The value co-creation journey: a longitudinal process unfolding in a network through collaboration

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Abstract

Purpose – This study aims to develop our understanding of the value co-creation process in business networks. This study identifies four key sub-processes that characterize the value co-creation journey as it unfolds across an inter-organizational network. These four sub-processes are opportunity co-creation, solution co-creation, complementary co-creation and activated co-creation.

Design/methodology/approach – Reflecting the exploratory nature of this research, the methodology relies on an in-depth case study, which is analyzed through the lens of the resource interaction occurring within the specific business relationships and collaborative episodes that affected the nine-year long development of Deko, a new architectural lighting solution.

Findings – The main contribution of the paper is identifying the sub-processes comprising the value co-creation journey of a technology development solution based on resource combining, re-combining and un-combining across a business network. That value co-creation occurs through a time-consuming journey requiring multiple episodes of collaboration can also inspire the practice of handling this process for instance for a small business such as the one featured in this case study.

Originality/value – This paper highlights that the value co-creation journey process has the potential to frame the unfolding of collaboration in practice for a small business.

Keywords Value co-creation, Collaborations, Network resources, Business relationships, Network, Roles, Lighting, Technology co-creation journey

Paper type Research paper

1. Introduction

This paper explores the value co-creation process in business networks. The concept of value co-creation has been elaborated within the service-dominant logic (SDL) (Vargo and Lusch, 2004) as an evolution of the traditional product-centric approach to the market: co-creation implies the presence of customers as co-producers of services and providers as value propositions makers (Vargo and Lusch, 2004); "A service-centered dominant logic implies that value is defined by and co-created with the consumer rather than embedded in output" (Vargo and Lusch, 2004, p. 6).

According to this view, suppliers and customers exchange and integrate resources in an active manner (Romero and Molina, 2011) and accordingly become "co-creators". Suppliers and customers jointly create value which "takes shape" and becomes visible in terms of offered product/service; in other words, value becomes the outcome of direct or indirect

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utilization of the offering (Komulainen, 2014). Value co-creation therefore seems to be considered as an outcome, falling somehow in the same fallacy that Van de Ven *et al.* (1999) criticize in the traditional innovation literature that views innovation just like an outcome (e.g. a new product). Moreover, while the term "creation" suggests that according to SDL there is a process behind the outcome of value, this process is considered as synchronic, that is, occurring over a short timeframe if not instantaneously, as suggested by the notion of service encounter (Bitner *et al.*, 1990; Jayawardhena, 2010).

Such approaches to co-creation do not capture fully the unfolding of time associated with this process, or the time required to bring together various pieces necessary to concretely create value in a business-to-business context (see, for comparison, Bocconcelli *et al.*, 2020). While there are certainly situations where value co-creation can occur by means simply of meetings between a customer and a supplier, there are many situations in which co-creation requires more demanding and time-consuming collaborations (Perna *et al.*, 2019), which may involve additional actors and which stretch over longer timeframes. Some studies show that one key factor in value co-creation are collaborations with specific counterparts (Malshe and Friend, 2008; Berenguer-Contrí *et al.*, 2020). In addition, as Ramaswamy and Ozcan (2018) stress, we need to expand the perspective on value co-creation by recognizing not only the interactive but also the context-dependent nature of this process, beyond a single supplier and customer, i.e. the co-creating dyad. Accordingly, to understand value co-creation requires a capturing of the entire process behind that value rather than only considering the meeting point on the customer side: the literature has not fully grasped the complex and longitudinal nature of value co-creation (Payne *et al.*, 2008) which builds on a series of subsequent interactions with multiple actors across business networks (Håkansson and Snehota, 1995; Håkansson and Waluszewski, 2002; Baraldi and Strömsten, 2006).

Collaboration (or better several episodes of collaboration) are expected to sustain value co-creation, but conflicts and ambiguities may also hinder collaborations and hence value co-creation (Chowdhury *et al.*, 2016). Considering these issues, we argue that a full process view is necessary to make sense of value co-creation, to capture its intricacies and display fully its longitudinal nature, which can be well captured by the metaphor of a "journey" of co-creation (Van de Ven *et al.*, 1999): one can trace the moment when the journey starts and how it unfolds toward its destination, the value (s) being co-created. However, the journey can also end abruptly, causing a "termination" (Ibid), if obstacles appears or problems emerge in the collaborations making up the co-creation process.

Against this background, the purpose of this paper is to offer a fine-grained view of the interactive and collaborative patterns that characterize the value co-creation process. In particular, relying on an in-depth case study of the development, sale and installation of a customized lighting solution, we show that value co-creation happens within a network, where various actors not only interact but also collaborate intensively (Håkansson and Waluszewski, 2007). Since value is created by various network actors "working together", which is the basic meaning of "collaborating", the paper focuses on collaborative episodes and their direct as well as indirect influence on the co-creation process, considering also the role played by the specific actors involved.

More specifically, our research questions are as follows:

RQ1. How did the actors collaborate to co-create value?

RQ2. How did these collaborations shape the value co-creation journey?

In practice, we answer these questions by focusing on how various resources were combined, un-combined and re-combined (Baraldi *et al.*, 2012; Håkansson and Waluszewski, 2002). A co-creation process oriented approach (Payne *et al.*, 2008; Frow *et al.*, 2015) complements the rich vein of business network studies in technology development (Håkansson, 1987, 1990; Håkansson and Waluszewski, 2007; Laage-Hellman, 1997).

Our study adds to the literature on value co-creation in three ways: first, it focuses on the evolution of the co-creation process, which we view as a complex and time-consuming journey, similar to the "innovation journey" (Dooley and Van de Ven, 1999). In particular, we identify four sub-processes of the co- creation journey, which are based on salient episodes in this journey and frame key changes in the resource combination and interaction patterns among the actors in a network (Håkansson and Waluszewski, 2002; Baraldi *et al.*, 2012).

The second contribution of our study is to present the interaction processes (particular collaboration patterns) and the actors' roles associated with each period of the co-creation journey. This understanding elucidates the specific patterns of co-creation between and across actors in the network and provides another layer of understanding of what happens in the space between actors in a network, thereby adding to studies focusing on how actors work together to co-create, for example, using joint problem-solving (Aarikka-Stenroos and Jaakkola, 2012; La Rocca *et al.*, 2016).

Finally, our study provides an in-depth analysis of a particular context, namely, a small firm whose product technology is realized within a professional network, that is, custom-made lighting solutions finally implemented in a building project by architects, contractors and clients. This contributes to the growing body of business network work that focuses on smaller firm and, in particular, to technology development in this context (Aaboen *et al.*, 2017; La Rocca and Snehota, 2014; McGrath *et al.*, 2018). The paper is organized as follows: after providing our theoretical framing, we describe our methodology. Then, we present the case of Antrox and the new lighting solution Deko, followed by our analysis and discussion. We conclude the paper with limitations, further research and managerial implications.

