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Value creation in the market ecosystem: A Service-Dominant logic perspective

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Abstract

A conceptual platform for value creation in market ecosystems is proposed in this study, which extends the Value-based Strategy view and models market interactions under the Service-Dominant logic. The platform helps addressing a number of emerging questions, such as: (i) how stakeholders offering concrete value propositions interact with stakeholders bearing unique value dispositions in a Service-Dominant prevailing market setting, i.e. a service ecosystem, and (ii) how firms position themselves favorably toward rivals through exploiting emerging Service-Dominant market insights. We posit that the firm's co-creation capacity and the customer's willingness to co-create are fundamental towards helping firms differentiate themselves from competition. On that basis, we identify four value co-creation strategies which can lead to competitive advantage. To demonstrate the applicability of our platform, we then develop a set of games and emphasize on its business relevance through a case study. The macro insights gained from the value co-creation phenomenon in a market transaction within a service ecosystem are highlighted throughout.

Keywords: value co-creation, Service-Dominant logic, Value-based strategy, service ecosystem, value propositions, cooperative game theory

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Introduction

Operating within globalized "service economies", firms nowadays are competing in interconnected markets with informed, empowered, and active consumers, who often ask for "integrated bundles of customer-focused combinations of goods, services, support, self-service and knowledge" (Prahalad and Ramaswamy 2004a, p. 6; Raja et al. 2013, p. 1130-1135). The focus in business interactions has diverted from being goods-centric to service-centric, even in a manufacturing context (Kastalli and Van Looy 2013; Suarez et al. 2013; Guajardo et al. 2015), ushering in an era of a *Service-Dominant (S-D) business logic* (Vargo and Lusch 2004; Lusch and Vargo 2006b; Vargo and Lusch 2008; Vargo et al. 2008). At the same time, a new market concept of a *service ecosystem* has been emerging (Lusch 2011; Chandler and Lusch 2015), which, among others, emphasizes on the significance of the inclusion of end-users in the value creation process. In this new business rationale, *value co-creation* among firms and their stakeholders forms a pivotal concept: it constitutes a strategic goal that can help firms identify and understand customers' needs, desires, and perspectives (Lusch and Vargo 2006a; Payne et al. 2008). Recent literature in service science, strategy, marketing and operations management has, in fact, focused on the importance, benefits, and mechanisms of co-creating value with customers. In much of the existing work however, the value co-creation process is conceptualized in a rather myopic manner: it is isolated from the rest of the market ecosystem and focuses solely on a microscopic analysis of the interactions in the firm-customer dyad. Existing literature currently lacks a model that integrates *value co-creation propositions* (i.e. the ensemble of a series of co-creation activities a firm can facilitate on the basis of its *co-creation capabilities*) and *value co-creation dispositions* (i.e. the stakeholders' ability and willingness to co-create) in the value creation process within the wider context of a market ecosystem. Failing to recognize the importance of such an approach discourages practitioners from placing the co-creation notion into the

perspective of a wider market context and subsequently forming successful strategies to differentiate.

In line with Vega-Vazquez et al. (2013), who stress that "…there is great interest for a new reference framework for value creation, centered on the co-creation process" (p. 1946), we hereby propose a conceptual platform for analyzing the value creation and co-creation process of market interactions within service ecosystems while adopting a *macroscopic* view. To this end, we argue that context is undoubtedly both affecting, as well as affected by the value co-creation process: on one hand, both the value network and the wider market ecosystem play a significant role in the value creation/ co-creation process of the transaction, as the customer may actually engage in a transaction and/or change his unique co-creation disposition, on the basis of how this relates to the stakeholders' co-creation propositions. On the other hand, the acquisition of co-creation capabilities may constitute a competitive advantage for the firm towards competition, encouraging the firm to invest in amplifying its co-creation proposition. The above are illustrated later through a case-study of a mobile network company, which invests in a community-based business model to facilitate co-creation practices of various forms. Customers interested in such practices choose this specific provider over others, because its business model tallies with their co-creation disposition (context -affecting - the co-creation process). Moreover, the strategic choice of this firm to continually reinforce its co-creation proposition provides a competitive advantage (context - affected by - the co-creation process). In both cases, context has a determinative impact on the value created/ co-created among stakeholders, and cannot thus be ignored when forming a value-based strategy.

Our work builds on and extends the seminal work on the *Value-based Business Strategy* of Brandenburger and Stuart (1996). More specifically, we hereby argue that the Value-based Strategy view, if reframed on the basis of the S-D perspective to include value co-creation propositions and dispositions of stakeholders, may provide a rich model platform for studying

value creation of modern market transaction interactions, in a value network within an interconnected market ecosystem.

