–industry R&D collaboration extends well beyond the participating parties. In addition to the production of new knowledge, there are significant societal benefits (Hartley & Benington, 2000) and the potential to accelerate the discovery process (Bramwell & Wolfe, 2008; Lee, 2000). In advancing the conceptual understanding of the mechanisms for the successful co-production of value, this research contributes both theoretically and practically to the debate.

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