2. Theoretical framework: from instantaneous to longitudinal value co-creation

2.1 Collaboration as a key feature of the value co-creation journey in networks

Our major research interest deals with the understanding of the value co-creation process in business networks (Håkansson and Snehota, 1995) by taking a long-term-oriented process perspective. More in-depth understanding on how value is co-constructed through interaction mechanisms behind collaborative patterns in a network constitute an important research area, as also witnessed by recent contributions (Kohtamäki and Rajala, 2016; Jaakkola and Hakanen, 2013; Saha *et al.*, 2022). The concept of value co-creation emerged in business and management in the 2000s, with solid roots primarily within SDL (Vargo and Lusch, 2004), which

emphasizes the specific active role of customers to nurture value within dyadic relationships. These authors point out that providers and customers may assume distinct and well identifiable roles during the value creation process: customers are essential to the entire value process and they assume an influential position with respect to the success or not of the emerging solutions, whereas suppliers "can only make value propositions" (Vargo and Lusch, 2004). However, SDL does not stress the importance of interactions and collaborations, which are critical in a business-to-business setting (Leroy *et al.*, 2012).

Interactions, collaborations and collaborative episodes are instead fundamental elements of the value co-creation process in *industrial networks* as pointed out by several studies (Ford, 2011; Aarikka-Stenroos and Jaakkola, 2012). While SDL (Vargo and Lusch, 2004) focuses on more surface interactions, such as service encounters with short-term orientations, in a business network there are much deeper interaction among the involved actors, and these are essential for value co-creation. In a network setting – with complex technical solutions like the one featured in our case – it is important to look at the entire value creation process, stretching back in time and including not only slight and instantaneous interactions but also complex collaborations. We view collaboration in this paper as a deep form of interaction between two or more actors who have a jointly agreed purpose to be achieved by combining, recombining and eventually adapting resources (Baraldi *et al.*, 2011). Thus, collaboration entails not only the exchange of tangible as well as intangible resources among the involved parties, but also adaptations of these resources to develop, for instance, a new product. Episodes which may happen during the collaborations among actors – such as meetings, investments, adaptations (Ford, 2011) – have an influence, either positive or negative, over the entire process as collaborations vary in the degree and depth of the engagement of actors (Lynch *et al.*, 2016). Some of these collaborative episodes will generate direct economic value, especially the later ones, but all will have some benefit to the project being developed or indeed may hasten its decline if there is no long-term perceived value to the actors to be gained from their involvement.

The collaborations behind value co-creation entail complex interactions because they concern exchange and, especially, combinations of heterogeneous resources and changing roles of the involved actors (La Rocca *et al.*, 2016). Actors – conceived as individuals or organizations who manage resources and perform activities (Håkansson and Snehota, 1995) – play various roles in resource activation, combination and use. Moreover, their roles change as actors can both provide and use various resources during the development of a solution; meaning the same actor is able to switch from provider to user or assume both roles at once (Cantù *et al.*, 2012). While changing their roles the actors' impact at network level will also change (Guercini and Runfola, 2015). Collaborations entail two or more actors defining a joint purpose, and achieving these joint goals require time, commitment and effort by the actors. As the resources involved and the actors' roles change over time, it is not possible to forecast the final outcome of the value co-creation process: one knows when the journey starts but not when and where it may finish (Van de Ven *et al.*, 1999), which requires taking a long-term perspective to understand how the value co-creation process unfolds.

Resources are essential in accomplishing value co-creation (Alves *et al.*, 2016; Breidbach and Maglio, 2016), because it is by combining resources of various types that value can be embedded and used across networks (Baraldi and Strömsten, 2006; Håkansson *et al.*, 2009; Baraldi *et al.*, 2011). In particular, actors bring into this process both tangible and intangibles resources, which can be classified for instance in four typologies: products (including e.g. raw materials and components), facilities, organizational units (including e.g. knowledge, skills and competences) and business relationships (Håkansson and Waluszewski, 2002; Baraldi *et al.*, 2012). The specific resources that need to be combined or even re-combined to achieve value creation vary depending on the context of the collaborative episode, including the technical domain and the specific needs of users. In general, any value co-creation process includes a great variety of resources, ranging from physical prototypes to innovative ideas and other forms of knowledge (Bonamigo *et al.*, 2022).

Therefore, inspired by the industrial marketing and purchasing (IMP) view (Håkansson and Snehota, 1995), we view value co-creation as a process driven by a series of connected collaborative episodes unfolding over time across inter-organizational networks. This process takes time and requires the mobilization of many resources by the actors involved. While there are situations of value co-creation that can occur through routine encounters and relatively simple interaction, especially in the context of services, when we deal with business-to-business settings focusing on tailored solutions, more complex resource combinations are necessary, which require deeper interactions manifest in collaborations to achieve jointly identified purposes.

We use the metaphor of a *journey* of co-creation to capture the complex series of episodes leading to users eventually obtaining value from the development of innovative or tailored solutions, similarly to Van de Ven *et al.*'s (1999) use of the metaphor of an "innovation journey". The co-creation journey ebbs and flows among the actors as resources are combined, re-combined and un-combined (Lynch *et al.*, 2014). We stress here the longitudinal nature of the co-creation process: co-creation unfolds over time and indeed often requires considerable time to elapse so to allow a multiplicity of changes in resources and actors to become consolidated. In other words, co-creation is a process not only of combining and matching existing resources *here and now*, as implied for instance by the notion of "resource integration" within service ecosystems (Kleinaltenkamp *et al.*, 2012; Vargo and Lusch, 2016, 2017), but it is a particularly time-consuming process of adapting these resources to each other by *changing* their key features and thereby creating new, often unexpected, value (Håkansson and Waluszewski, 2002; Baraldi *et al.*, 2012).

It is specifically these adaptations and changes in resources that require time but also make value co-creation a dynamic process, which includes both the embedding of new value in a particular resource or combination of resources (Baraldi *et al.*, 2011) and the use of such value by one or several involved actors (Baraldi and Strömsten, 2006; Huang and Nenonen, 2022). Needless to say, this longitudinal process faces barriers similar to innovation processes in general, such as resistance to

change (Håkansson, 1987), opposition by some actors (Cantù *et al.*, 2012) and the heaviness of existing investment and resource structures (Håkansson and Waluszewski, 2007). Consequently, the value co-creation journey can take many unexpected turns, revert back to previous states in resource combinations, be paused, terminated or restarted as its network context constantly changes (Van de Ven *et al.*, 1999).

2.2 Sub-processes in the co-creation journey

In network-based co-creation, tasks and roles played by the actors are more fluid and can move between partners and across the network. But a commitment to collaboration has to be present in this co-creation journey, as it would be very difficult to specify every eventuality in a technology development agreement among partners at the outset (Athaide and Klink, 2009; Schleimer and Shulman, 2011). We use the extant literature to define sub-processes in the co-creation journey only in outline because we developed our framing and description of this process by cycling back and forth between our data and the literature in an abductive way (Dubois and Gadde, 2002; Nordqvist *et al.*, 2009).