The purpose of our work is therefore to shed light on *the value creation interactive mechanism within a wider transaction context*, and investigate how firms can form and benefit from integrated *value co-creation strategies*. This work: i) extends current literature by offering a novel conceptual platform to act as a strategic tool for studying stakeholders' interaction in business market ecosystems under the S-D logic, ii) emphasizes and focuses on the macro insights emerging from the value co-creation process, placing the value co-creation research within a broader market context, and iii) presents a number of empirical implications while identifying a series of value co-creation strategies, which may help managers and practitioners form successful business strategies that can lead to competitive advantage.

The rest of the paper is organized as follows: in the next section, we present the theoretical background of this work. We then analyze and present basic conceptual considerations and state our research questions. Thereafter, we briefly review the Value-based Business Strategy – its strong, as well as weak points. We then elaborate on the co-creation variables of customer Willingness to Co-Create, Co-Creation Cost and firm Co-Creation Capacity and subsequently showcase, through a simple cooperative game, how these new elements are placed in our market interactions' platform. Next, we identify four co-creation strategies, articulate them as theoretical propositions and showcase them as hybrid games with many players. Last, a case study on the successful co-creation practices of the UK mobile company Giffgaff is discussed, illustrating the importance of applying these co-creation strategies in real market contexts. We conclude with future work and some further research propositions.

Theoretical background

In this section we first discuss the emergence of the service logic in business, and present its main points and fundamental concepts. Our line of argumentation is initially unwrapped through a strand of closely interrelated facts: since the 1960s, services have been gradually outperforming manufacturing in many of the world economies (Heineke and Davis 2007). Soon, the dichotomy between products and services began to rapidly vanish (Kotler 1977), making the pursuit of servitization a priority for many manufacturing industries (Neely 2008). Nowadays, most firms share the aim to "offer fuller bundles of customer-focused combinations of goods, services, support, self-service and knowledge" (Vandermerwe and Rada 1988). Not surprisingly, the realization of services' significance is well-established, in business and academia alike (Heineke and Davis 2007), where these major market transformations and their specific implications are objects of study in the fields of marketing, strategy and operations management, as well as within the newly emerging disciplines of service science (Chesbrough 2005; Horn 2005) and service operations management (Heineke and Davis 2007).

The service-dominant logic

In the last ten years, the service-dominant logic or S-D logic emerged as a new business paradigm (as opposed to the formerly dominant goods-grounded logic) for understanding modern economic exchange and value-creation (Vargo and Lusch 2004; Lusch and Vargo 2006b). According to the S-D logic, service is the fundamental basis of exchange among all actors, who interact as resource integrators to co-create value (Vargo and Lusch 2004). An exhaustive literature review on the S-D logic is beyond the scope of this paper. However, we will next briefly discuss some of the foundational premises of the S-D logic outlined by Vargo and Lusch (2004; 2008) that provide the building blocks of the conceptual constructs we propose in this paper.

The concept of value co-creation is central in S-D logic: value is viewed from a service-grounded perspective and is co-created among the various actors who interact within the market ecosystem, with both the firm and consumer always considered co-creators of value (Vargo and Lusch 2008; Vargo et al. 2008). According to the S-D logic, customers are an integral part of value creation; the firm becomes a facilitator rather than a supplier of value that works out value proposals and may get the opportunity to become a co-creator of value during interaction (Grönroos 2008; Vargo and Lusch 2008). Furthermore, value is not inherent to a product and created within the boundaries of a firm, but it is what customers get out of the product (Karpen et al. 2012). The view of value as "value in exchange" is tied to the monetary revenue in return for the firm's product/offering and has its roots to the G-D logic. Without ignoring value in exchange, S-D logic principally highlights "value in use", i.e. "the value that users obtain from the experience of using a marketplace offering and integrating it with other resources" (Lusch 2011). The concept of "value-in-context" is also of primary significance: in S-D logic, value is considered a contextual, idiosyncratic, phenomenological outcome, which is uniquely determined by the individual customer (Grönroos 2006; Vargo and Lusch 2008). Customers are not seen as isolated targets but as social partners, with whom relations are collaborative and favorable (Grönroos 2007; Tuli, et al. 2007). Last but not least, in accordance with the resource-based view of strategy (Wernerfelt 1984; Barney 1991; Conner 1991), the S-D logic states that customers, firms and their partners deploy and integrate both operand (physical), but mostly operant (non-physical) resources to co-create value (Vargo and Lusch 2008). S-D logic views operant resources such as knowledge, skills and dynamic capabilities (e.g. speed and adaptability) as a fundamental source of competitive advantage (Lusch 2011). Interacting firms proactively partner with other stakeholders into interorganizational co-creation relationships to acquire the operant resources they lack; also, customers depend on their access to operant resources to co-create value (Möller 2006; Vargo and Lusch 2008).

The above can capture the complex, multidimensional nature of modern market transactions, where the exchange offering is a customizable bundle of services, products, information and support, resulting in its final form through meaningful interactions among the firm, its network of partners and connected, informed, empowered, and active consumers (Prahalad and Ramaswamy 2004a). This multi-perspective S-D view of transactions in the market ecosystem is the corner stone of our paper's reasoning.

The value co-creation process

Value co-creation in the S-D logic is also fundamental to our discussion. In general, the concepts of value, value creation, and value co-creation are still characterized as ill-defined in the management literature (Grönroos 2011; Sànchez-Fernàndez and Iniesta-Bonillo 2007). Due to the abstract and ambiguous nature of the value co-creation concept, the literature focuses on either understanding the concept through empirical approaches (e.g. Kristensson et al. 2008; Ramaswamy 2008; Andreu et al. 2010; Sarker et al. 2012; McColl-Kennedy et al. 2012; Kassinis and Soteriou 2016) or shedding light on the mechanism of value creation per se using conceptual models.

A number of important pieces of work have recently contributed to a more thorough understanding of the value co-creation process. For example, Grönroos (2011) extensively discusses the notion of value, value creation, and co-creation under the S-D logic and concludes that the customer creates value, and the firm facilitates value creation. He further stresses that the basic contribution of the S-D logic to the concept of value creation is not that customers become co-creators of value but rather that firms get opportunities to become co-creators of value with their customers only when direct interactions between firm and customers exist (p. 290). Grönroos and Voima (2013) further propose a model based on the aforementioned rationale, which consists of different value creation spheres that coexist in a transaction: the provider

sphere, where the provider acts as the value facilitator and produces the resources of potential value, which customers later turn into real value (-in-use); the customer sphere, where independent creation of value-in-use happens; and a joint sphere, where real value is jointly co-created when the provider and the customer interact directly. A similar conceptualization is provided by Grönroos and Ravald (2011), who divide the customer's value creation process into an open and a closed part. In the open part, during interaction, joint value creation of the firm with the customer may happen. In the closed part, the firm is not present as a co-creator of value. Likewise, the firm's process is divided into a production phase, where value creation is facilitated, and an interaction phase, where interaction happens. Last, Zhang and Chen (2006, 2008), emphasizing on the acquisition of operant resources, propose a customer participative chain model according to which a firm may involve customers in a series of co-creating activities and turn their inputs into new capabilities; this way, customers obtain their customized products/services and the firm gains new competitive capabilities.

Towards a Service Ecosystem

There is also a string of literature that views market interactions from a systems or network perspective and studies value creation accordingly (e.g. Chandler and Lusch 2015; Vargo et al. 2012; Fyrberg and Jüriado 2009; Vargo et al. 2008). The network view has been gradually adopted beforehand in the supply chain management (SCM) research, as supply chains have evolved from linear arrays of market actors (e.g. Handfield and Nichols 1999) to complex supply networks (e.g. Johnsen et al. 2008; Lamming et al. 2000; Lambert et al. 1998). The S-D logic goes a step further and views supply chains as value co-creation networks (Tokman and Beitelspacher 2011). Lusch et al. (2010) and Lusch (2011) specifically stress that the SCM research is a natural fit with S-D logic, and that shifting the prevailing thinking of SCM towards the S-D rationale may lead to new paths for research and organizational excellence. In S-D logic, a supply chain is explicitly referred to as a *service ecosystem*, which "views actors as making

value propositions to each other versus delivering or adding value"... and "puts emphasis on the co-production and co-creation that occurs between actors, focusing on collaborative processes" (Lusch et al. 2010; Lusch 2011).

Chandler and Lusch (2015) build a compelling proposition of a theoretical alternative of the market as a broader, dynamic, nonlinear service ecosystem; in their work, they elaborate on the importance of *value propositions* as invitations from actors to one another to engage in a service, and as catalysts of the actors' *service experience*; *customer engagement* is considered a function of five properties, namely temporal and relational connections (i.e. external properties of time and context/network) and past, present and future dispositions (i.e. internal actors' psychological states/proclivities in relation to time). When all properties are aligned through the catalytic effect of proper value propositions, customer engagement happens. Transactions within the service ecosystem are described as many-to-many engagements of actors through the notion of a service experience, and the whole service experience cycle is discussed. This conceptual depiction of a service system described by Chandler and Lusch (2015) is greatly appealing for a number of reasons. Among others, it helps with exploring how a service experience evolves with respect to actors' value propositions and customer engagement in the service system; it stresses the importance of value propositions; it helps with decoding the distinct properties of customer engagement considering actor's internal proclivities, time and context; also, it ultimately brings all components together under the notion of the service experience. Nevertheless, we argue that developing a *value-based model* of the market ecosystem may further assist towards exploiting the ecosystem's qualities at a practical, strategic and/or operational level. Furthermore, highlighting the co-creation "merits" (and/or co-destruction "evils") for the actors of the service ecosystem is important. Since Chandler and Lusch's (2015) framework radically deviates from the market's standard neoclassical economics view, a different approach may be needed.