The initial sub-process is likely to be more intense amongst the actors who are developing the idea for eventual use – we label this process *opportunity co-creation*. Various resources such as components, materials, facilities and knowledge (Håkansson and Waluszewski, 2002; and Baraldi *et al.*, 2012 for resource classifications) are explored between the partners as they assess the combination of resources that they expect might work best in concrete use (Gadde *et al.*, 2012). All the initial ideas will not work so resources will have to be re-combined and, in some case, un-combined and eventually discarded in this process. This sub-process can involve some intensive work on technical and design issues to do initial road testing of ideas to ensure they are workable. The partners will have a rationale to cooperate but need to work with idea configurations and agree on a combination that they think could be developed to be brought to customers. By the end of this sub-process, the partners are likely to have agreed on a workable innovation concept that can be co-created with the involvement of users too. This will enable the project to move to the next period. The co-created opportunity could still ultimately fail when facing customers. The roles of the actors and the task they perform are likely to be relatively simple, especially if small firms are involved as in our case study (Aaboen *et al.*, 2017; McGrath and O'Toole, 2013).

The second sub-process of the co-creation journey is where the new solution is designed in the network – we label this period *solution co-creation*. This process includes the engagement of a wider pool of experts on the proposed new solution, that is, the design is now co-created to a more saleable idea in a wider network. This broader engagement will facilitate a reflection and assessment among the partners on whether to invest more resources in this version of the solution or whether to re-combine the resources around a new adapted idea emerging from this process. This resource combination period is one of working with a larger set of actors and reflecting on potential and developing further the potential customers or going back and adapting resources in the project to further open the network to the new idea (Cantù *et al.*, 2012; Jaakkola and Hakanen, 2013). The tasks of the actors in this sub-process are all about responsiveness and engagement with each other to crystalize the initial opportunity and bring in new actors who can add to the development process. At the end of this sub-process, the new solution should be ready to be proposed to one or multiple users.

The third sub-process in the co-creation journey is about adding services to the material solution, e.g. a product, so to actually get it into the using setting. We label this sub-process *complementary co-creation*. Here, the focus is on marketing and communication, which adds also the intangible service resources of the partners to communicate and commercialize the final combination of ideas. The closer the new solution is to an existing network the easier it will be to gain entry. Being in an outsider position would make it very difficult to become trusted. Context plays a role as the regional infrastructure and reputation can have a halo effect on all firms in a particular area lifting the entry potential into a new market. Direct interaction with intermediaries in distribution, and architects in our empirical case, is likely to be the best form of marketing (Gemünden *et al.*, 1996). Getting the product listed in the distribution system and known is usually done on a personal basis. But adding particular intermediaries to the new solution who will recommend the vendors in particular construction contracts or ones who will add reputation and interest to the solution are important new roles in the co-creation process. These additional actors and their roles become part of the journey: they add important new values to the initial technical solutions, and without them value co-creation would not succeed.

The final sub-process of the co-creation journey is the realization of the solution with, or for, the customer for direct use, that is, in our case study the finalization of a particular lighting installation in a new building and the contract and delivery system around this. We label this sub-process as *activated co-creation*. This sub-process includes both the activation of the contract and the delivery system for the new solution, and the economic value is realized to the parties involved in the co-creation process. The roles and task to be performed combine negotiation and specification on final design to be realized on-site and on final prices. In addition, the production, logistics and installation tasks have to be performed by all the actors involved (Sinkovics *et al.*, 2018). These latter activities will be new to the initial partners in the co-creation process and have to be co-created with a range of other, often new actors. The value can only be realized when the (lighting) solution is installed and is working on-site, which require several adaptations to be made for the first time. In replicated future projects, this period is likely to be similar but never quite the same. Unique aspects of final use, delivery, logistics, and engagement with the on-site contractors will be part of this period, which is layered onto the production and supply network of, in our case study, the lighting designers/producers.

3. Research design and methodology

As pointed out in our theoretical section, co-creation in interaction is less divisible to the individual actor as the control over any part of the process is more dispersed across a network. That is, co-creation in a business network (i.e. IMP) approach

is a contextual, time-consuming and continually changing process. Therefore, to investigate practically this phenomenon and avoid seeing co-creation only as an outcome, requires a longitudinal methodology (La Rocca and Snehota, 2014; McGrath, O'Toole *et al.*, 2018). Process research methods facilitate understanding of the "how" question and thus are well aligned to our question as to how value is co-created between a network of actors (Dagnino *et al.*, 2015; Pettigrew, 1997; Ring and Van de Ven, 1994). We are in line also with Kohtamäki and Rajala (2016) who consider the processual view of value co-creation to be highly applicable to understand a complex phenomenon. In addition, they recognized the need to apply new methodological tools when studying collaborative episodes.

As our purpose is to explore value co-creation across business networks by analyzing the collaborations as well as the specific roles played by the involved actors, we rely on an in-depth, longitudinal qualitative case study (Yin, 2009). The single case study strategy has been chosen due to the explorative nature of this study (Ibid). In fact case studies are used when the interactions and the connections between phenomena and context are complex and unknown (Dubois and Gadde, 2002). Our decision to rely on a qualitative case study is therefore motivated by the authors' intention of exploring how value is co-created in a business network. Moreover, applying a longitudinal research design (Pettigrew, 1990) allowed the authors to study the phenomenon at hand for a continuous period of time (Ryan *et al.*, 2002).

Our case study was selected because it illustrates interaction patterns and collaborations enabling us to investigate how co-creation in network-based markets happened. Furthermore, one of the paper's authors has established, over the past years, academic collaborations with the management of one of the key actors in the case, Antrox, including joint research projects. These continuous collaborations offered detailed insights regarding the business context of Antrox and its way of approaching and facing product development and interactions with customers and suppliers.

The empirical material was collected in several waves, with earlier versions of our study based on data that focused on drawing a general map of the co-creation journey and penetrating single relationships. The subsequent wave of data collection focused on grasping better the network level of this process as well as its details in terms of collaborative episodes. These data collection and analytical steps were necessary to dig deeper into the historical process of value co-creation and also capture the roles of the various involved actors (the focal company, key suppliers, installation partners and final customers). A total of 12 face-to-face interviews have been conducted with representatives of the 2 key actors who initiated the value co-creation process, that is, the lighting solution provider, Antrox, and its materials supplier, NelDesign; 11 interviews have been carried out at Antrox with the President and the Vice-president of the company, and one with the founder of NelDesign. The interview questions covered which resources, activities and actors have been involved in the creation of the focal new solution, Deko. In addition, 600 e-mails exchanged between Antrox and NelDesign have been analyzed to develop a chronology of the key episodes behind the technology and its commercial development. In addition to the interviews and e-mails, data were collected in the form of internal reports, and brochures. Websites of the two focal companies have also been consulted as well as digital material available on-line. All the interviews were transcribed and shared among the authors to provide a common knowledge base for analysis.

In conducting this study, we have adopted an abductive logic (Dubois and Gadde, 2002), whereby theoretical concepts and empirical data were constantly compared. As for the data analysis process – which included mostly the informants' interview transcripts (Makkonen *et al.*, 2012) and e-mail texts – we have identified the various episodes from a time perspective and grouped them into relevant periods. Therefore, time has been used as a dimension to organize the data as the case had natural time points where collaborations started, unfolded or ended. More precisely, we have relied on the utilization of the temporal bracketing formula in order to structure the description of the episode (Langley, 1999).