Conceptual Considerations and Research Questions

Adding to the above point, we further stress that an important omission in many of the existing conceptualizations of value co-creation we previously reviewed is that, in these models, the value co-creation process between the customer and the firm is viewed at the micro-level of the transaction - *in isolation from the market ecosystem*, as if it is not affected from external value co-creation propositions. Contrary to this limited view, we propose that co-creation must be modelled in a way that considers both the value network and the wider market ecosystem where the customer and the firm interact. This macroscopic logic adopts a network view of market transactions - a service ecosystem view, and can greatly help in strategy forming; it is also in line with the contextual view of the value creation process (*context affecting value co-creation)* in the S-D logic (Vargo and Lusch 2008), as well as with current management literature that acknowledges the importance of co-creation capabilities in the pursuit of competitive advantages (*value co-creation having an impact upon context*) (Prahalad and Ramaswamy 2004a; Volberda et al. 2010; Andreu et al. 2010; Karpen et al. 2015). Essentially, a customer can choose to engage in a transaction with a firm based on that *firm's co-creation proposition* (Grönroos and Ravald 2011) as opposed to the co-creation propositions of its competitors. In this context, a firm can invest in further developing its *organizational co-creation capabilities* to enhance its *organizational co-creation proposition* or not. Also, customers can choose to interact with a firm, putting the minimum co-creation effort necessary for the transaction to be successfully fulfilled or further amplify their *co-creation disposition,* i.e., their ability and willingness to co-create.

In light of the above, two important questions emerge: *How do stakeholders interact through their value co-creation propositions and dispositions in the wider value network, within the market ecosystem?* And, *given the wider market ecosystem, how can firms form and benefit from integrated value co-creation strategies?* Current literature lacks a theoretical interactions framework for macroscopically analyzing the value co-creation interplay among stakeholders in

the value network and among players in the wider market context. Such a framework could further have a number of empirical implications and may help addressing various practical questions of significant business relevance, such as for example in which ways can firms use their co-creation propositions to attract customers and/or get significant extra value; how should firms adjust their co-creation proposition and what alternative co-creation strategies can they apply on the basis of the current market ecosystem; how actors deal with conflicting value propositions in the market; what changes if a new firm enters the ecosystem; how can customers benefit from their co-creation disposition, etc.

In this paper, we propose a novel theoretical interactions platform for value co-creation dispositions and propositions in the context of a market ecosystem, which builds on the Value-based Business Strategy of Brandenburger and Stuart (1996). In other words, we attempt to extend the Value-based Strategy view using the cognitive tools of the S-D logic by incorporating the fundamental notion of value co-creation. In doing so, we seek to augment our understanding of the value co-creation process within a broader interactions context and to develop a strategists' tool to identify the successful value co-creation strategies that may lead to competitive advantage for the actors involved.

Value-based Business Strategy

Brandenburger and Stuart (1996) proposed the Value-based Business Strategy view to define the value created by firms together with their suppliers and customers, as well as the value appropriated (the "added value") by each stakeholder; they further identified four "value-based" strategies that lead to a competitive advantage for firms (a "positive added value"). Following Porter (1980, 1985), Brandenburger and Stuart argued that value is created by the interplay of a vertical chain of players (customers, firms, suppliers), and used analytical tools of cooperative game theory to model the free-form interactions among market players to reach their proposed value-based strategies.

A few points are worth noting. First, a serial, chain view of transactions is adopted – a conception that has been overtaken by the complex network structures of modern transactions as previously discussed. Also, Value-based Business Strategy utilizes game theory and assumes actors behave rationally; competition is conceptualized upon the notion of "unrestricted bargaining" that can be summarized as "no good deal goes undone" (Chatain and Mindruta 2017). Furthermore, an economic,
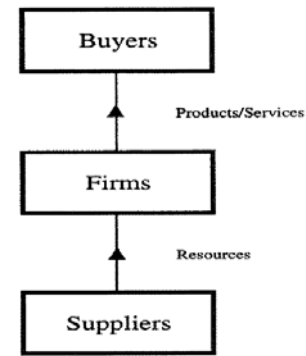

Figure 1: The value chain according to Porter (1980)

production view of value is adopted, which is a rather narrow, simplified view that does not include non-monetary variants of value (e.g. knowledge, relational value, etc.). Most importantly, value is conceptualized according to Porter's (1985) definition that "value is what customers are willing to pay". As a matter of fact, Porter's (1980) conceptualization of the value chain was proposed in a manufacturing-driven era (Heineke and Davis 2007), thus market transactions of that time are described under a goods-dominant logic. Indeed, as shown in Figure 1, the flow of communication in Porter's representation is linear and one-way: from the supplier to the firm to the consumer. Implicitly, this view makes the assumption that firms act as autonomous entities during product design, production and marketing, which means there is no interaction with or interference from customers during these processes, who only get involved at the time of transaction (Prahalad and Ramaswamy 2004a). Under this view, the process of value creation is firm-centric and the interactions between firms and customers are not seen as a source of value creation (Porter 1985, Wikstrom 1996). We further note that in the Value-based Business Strategy, the concepts of "willingness to pay" and "opportunity cost", as defined through their respective thought experiments (Brandenburger and Stuart 1996, p. 8-9), clearly do not embody the notion of value co-creation: by the definition given, the customer decides what he is willing to pay for a service or product *in isolation from the wider context of the transaction,* and therefore the additional value generated from the interaction per se is not taken into account. Similar

argumentation also applies to the definition of opportunity cost, as the supplier defines the opportunity cost in isolation from the wider market context. Thus, the value generated from co-creation activities is neither portrayed nor considered in the Value –Based Strategy view.

Interestingly, although the willingness to pay (WtP) is assumed to be explicitly defined with opportunities outside the game "on the basis of well-defined prices elsewhere in the economy" (Brandenburger and Stuart 1996, p. 9), the very definition of the WtP does not preclude customers having different WtP for the same bundle offering. To this end, an example provided by Brandenburger and Stuart for determining WtP in real contexts (p. 8) is quite revealing. Specifically, in the case of an industrial buyer of a piece of equipment, they identify as the willingness to pay the savings in the buyer's operating costs from the utilization of this new equipment (which will be ultimately calculated on the basis of well-defined prices elsewhere in the economy). This means that two different customers may evaluate differently the offering (e.g. in terms of their projects' particularities) and will thus be willing to pay different amounts for the same bundle offering. This is an important observation that leaves room for the phenomenological view of WtP in the model of Brandenburger and Stuart, albeit its G-D orientation. Relying on this observation which is fundamental to the S-D paradigm, we argue that the Value-based Strategy view can be reframed on the basis of the S-D logic: by integrating co-creation propositions and dispositions in a broad contextual setting, a novel model platform can be created for studying value creation from transaction interactions, in a value network within an interconnected market context. We next define three concepts that are fundamental to the construction of our model: the customer's Willingness to Co-Create, the Co-Creation Cost and the firm's Co-Creation Capacity.

Customer Willingness to Co-Create, Co-Creation Cost, firm Co-Creation Capacity

The core concept of S-D logic is that the customer is always a co-creator of value (Vargo and Lusch 2008). There is, therefore, co-creation of value in all transactions: co-creation is required in

part for conducting basic functions of the transaction and in part for conducting potential voluntary, additional, functions of the transaction. In this light, Groth (2005), Bove et al. (2008), Yi et al. (2011) and Yi and Gong (2013) refer to customer *in-role (or participation)* and *extra-role (or citizenship) behaviors* that both facilitate co-creation between the customer and the firm: customer in-role behaviors are necessary for successful service delivery such as consenting to a medical treatment, providing the necessary personal data to check a banking account, paying for a service, etc. In contrast, extra-role behaviors are voluntary behaviors enacted towards the firm or other stakeholders, which are not necessary for the core service delivery, such as supporting other patients, providing evaluation feedback for the bank, actively promoting a service, etc.

Customer's Willingness to Co-Create

Customers co-create with firms in different ways and on the basis of their specific needs (Sampson and Spring 2012), they therefore have different willingness for co-creation during transactions. Handrich and Heidenreich (2013) conceptualize a customer's Willingness to Co-Create in the context of technology-based services. In line with Prahalad and Ramaswamy (2004b), they define Willingness to Co-Create as "a condition or state, in which a customer is prepared and likely to create value together with the company by actively engaging in the service provision and consumption of a technology-based service" (Handrich and Heidenreich 2013, p. 9). In this context, they develop a construct to measure Willingness to Co-Create and identify three dimensions: effort, information sharing, and customization. Essentially, in line with Ennew and Binks (1999), who claim that customers participate only if they anticipate benefits from the relationship, Handrich and Heidenreich (2013) argue that customers are only willing to engage in co-creation if the benefit (i.e., a high degree of customization) outweighs the costs (i.e., the effort needed, as well as the uncomfortable feeling to share personal information necessary for co-creation activities). It is also implied that the value derived from co-creation for the customer is in the form of a higher degree of customization. Other benefits for the customer that engages in co-

creation may include enhanced knowledge, reputation, intrinsic benefits like self enhancement, or social motives like desire to support the firm, as well as tangible benefits, like various economic savings or expectations of those (Choi and Lotz 2016; Füller 2010; Nambisan and Baron 2009).

In this work, we define the *Customer's Willingness to Co-Create (WCC)* as the disposition *and ability*[1] of the customer to co-create value with the firm. In our model, a customer's WCC can be thought of as a proxy of the customer's actual engagement, as defined in Chandler and Lusch (2015). As a consequence, the overall willingness of an actor to co-create is also a function of his external temporal and relational connections and his internal past, present and future dispositions; this means that WCC is influenced by the customer's intrinsic psychological states, as well as the exterior context, value network and time; for the customer to become ultimately engaged, these properties should be aligned through the catalytic effect of the firm's value proposition. E.g. the decision of a customer to review online a hotel stay happens on the basis of a concrete hotel value proposition; the customer's decision is further influenced not only by the current experience but also by the customer's former experiences with the hotel or other hotels. The online social