In particular, the four sub-processes already presented in our theoretical framing have been identified inductively during the research process (Ragin, 1992) by analyzing the empirical materials in search of contents and consequences of the various episodes occurring over time. We identified first the sequence of these episodes as illustrated in Table 1 and then we grouped these episodes into sub-processes characterizing each one by the actors' focusing on particular resources (e.g. material resources such as components and materials as opposed to immaterial ones such as knowledge and routines), tasks and

Table 1 Key events of Deko

Key events behind the development and installation of Deko			
– R&D project of Porotex (precursor to Deko) is jointly initiated by Antrox and Nel Design; **– The R&D project is ended;** **– Birth of the new R&D project named "Antrox Lab";** **– New uses of Porotex are discovered**	– First attempt at commercializing Antrox Lab fails; – Revision and improvement of the coating process; – Birth of Deko; – Deko presented to Studitalia (intermediary); – Deko is specified in new building project; – Antrox elaborates an economic proposal to FourZone (contractor)	– Technical discussions between Antrox and FourZone; – The prototype of Deko is finalized by NelDesign; – Acceptance of the economic proposal by FourZone	– Organization of the logistic around Deko; – Final checks; – Shipping and installation completed

goals which caused clear changes over time (Van de Ven, 1992). Thus, the movement from a sub-process to another was signaled by episodes whereby actors focused on different resources, tasks and goals. The analysis of the 600 emails contributed to map not only the sequence of the episodes but also to understand when the actors showed up and the content of their interactions over the co-creation journey. Thus, the analysis of the case was guided by our emerging framework, including the aforementioned theoretical concepts, and focused on linking the sequence of key episodes, which contributed to value generation, with particular collaboration patterns, the involved actors, their roles and consequences for resources. The actor roles were identified inductively from the empirical material.

4. Case study: co-creating value around Deko

4.1 Antrox and NelDesign

Antrox and NelDesign are two small Italian companies that operate in the architectural design industry. Antrox was established in 2000 by Mr Luca Giraldi – who is the Vice-President – and in 2018 the company's sales reached €1.5m with 10 employees. Currently, the ownership is split in two equal shares between Mr Giraldi and Mr Rinaldi, who is the company's President. The business focuses on the design and project installation of architectural lighting systems for both private and public buildings.

Antrox outsources the production of its lighting solutions to local suppliers. Instead, Antrox focuses on supplying lighting solutions and managing their installation at the customer's site. However, Antrox does not have enough competences and resources to deal directly with the final customers, estate owners. Therefore, they have to rely on distributors of lighting products, agents and architects to get in contact with such customers. Architects are extremely important because they influence the contractors' choice of the lighting systems to be installed in a new building. Architects can specify Antrox technology and hence push it toward the contractors.

NelDesign was founded in 2008 by Mr Sauro Raschiatore and is located about 70 km from Antrox's headquarters. Employing three people, the company's revenue in 2018 was 500,000 euro, and its customers were solely from Italy. NelDesign is a producer of polystyrene carving for construction and design purposes, using virtual prototyping as a method for product development. Its 3D digital models are usually built-up with the customers: once they are created, they are sent to production to create tailored shapes. The whole process ends up with a coating process to make the structure more solid. Over the years, the company has developed specific skills concerning R&D activities in the field of new materials by collaborating with a number of partners (research centers, materials and equipment suppliers, etc.). From a sales perspective, the products are sold through intermediaries such as retailers and agents for the Italian market. One of the most important results achieved by NelDesign is the development of "Porotex", which is a type of coating material made out of polystyrene. According to Mr Raschiatore, Porotex presents a number of advantages for the customer due to its high durability, light weight and high customization.

4.2 Joint new product development: the birth of Deko

Since 2008, Antrox and NelDesign had been trying to collaborate to develop new architectural lighting solutions. Mr Giraldi wanted to explore the potential innovative applications of polystyrene in the lighting world and decided to share his idea with Mr Raschiatore and, after a while, the two companies agreed to start a joint R&D project. The goal was to combine the lighting solutions made by Antrox with NelDesign's Porotex material. The two companies made several attempts to verify whether the combination of Porotex and Antrox lamps would be possible. However, neither Antrox nor NelDesign decided to commit fully to this effort and therefore the project was put on a hold.

In 2014, the two companies decided to make a small joint investment to develop a new product family named "Antrox LAB". Antrox LAB was conceived as a label to give an identity to the upcoming generation of Antrox' new products – a LED light installed and placed inside the Porotex material. According to the two companies, there were no similar products available on the market and the expected benefits would have been much greater than the proposed price: the combination of LED lamps and Porotex can be customized more easily than the standard off-the-shelf solutions for both interior and exterior applications.

However, several issues occurred through the whole development process (Mengoni *et al.*, 2017): for example, how to design and then cut the shape of the lamp represented an important problem since polystyrene required a particular cutting process to be performed at a certain speed. It was mostly Mr Giraldi and his team who steered the product development process, whereas NelDesign was more "passive" due to the lack of knowledge of lighting systems and LED technology's potential applications.

After several months of trials, the product co-developed by Antrox and NelDesign resulted in an application lighter in weight than traditional alternatives but a major problem was that polystyrene was considered – according to several opinion leaders involved by Antrox, such as architects and lighting distributors – fragile and a low-value material. To overcome the negative perception of their product, Antrox pushed NelDesign to work more on the coating process. The result was encouraging from a technical point of view, but the issue remained that the potential to commercialize this new product seemed far from satisfactory.

What went wrong with Antrox LAB was a major point to discuss as quickly as possible between Antrox and NelDesign. After a while, Mr Giraldi sought feedback from about 10 actors – such as designers, architects and old customers – and realized that the issue was the coating. Combining LED lights with Porotex was not appreciated since that combination did not look attractive from an esthetic point of view. The product was considered unpolished and since the idea was to promote Antrox LAB toward very demanding architects, Antrox and NelDesign had to step back and think again how to solve the "coating issue" and its negative impact on perceived quality.

The two firms did not give up and they started to search for new suppliers of different coatings. After several weeks of work, a suitable new supplier only 50 km away from Antrox's headquarters was found. The new development process took about six months. The new prototype could also have particular

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indoor or even outdoor applications since the lighting system composed by a LED source was integrated into a decorative panel. The first "wall" containing LED lamps was born under the name of Deko.

When Antrox and NelDesign came up with the prototype of Deko, they realized that they had created something rather special. Deko was shown to some local architects and small lighting distributors. It was positively assessed and Antrox setup an email marketing campaign to inform potential customers about the technical features of Deko and its possible applications.

4.3 Deko attracts interest in the construction business

During the spring of 2015, Mr Massimo Rinaldi set-up a meeting with Studitalia Décor (Studitalia), an architectural bureau located in Dubai and owned by Mr Massimo Bertelli. This meeting was aimed at informing Studitalia about the existence of Deko and to get updates about the business opportunities in Dubai.

Studitalia offers services such as structural and interior design to building contractors. They have connections with European suppliers of architectural components and products and provide turnkey solutions to the contractors. Studitalia has a strong tie to Dubai Contracting Company (DCC), a construction firm located in the Middle East. Over the years, Studitalia developed most of its projects in private villas, hotels and airports due to their relationship with DCC. The trip by Mr Rinaldi also aimed to demonstrate Deko to other contacts located in that area, even if Mr Rinaldi's main goal was to impress Studitalia due to its powerful link to DCC.