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[1] We extend the WCC definition as presented in Handrich and Heidenreich (2013), to include not only an individual's willingness (aka intention), but also his *ability* to co-create, since S-D logic stresses that customers depend on operant resources such as knowledge and skills, to co-create value (Möller 2006; Vargo and Lusch 2008). We notably define the WCC as the *interaction* of willingness with ability, on the basis of the notion that they are two intrinsically bound, interrelated terms, since willingness may be confined by one's abilities. For instance, an individual may demonstrate high willingness to evaluate a service online but he may be constrained to do so by his limited ICT skills. Furthermore, according to Triandis (1977, 1979), the probability of an act P(a) can be expressed as follows: $P(a) = (w_1H + w_2I)\,F$, where H denotes habit, I intention, and F denotes facilitating conditions (e.g. one's ability to perform an act). In our setting H=0 (as we do not consider repeated behavior), thus the probability that an act will be performed is defined by the interaction of intention (willingness) and ability, which is accordant with our definition of the WCC.

community and the associated reviewing platform, as well as timing and other contextual factors may also affect the customer's decision.

There also exist indications that value co-creation is of a hierarchical nature. Specifically, Sweeney et al. (2015), while exploring customer value co-creation in health care, identified a hierarchy of value co-creation activities, which represent varying levels of customer effort—from complying with basic requirements to extensive decision making. Chandler and Lusch (2015) define also an actor's engagement as a scalable construct, which "occurs within a specific set of situational conditions generating differing customer engagement levels". We thus argue that WCC is also scalable consisting of the co-creation activities a customer is willing and able to engage into with a firm.

Furthermore and as previously discussed, a part of the WCC is intrinsic to the transaction, necessary for its successful conduct and fixed for all; without this part, the transaction cannot be successfully completed. We refer to this WCC part as the *in-role WCC*. The other WCC part is extrinsic to the transaction; it is "over and above" the in-role WCC and may require special capabilities and co-creation disposition from the customer to be fulfilled. We refer to this as the *extra-role WCC*. In our model, for simplification purposes, *we define the extra-role WCC as the willingness of a customer to participate in those co-creation activities that can be outsourced*, i.e. delegated to and implemented by a third party. Although limiting the scope of the extra-role WCC, since by definition relational and cerebral co-creation activities are excluded, we use this definition to quantify WCC in monetary terms. Specifically, since it can be outsourced, it is worth the value (e.g., a payment) a third party would accept to implement the specified activities.

To demonstrate the customer's in-role and extra-role WCC, let us consider the value co-creation activities of customers in health care as identified by McColl-Kennedy et al. (2012). 'Cooperating' refers to compliance with basics and accepting information and a customer

enacting this activity only demonstrates in-role WCC. When, however, a customer engages in any other of the activities such as 'Collating' information, 'Combining' complementary therapies, 'Colearning', 'Changing' ways of doing things, 'Connecting', 'Coproduction' and 'Cerebral Activities', he demonstrates extra-role WCC, over and above the basic requirements. Apart from connecting and cerebral activities, others could be hypothetically implemented by a third party (e.g. a counselor or a personal assistant) on behalf of a customer, which is consistent with our definition of the extra-role WCC. Another example from the tourism industry is when a customer books a hotel through a physical agent: he should initially provide personal information, accommodation requirements and dates, choose an option provided by the agent and then pay the agent. These are considered in-role WCC activities. If the customer chooses instead to make all search and necessary bookings through an IT-enabled platform and also evaluate online the respective services provided by the hotel after his stay, he demonstrates extra-role WCC (as he acts as the agent himself and an external evaluator).

It should be further noted that, depending on the available co-creation setting, the customer's WCC and WtP may be exogenously defined, independently from one another or, these value terms may actually relate to one other. To this end, Xia and Suri (2014) stress that there are many contexts where psychological and other non-monetary benefits might be sufficient for motivating the customers to co-create, and other contexts where such benefits are considered insufficient and customers choose to get engaged through monetary rewards. In various market transaction platforms, WCC is indeed correlated to WtP: this is the case when the customer acts as the employee himself (Mills et al. 1983) or co-produces (Ramirez 1999), i.e. completes a part of the actual work to save costs, e.g. when buying do-it-yourself furniture, or when booking online- thus saving any intermediate agent costs; also, cases where variable pricing or monetary incentives are used, depending on how much the customer is willing to co-create (Xia and Suri 2014), e.g. when issuing reward competitions for customers for the best new idea or logo design. There are also

alternative cocreation market settings, where the customer's benefits from co-creation may include other types of motivation than monetary, e.g. customization, knowledge, intrinsic/psychological or social benefits, etc. In these settings, WCC is independent to WtP. Examples include evaluating a product or service through reviewing systems e.g. through online Word-of-Mouth (Chevalier and Mayzlin 2006, Duan et al. 2008), mentoring other customers, contributing for free with ideas on new concepts or improvements of the offered value bundle through crowd-sourcing platforms, etc. Last but not least, some firms offer a mixed type of co-creation activities, including activities where WCC is both correlated with WtP, as well as exogenously defined. We will showcase later a prominent case study of this mixed type.