The meeting with Mr Bertelli was extremely successful. As soon as he understood the characteristics of Deko, he decided to make a proposal to Mr Rinaldi and Antrox. A couple of months before that meeting, Studitalia had received a complex task from DCC: to entirely design the interior of a large hotel in Dubai. The project proposal presented to DCC was accepted, but it was ambitious and costly, hence Studitalia wanted to find a solution for reducing the costs. The meeting with Mr Rinaldi presented Mr Bertelli with the solution. It was possible to use the Deko material to reduce part of the costs of the lighting installations: instead of plugging the lights into the walls, Deko presented an alternative to save time and avoid costly activity on the construction site. In addition to the possibility of using Deko as a shell in which to host the lights, Studitalia considered Deko as an option for decorating other interiors of the hotel. However, neither Antrox nor NelDesign had specific experiences of scaling up the application of Deko in a large hotel project, and certainly not if it were to be used for decorating other areas of the building. Nonetheless, Studitalia inserted Deko among the technical and design specifications and, shortly afterwards shared the updated version of the project with DCC.

DCC was satisfied with the proposal, but the big challenge for Mr Rinaldi would come from interacting with the contractor in charge of realizing the interiors of the hotel, which was finally identified in the summer 2015. DCC accepted the offer presented by the company FourZone – established in 2003 in Dubai and focused in creating hotel interiors for the Middle East. Basically, FourZone was granted the contract for constructing the interiors of the future hotel. Since the material Deko was specified in the project drawings made by Studitalia, in September 2015, FourZone contacted Antrox to receive technical information as well as a price quote for Deko. FourZone also wanted to know how long it would take Antrox to perform its activities and deliver Deko. In the hotel project, Antrox would have the task of designing and building an entire wall, which would include Deko lamps. "This is going to be a big challenge for us and for NelDesign" claimed Mr Massimo Rinaldi, if we are successful, once he came back to his office in Italy.

4.4 Preparing for the implementation of Deko

The new hotel project in Dubai required Antrox to develop something it had never done before, a 22 meter "Deko wall" and it had to be accomplished in a very tight deadline. Moreover, the complexity was related to the fact that only a very small number of Deko prototypes had been commercialized by Antrox up to that point. But since this new project was worth €240,000, both Antrox and NelDesign decided to focus mainly on this work. For NelDesign, it was also an exciting opportunity to work on a big construction project outside Italy.

One of the first activities carried out by Antrox was preparing the tender proposal to be sent to the contractor FourZone. In another short trip to Dubai, Mr Rinaldi visited the construction site and met the manager of the site as well as the CEO of FourZone. He came back home with more precise information about the design of the product, measurements, and other details. Soon, Antrox provided its bid to FourZone. As pointed by Mr Rinaldi "The bid has been revised many times since FourZone wanted to really squeeze the price and impose their purchasing policy! The entire negotiation process with them took a lot of time and efforts!" Mr Rinaldi also sought the support of Studitalia to withstand FourZone's bargaining pressure, but Studitalia informed that they could not help Antrox in negotiating with FourZone.

In the meantime, the task of NelDesign was to verify the technical feasibility of the project. Some experts and consultants were appointed to carry out simulations, tests of new glues and other components. Other issues were related to the fact that once assembled in Italy, Deko would have to be shipped to Dubai in a container. How to make Deko fit into a container? How to write manuals and instructions to reduce the work for FourZone and avoid sending people overseas to install Deko? Those were open questions to manage and solve within a very tight deadline.

Once again, Mr Giraldi played an important role in suggesting potential solutions to NelDesign. Giraldi, for instance, suggested designing the prototype in a way that would make it easy to transport. Deko was designed in several "modules" instead of just one piece, and precise instructions were written to facilitate the installation even by untrained people. Mr Rinaldi pointed out:

> The idea of Antrox was to imitate the model of IKEA: assembling Deko must be 'funny' like assembling any IKEA item and every contractor should do that within few days.

NelDesign and Antrox developed a prototype in Italy in three months. The creation of the prototype was an important step: Antrox and NelDesign better understood how to put together the different components of the "Deko wall" project and

figured out what would be the best way of combining lamps with the wall. However, the lack of experience by almost all the involved actors made it very demanding to create all the necessary documents, calculations and schemes.

Antrox shared pictures and videos of the prototype as well as the technical documentation with FourZone, which had to verify the conditions of the purchase and the technical aspects of implementing Deko. Antrox shared almost the final version of the project's solution, but kept some key information secret which would have been shared with FourZone after the signing of the contract. As the decision of using Deko had been driven by Studitalia and specified in the project proposal, Antrox was hoping that there would be no issues with FourZone. However, in the worst case scenario, FourZone could decide to reject Studitalia's proposal and drop Antrox as a supplier.

FourZone spent several days analyzing Antrox's proposal. They were not really convinced about the feasibility of the Deko solution, but in the end they had to accept it. According to Mr Rinaldi:

> Thanks to the long lasting relationship between Studitalia and DCC, we got the opportunity of installing Deko: FourZone may have rejected us, but DCC was excited and amazed by Deko and this helped a lot to get the job. In the end, the paying customer and decision maker is DCC.

4.5 "Packing" and installing Deko

Once the proposal was accepted by FourZone, Antrox and NelDesign planned the next activities. NelDesign started purchasing materials and components with the goal of scaling up the Deko prototype. In the meantime, Antrox was dealing with the lighting systems to be combined with Deko. NelDesign had to deal with the major and more complex task: they had the responsibility of scaling up the pivotal element of the project: the Deko wall. It was also necessary to travel again to the construction site to make additional checks for the project. One technician of NelDesign – the only one able to speak English – travelled to Dubai and had meetings with FourZone: it was also an occasion to talk in detail about the installation of Deko.

Due to the large size of the wall, it was divided into several modules to be assembled directly on the construction site in Dubai. Once the production of all the modules was finished, NelDesign struggled to organize the transportation of the wall. For instance, all the Deko modules and the necessary tools for the installation were stocked in a warehouse to make additional checks and to facilitate the loading operations. And all the documentation to be delivered to FourZone had to be carefully reviewed. NelDesign was very keen to avoid any possible issue during the installation stage at the customer's site.

Deko was shipped to Dubai split over six containers and, after unloading them, the contractor was supposed to start with the installation independently. With NelDesign and Antrox materials and support, the contractor, FourZone, should have enough knowledge to proceed autonomously with the installation of Deko. However, three people from Antrox and NelDesign had to travel to Dubai and support FourZone during the installation. Installing Deko took about two months and was completed successfully in the summer of 2017.

5. Analysis and discussion

The value co-creation journey featured in this paper started in 2008 with the first tests of a new plastic material capable of embedding lighting elements and reached the first installation in a major building project in Dubai in the summer of 2017. During these 9 years, actors dealing with technical development and production (Antrox, NelDesign, as well as several local sub-suppliers and technical experts) interacted with each other and with actors dealing with using the various solutions, including different kinds of customers (hotel owners as final users, but also intermediate users such as the architect, Studitalia, and the contractor, FourZone). These actors focused on different demands from the technology development process with the actors involved primarily with development and production focusing on technical novelty and production efficiency and the actors on the using side of the network focusing on esthetics, durability, and cost of using or owning (Håkansson and Waluszewski, 2007; Baraldi *et al.*, 2011). The different foci and interests of the various actors also entailed different and multiple roles (Aarikka-Stenroos and Jaakkola, 2012; La Rocca *et al.*, 2016).