Co-Creation Cost

There is also an actual cost for the firm associated with co-creation activities and the WCC of the customer (e.g. operating and maintenance costs for the online travel tourism platform and extra personnel costs for the health care co-creation activities). This is called *Co-Creation Cost (CCCost)* and, in line with Brandenburger and Stuart (1996) and in a similar manner, we further define a *Co-Creation Opportunity Cost* for the suppliers. There is, however, a notable difference in relation to the cost and opportunity cost defined in Brandenburger and Stuart (1996): co-creation cost and co-creation opportunity cost are not fixed for a particular product/service, but they differ for different co-creation activities the customer chooses to engage in. Thus, they both vary with the customer's willingness to co-create.

A number of additional points should be mentioned: Firstly, not all value offerings require investments of high co-creation cost. Highly customizable offerings indeed require a high level of both customer engagement and investment, thus bear high co-creation cost; however, standardized offerings like commodity products/services do not usually require heavy customer involvement or extra investments. As a consequence, not all firms should invest in high-level co-

creative activities because these might not pay off due to the associated co-creation cost (Maas et al. 2014). Also, co-creation cost is -among others- an investment cost, and as other types of investments, it may be subject to diminishing returns; excessive investments of this kind may thus result into negative returns or deteriorating firm performance (Das et al. 2006). From the above points, it is obvious that no single optimal level of value co-creation exists, as Das et al. (2006) stress.

Firm's Co-Creation Capacity

As regards the co-creation capacity of the firm, a few things are worth noting. Lawer (2006) identified eight styles of value co-creation that firms practice, with different levels of firm-customer interaction and customer involvement, attesting to varying capacity levels needed. Karpen et al. (2012) propose six S-D capabilities (individuated, relational, ethical, developmental, empowered, and concerted) that facilitate and/or enhance collaboration with customers (and other network partners) to better integrate resources and create value. We therefore define the *firm's Co-Creation Capacity (CCCap)* as the compilation of co-creation activities a firm can facilitate through adopting a special mixture of S-D orientation capabilities, which are necessary to facilitate co-creation with customers, as described in Karpen et al. (2012). Essentially, the firm CCCap constitutes the *co-creation proposition* of the firm and sets an upper bound to the co-creation activities a firm can facilitate. As is the case for WCC, CCCap consists of a part of the firm's capacity to facilitate basic co-creation activities (essential capacity) and a part of the capacity to facilitate the extra-role WCC activities.
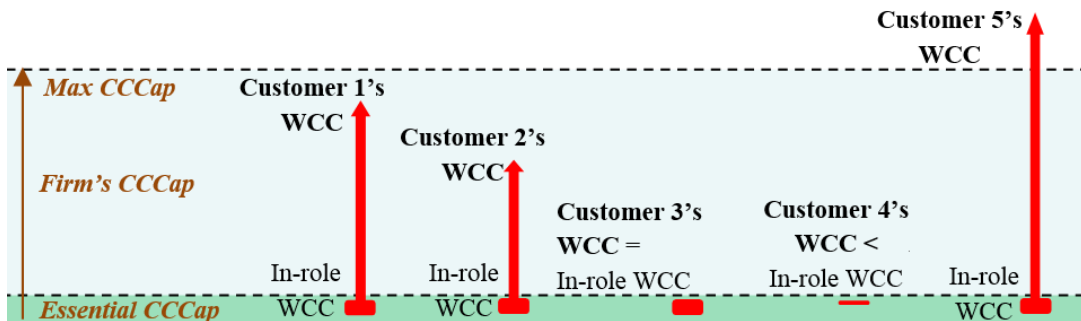
Figure 2: A firm's CCCap in relation to customers with different WCC.

In Figure 2, we demonstrate a simplified example to highlight the significance of the customer's willingness to co-create and an adequate co-creation capacity for firms. Five different cases are illustrated, where hypothetical customers ask for the same value bundle from the firm but exhibit different WCC levels (for now, let us assume co-creation cost is negligible). In the first two cases, Customers 1 and 2 have WCC levels within the capacity of the firm and will thus be facilitated by the firm, generating additional value from the co-creation activities of their choice. Ceteris paribus however, Customer 1 is preferable to the organization, since more co-creation - thus overall value will be generated. Customer 3 comes with a willingness to co-create only the basic activities required for the service to be delivered. Although no additional co-creation value is generated in this case for both the firm and Customer 3, the price for the offered service may be the same as for the first two customers who generated additional value (depending on whether WCC is correlated to WtP or not). In the case of Customer 4, his WCC is below the necessary in-role WCC required for the service to be delivered and thus the service will fail. Customer 5 has a higher WCC than what the firm can facilitate. Both Customers 4 and 5 will be forced either to upgrade and downgrade their WCC, respectively, or migrate to other firms that will have the capacity to satisfy their WCC as is. Co-creation cost needs to be taken into consideration as well.