During the value co-creation journey, these various actors interacted and collaborated around key physical resources, that is, artifacts such as the product (s) being developed (for example, Deko), and exploited immaterial resources such as new relationships that connected them directly or through intermediaries (for example, the architect, Studitalia) acting as brokers (Håkansson and Waluszewski, 2002). Some resources did not work well as connecting elements and soon disappeared during this journey: for instance Antrox LAB was a product that, despite its novelty and technically superior features, did not appeal to the using side of the network. And as there was no broker able to connect it to users interested in Antrox LAB's key feature of flexibility (and less concerned with esthetics, its poorer value element), the product had to be basically discarded. An interesting overall feature of this value co-creation journey is its resilience, that is, it continues even if some of its elements are discarded and changed, so that the value-creating solution appearing and being eventually implemented is different from the one invented originally (Van de Ven *et al.*, 1999).

Various kinds of material and immaterial resources, such as products, machinery, competence and relationships (Baraldi *et al.*, 2012), are continuously combined, un-combined, re-combined and discarded during this process: the constant willingness of the actors involved to retry and re-combine the resources after every episode of unsatisfactory combination seems to be a key driver that made this co-creation journey endure and overcome several barriers – technical as well as economic. Table 2 summarizes the four sub-processes that we identified in this value co-creation process as a result of our abductive framing.

5.1 First sub-process – opportunity co-creation

We term this sub-process "opportunity co-creation" because two actors identify and start developing an opportunity together to create new value in a particular application – an architectural lighting solution. It is important to stress here that this first sub-process differs from the typical start of innovation

processes where the focus is on a single actor's idea generation or the birth of an "entrepreneurial opportunity". Our case shows how two actors interacted and collaborated at this early stage of the process by combining their respective competences and perspectives on the problem at hand and potentials solutions that can bring value. More specifically, the value envisaged concerned more lightness, better customizability, lower assembly costs and simpler installation. This sub-process had a very slow start and evolved first at a conversation and idea level (Håkansson and Waluszewski, 2002) between Antrox and NelDesign, two companies with established actor bonds (Håkansson and Snehota, 1995). But after this slow start with interactions at actor level only, in 2014 interactions became more intensive and embraced the resource layer (Ibid), with the creation of the new resource combinations (Håkansson and Waluszewski, 2002) behind Antrox LAB. Moreover, several resources combinations were explored, but some did not work so they were "uncombined" leading to discarding some physical and technical resource elements. The actors intervening in this sub-process, Antrox and NelDesign, had the clearly focused roles of *proposers* of technical solutions (both) and of *explorer* (Antrox) of how they could match general user needs. Together, the two actors also played the role of *agreeing* on the solutions to be discarded and those to carry on for new re-combinations, even if Antrox assumed the role of *leader* in the technical project.

5.2 Second sub-process – solution co-creation

We term this sub-process "solution co-creation" because several actors intervene in assessing and recombining various resources that eventually create a particular solution, which various actors agree to pursue further. However, it was clearly not a linear process getting to this particular combination. In fact, in late 2014 the product Antrox LAB started being questioned as sales did not gain momentum. Antrox's interaction with experts and potential users pointed out more or less unsolvable problems with this product. At this point, Antrox got involved in more information-seeking interactions with many actors (experts and users) with the goal of obtaining a broader picture of the "market" for this product. Relying on the information from these broader and less deep interactions, the decision was made to abandon Antrox LAB. At the same time, Antrox opted for deepening its interactions once again with NelDesign to test and conduct the complex resource re-combinations leading to the new product, Deko. These new intensive interactions between Antrox and NelDesign and the extensive re-combinations of resources took about six months to become crystallized in the new technical solution, Deko. In parallel, Antrox undertook less deep interactions in browsing its own supplier network in search of other key resources such as new materials and technical solutions, which then led them to identify a particular partner who became the supplier of the new key coating component for Deko, and hence acted as a *technical problem solver*. Antrox played a major role of *connector* to a broader network of *opinion leaders*, who in turn played two important roles: they were *evaluators* of the emerging solutions (first Antrox LAB and then Deko) and, being experts, would possibly *influence* other actors too.

5.3 Third sub-process – complementary co-creation

We term this sub-process "complementary co-creation" because, whereas in the previous sub-process the focus was on assessing and (re)combining mostly tangible and technical resources, this new sub-process deals mostly with complementary intangible resources, which can complete the core solution addressed in the previous sub-processes. In particular, intangible resources from marketing, communication and service provision were attached to tangible ones, including complementary knowledge. All this happened with the purpose of adding, communicating and creating further value around the focal solution. The interactions that dominate this sub-process are communication-oriented, supporting the marketing of the new product Deko conducted by Antrox. Importantly, these marketing interactions now include a very deep interaction and negotiation between Antrox and the architect Studitalia. From this intensive negotiation, an informal alliance emerged between Antrox and Studitalia to support the acceptance and even the first installation of Deko at customer locations. In turn, the collaboration with Studitalia led Antrox to start interacting, initially in a superficial way, with the contractor FourZone, who was expected to be formally the direct customer (also supervising the installation) of Deko. Throughout the third sub-process, it was only one of the developing parties involved, namely, Antrox, who played active roles, while NelDesign remained in the background. In particular, Antrox acted as *marketer* and *communicator* of the value made available by Deko over a broad network, but also acting as *influencer* over 1-to-1 relationships first with Studitalia and then with FourZone. Studitalia played, in turn, a very important role of *gatekeeper* to the first construction project and of supporting Deko by means of its *recommendations* manifested in the product specifications requiring this product to be used in the new hotel building.

5.4 Fourth sub-process – activated co-creation

We term this last sub-process "activated co-creation" because here the various involved resources, mostly intangible and service-related ones, intervene to activate and make available finally in a specific installation the value connected with the focal solution. Again, like in previous sub-processes, it was not an easy and linear sequence of episodes leading to this actual and realized value. In fact, this sub-process entails first the struggle to achieve a signed contract to supply the new hotel in Dubai and then several adaptations that were necessary to deliver the actual solution in the form of a very large installation of the product, Deko. Interactions in this sub-process were first very intense but adversarial with the building contractor, FourZone, on the using side of the network, and concerned quite demanding negotiations about both the price and the technical performance of the core product. Then, with the signed contract in place, more collaborative interaction moved to the developing and supply side of the network, with Antrox and NelDesign discussing intensively how to practically perform the production and delivery activities. Finally, with the product on site at the hotel, the interactions which became very deep and intense were again those between Antrox and the building contractor, FourZone, who needed, from Antrox, both training and written instructions on how to install Deko. At this point, all sorts of additional services and support activities became pivotal in order to really create value around the new product together with the local installer. Teaching and

Table 2 The sub-processes of the value co-creation journey

		Analysis of sub-processes			
Sub-processes	**Key episodes**	**Major resource combinations**	**Resource processes**	**Collaborations**	**Actors' roles**
Opportunity co-creation	– Joint analysis of Porotex applications for hosting lighting systems – Initiation and exit from the R&D project around Porotex – Formalization of new R&D project "Antrox LAB" to continue studying Porotex – Emerging of technical problems – Discovering multiple uses of Porotex	– Relationship between Mr Luca Giraldi (Antrox) and Mr Sauro Raschiatore (NelDesign) – Lighting solutions knowledge (Antrox) and polystyrene carving and coating technology (NelDesign) – Relationship to architects (Antrox) and perceived knowledge of using markets (Antrox and NelDesign) – Joint R&D investment (Antrox and NelDesign)	– Initial exploration of new resource combinations, attempted combinations, un-combining and discarding resources (Antrox and NelDesign)	– Antrox (Mr Giraldi) meets NelDesign (Mr Raschiatore) – Technical collaboration project, Antrox-NelDesign – Antrox takes the lead of the R&D project and intensifies contacts with NelDesign	– Proposer and explorer with focus on matching technical solutions and general needs – Reconfiguring idea and agreeing on workable solutions – Technical leader – Simple and focused roles especially as small firms are involved
Solution co-creation	– First product Antrox LAB is developed – First attempt at commercializing the product Antrox LAB fails – Coating process revised – New version of the product is created: the birth of Deko	– Market knowledge (network actors and users) and market sensing (Antrox) – Antrox's and NelDesigns' relationship to local suppliers – Recombination of LED solution (Antrox) with different coating on the polystryrene carving (NelDesign) – Deep interactions about technical resources between Antrox and NelDesign	– Assessing many previous combinations and re-combination of resources into a new crystallized idea (Antrox, NelDesign, new supplier)	– Antrox set-up meetings with opinion leaders – Antrox and NelDesign intensifies their collaboration to find technical solutions – Antrox engages with a new supplier of coating	– Connectors to a broader network of actors – Evaluators – Experts and influential actors – Technical problem solvers
Complementary co-creation	– Deko is shown to Studitalia – Studitalia offers a business opportunity to Antrox – Deko is the specified material in new building project – Antrox accept to elaborate an economic proposal for FourZone	– Relationship between Mr Massimo Rinaldi (Antrox) and Mr Massimo Bertelli (Studitalia) – Contract specification relationship between Studitalia and DCC – Relationship between DCC and FourZone – Beginning interaction between Antrox and FourZone	– Combining technical resource (product) with services, marketing and communication resources and complementary knowledge (Antrox, Studitalia, FourZone)	– Antrox set-up meetings with potential customers (architects and small distributors) – Antrox meets Studitalia in Dubai and an alliance to push Deko is formed – Antrox meets FourZone for the first time in Dubai	– Marketer & communicator – Reputation builder over broader network – Project gate keeper – Supporter of core solution by recommendation – Influencer in one-to-one relationships
Activated co-creation	– Technical discussions Antrox-FourZone's site manager – NelDesign	– Technical implementation and production of a larger scale project (NelDesign and Antrox)	– Implementing final resource combination in a fixed installation that realizes co-created value. – Further intangible service resources combined with focal technical	– Adversarial and hard negotiations between Antrox and FourZone – NelDesign involves suppliers (new and old)	– Negotiator – Requirement setting – Challenger and skeptic

(***continued***)

Table 2

Analysis of sub-processes					
Sub-processes	**Key episodes**	**Major resource combinations**	**Resource processes**	**Collaborations**	**Actors' roles**
	finalizes prototype of Deko with support of Antrox – Issues with the technical documentation – Antrox's proposal is accepted by FourZone – Struggles with packing Deko and its logistics organization – Antrox accomplishes its technical tasks – Final checks on Deko and its documentation – Deko is shipped to Dubai – Installation is completed in summer 2017	– Face-to-face information sharing (NelDesign and FourZone) – Information resources such as assembly manuals and other materials (NelDesign and Antrox) – On-site expertise and knowledge sharing (NelDesign, Antrox, FourZone and local lighting contractor)	solution to enable actual value-co-creation. – Final adaptations to local installation conditions (Antrox, NelDesign, FourZone, local installer)	to solve final technical problems – Antrox shares technical documents with FourZone – Technicians from Antrox and NelDesign teach and advice FourZone at the construction site	– Adaptor – Teacher – Final problem solver and enabler

advising became the key contents of the collaboration involving Antrox, NelDesign, FourZone and the local installer. Collaborations and interactions changed during the fourth sub-process compared to the previous ones, and so did also the roles played by the various actors, which were also heterogeneous. Antrox acted as *negotiator* together with FourZone, who instead played the role unilaterally of *setting requirements*. Moreover, FourZone had, maybe as part of its negotiation tactics, also a role of *challenger and skeptic* of the solution proposed by Antrox, both in technical and economic terms. NelDesign played a key role as *adaptor* of many technical resources to fit transportation constraints and, together with Antrox, also acted as *teacher* for the customer and installer. Together, Antrox and NelDesign accordingly had a key role as *final problem solvers* and *enablers* at the end of this sub-process.

In addition to identifying the four sub-processes and their detailed contents as described above, another key finding of our study is recognizing the *changes in intensity and breadth* of the inter-organizational interactions that comprise a value co-creation process. In fact, Table 2 shows an acceleration of activities and resource combinations/re-combinations from a sub-process to the next: after a slow start, things start going quicker when the ball of value co-creation gets rolling. In particular, such an acceleration happens when bespoke projects are initiated, because they include their own deadlines for when various stakeholders, direct and indirect (final) users, expect to have realized the value they are paying for (for example, a new building with an innovative lighting solution). All activities become accordingly stressed to realize this value and all actors start to collaborate with an accelerated pace to meet the deadlines. Ample time for experimentation is no longer available in the later sub-processes of the value co-creation journey and economic terms become central, mainly due to the larger scale of production and the bigger contract at play compared to when the initial solutions were simply tested in a smaller scale between two collaborating partners, strictly a supplier and its direct customer. Even if, in this value co-creation journey, tests are conducted at the very last moments prior to sending the final solutions to the installation site – the "final place of value co-creation" – these tests are done with a clear focus on measuring and achieving particular results and with pressure to meet the final delivery deadline.

We can assume that this increased intensity and acceleration of interactions may well be a general characteristics of value co-creation journeys when they approach their later sub-processes. Increased speed and intensity of interactions in the various sub-processes seem to signal key episodes in the co-creation journey, such as the need to address technical problems or otherwise dissatisfied customers, or the need to connect tightly the three settings of development, producing and using (Håkansson and Waluszewski, 2007; Baraldi *et al.*, 2011). These aspects deserve to be studied deeper, also in other cases in new empirical settings.

Finally, looking at the actors' roles column in Table 2, one can see the great number of roles played by the actors involved: all in all, about 20 different roles were performed by the four main actors (Antrox, NelDesign, Studitalia and FourZone),

which indicates that the same actor performs multiple roles that change along the value co-creation journey. This is not surprising, as many activities need to be performed ranging from idea generation to product development, from prototyping to actual delivery and training. Moreover, technical as well economic issues need to be addressed, which also suggests the need for multiple roles to be played along the journey. Finally, with the growing number of actors appearing on the scene as the journey proceeds, more roles are played by these new actors and in response to them. The emergence and number of roles is clearly case specific, but this pattern of an increasing number and varying roles is likely common to other value co-creation journeys and should be accordingly analyzed in similar studies.

6. Conclusions

In this paper, we explored the phenomenon of value co-creation as viewed from an IMP network perspective and as a longitudinal process whereby actors combine resources through interactions and especially deeper former of collaboration. In fact, the process-like nature of value co-creation reflects the need to embed any new solution in the structure of the involved network (Håkansson and Waluszewski, 2002; Baraldi *et al.*, 2011) and the complex and demanding interactions whereby resources are assembled and combined to create innovative solutions (Ciabuschi *et al.*, 2012; Håkansson and Olsen, 2012). In our study, we avoided a pre-assigned view of the actors, their interaction pattern, their roles and how resources were combined. Instead, we captured value co-creation as "reality-in-flight" – unfolding in a network over time, according to a process perspective (Pettigrew, 1997). Combining a process-based view of value co-creation with the resource interaction approach (Baraldi *et al.*, 2012; Bocconcelli *et al.*, 2020) of the IMP tradition enabled our study to position value as an ongoing phenomenon, which accompanies and reflects a technology's development in our longitudinal case study.

In the main, prior empirical research provides an understanding of the protocols and skills needed to collaborate such as information sharing, trust and problem-solving (Aarikka-Stenroos and Jaakkola, 2012; Lynch *et al.*, 2016; McEvily and Marcus, 2005). We also comprehend the rationale for combining the notion of value co-creation with the markets-as-networks (or IMP) approach featuring actors interacting in a network (Cova and Salle, 2008) with the complexities of the structure of co-creation (Frow *et al.*, 2015). We propose to frame the phenomenon of value co-creation in a network context though the notion of a co-creation *journey* – a metaphor which enables us to capture how actors' roles and their collaborative interaction patterns, through resource combining, recombining and un-combining, unfold over time. The co-creation journey in our case study is a nine-year one and is made possible by a network of collaborating actors, but similarly it is constrained by this network context and, at the same time, singularly shaped by this network. Our value co-creation journey has parallels to other studies using an IMP approach that focus on a network of actors involved in a value creation process including Aarikka-Stenross *et al.*'s (2017) study of how diverse actors are involved in an innovation process over time, and Breidbach and Maglio's (2016) exploration of the value co-creation roles of different actors in a technology-enabled transformation process.

This paper provides mainly two contributions. First, it outlines the value co-creation journey by identifying its four key sub-processes and, second, it identifies the roles played by the involved actors during the unfolding of the co-creation process. In particular, we have partitioned the co-creation journey into four sub-processes, which represent significant collaborative episodes in the development journey. These sub-processes are grounded in the particular patterns of combination and transformation of the resources involved and may provide theoretical bracketing for future studies on various change processes, such as product development or innovation, relying on the interaction and interdependence assumptions of the markets-as-networks, IMP approach. The four sub-processes were labeled as – opportunity co-creation, solution co-creation, complementary co-creation and activated co-creation. They are characterized by distinct collaborative episodes and are unique in terms of the roles actors perform and the resources combined. Importantly, the co-creation journey is not completed until the last sub-processes, when the new technical solution is installed on-site and the financial and value-in-use is realized by the actors.

The co-creation journey, as conceived in this paper, is evolutionary and interdependent on actors to participate, undertake multiple and single roles, share, withdraw and adapt resources and to perceive the value in this process. A co-creation journey unfolds and spreads out across the network and can take considerable time in its pathway to value being realized, as witnessed by the nine-year long process of our case study. This unpredictable journey is dissimilar to innovation or development processes involving fewer actors and under the control of fewer actors, where a linear pathway from idea generation to realization can be sequenced in a more lifecycle fashion or indeed to co-created innovation where actor roles and resource contribution are pre-specified and development cycles are planned (Cousins *et al.*, 2006; Petersen *et al.*, 2005; Rothaermel and Deeds, 2004; Yeniyurt *et al.*, 2014). Indeed, being a journey, the co-creation process can stop abruptly during any of the four sub-processes that we have identified (Van de Ven *et al.*, 1999). While the case we analyzed features a process that reached its "destination" in terms of value being actually co-created for final users, cases of co-creation journeys that were terminated should also be investigated and compared with those that were brought to completion.

The resources used and combined among actors in the co-creation journey include many resource types, both tangible and intangible (Håkansson and Waluszewski, 2002; Baraldi *et al.*, 2012). It is not possible to identify a priori which particular resources are relevant for the specific co-creation journey, but they will become visible along the process when they are mobilized (Huang and Nenonen, 2022; Gadde *et al.*, 2012; Ford *et al.*, 2008; Ritter and Gemünden, 2003) between the actors. Another feature of the resources used in the studied network is that they can be combined, recombined and uncombined as needed by the actors. Another important finding from our single case, which deserves to be validated by other studies, is that the underlying processes of resource combination happen quite seamlessly and seem to have the

ability to overcome momentary obstacles: in particular, when resources need to be uncombined as they do not enable value co-creation, these episodes do not seem to affect the resilience of the network, which just continues working as a system for the actors involved (Kleinaltenkamp *et al.*, 2012; Vargo and Lusch, 2016, 2017). In particular, this paper provides a dynamic view of such an embedded system, showing changes in its structure, composition and, especially, the roles played by the various actors during the unfolding of the value co-creation journey. These roles are presented in detail in Table 2, which shows that multiple actors are needed to enable the co-creation journey and that the actors sometimes play multiple roles simultaneously. We identified unique roles, up to twenty, and label many of these roles according to the moment in the process when they appear and the particular activities they entail, as for example, connector, influencer, explorer and evaluator.

Our research has limitations, but opens many avenues for further research. We are aware that we took a particularistic view of the co-creation process and applied an abductive theory building approach, which is open to criticism and perhaps another co-creation process and methodological approach may yield a different result, for example, a more linear framed model would have entailed different sub-processes, or even periods being singled out. We consider our combination of theoretical assumptions, grounded on a processual view and the metaphor of a value co-creation journey, to offer a substantial contribution to understanding how a new solution's value is co-created in a network. The potential of each of the four sub-processes as a framing device on collaborative, co-created innovation and the associated resource combining patterns and roles presents opportunities for research application to other network settings: in particular, other cases of co-creation processes should be studied to verify to what extent the sub-processes and roles we identified in our study are common to other empirical settings. Another exciting avenue for further research is to continue to study the longitudinal process beyond the fourth sub-process (activated value co-creation) to see if it is possible to identify new sub-processes characterizing the diffusion of the technical solution in further installations to understand in which ways subsequent activities, roles, and resources combinations of value co-creation unfold.

For managers, recognizing which particular sub-process of the value co-creation process a company is operating in can provide relevant implications as to which particular interactions and collaborations would be needed to propel the journey to the following sub-process, as well as which particular actor roles would contribute to these important transitions all the way to "activated co-creation" and widespread utilization, when providers can collect the revenues that can hopefully compensate the costs incurred during the preceding sub-processes. Managers should also be able to switch from analyzing what happens in each of the sub-processes to how the various sub-processes are linked across the entire co-creation process, so to capture opportunities to learn how to cope with the value co-creation process as a whole when they experience it the next time.

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