The interplay of the customer's WCC and the firm's CCCap in terms of their intensity can be summarized as shown in figure 3. When both the firm's CCCap and the customer's WCC are high, their matching is a win-win situation; such matching is then characterized by niche markets

for customers asking for rich co-creation activities, probably with low competition. In the case the customer's WCC is high but the firm's CCCap is low (case B) there is a mismatch, as is the case for low willingness to co-create with high co-creation capacity (case D). In the former, the customer will be forced to downgrade his willingness to co-create or migrate to other more promising value propositions, whereas in the latter, the matching is unsuccessful as the firm is not compensated for the costly investment in raising its co-creation capacity by keeping customers with low willingness to co-create. Finally, when both the customer's WCC and the firm's CCCap are low, their matching is an unstable one, as there are many firms satisfying the customer's co-creation demands and thus competition is high.

Below, we set the stage of our modeling framework for simulating market interactions in a service ecosystem. Note that for the rest of this paper we will normalize the in-role WCC as the WCC reference point, since in-role WCC is fixed and thus the same for all customers. Therefore, WCC coincides with the extra-role WCC.
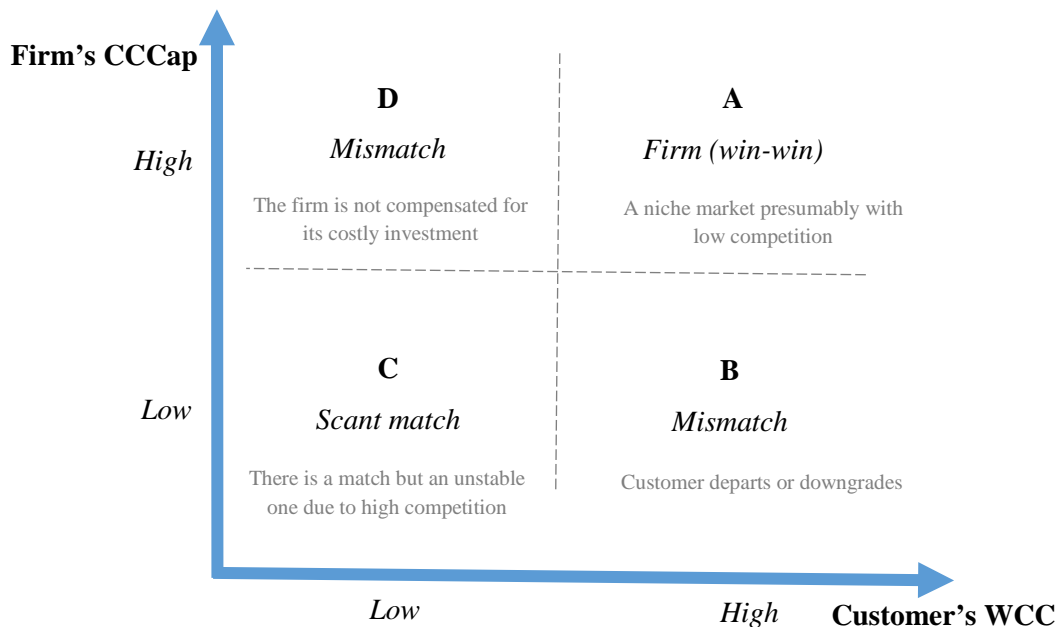

Figure 3: Co-creation Intensity Matching Matrix.

A basic service ecosystem interactions model

We will now introduce the fundamental components of our market ecosystem interactions model through a basic firm-customer transaction game example. We note here that, for the rest of this work, we define WtPs and WCCs exogenously with respect to opportunities outside the game, which means that they do not interact with or relate to each other. Since respective definitions in Brandenburger and Stuart (1996)'s conceptual platform are exogenously defined, this choice of ours is in accordance with the groundwork of our study; it also reflects a number of market transaction contexts where WCC is independent to WtP, as previously discussed. Nonetheless, a number of recent papers have been looking into market transaction settings where WCCs and WtPs are endogenously correlated (e.g. Martovoy and Dos Santos 2012, Xia and Suri 2014 etc.), and this also constitutes a future strand in our research agenda.

In Figures 4a and 4b, we model a simple interaction between one firm and two customers A and B, leaving suppliers out for the moment. It's important to note that in terms of time, we are observing the system prior to the customer's engagement and the initiation of the service experience as described in Chandler and Lusch (2015). We assume that the firm has adequate Co-Creation Capacity and resources for selling a single offering bundle, which customers A and B are interested in buying. Each customer interacts with the firm having a specific Willingness to Pay for the firm's offering, and an associated Cost is also generated for the firm, as defined in Brandenburger and Stuart (1996). The customer further demonstrates a specific Willingness to Co-Create for the interaction that is independent from WtP, and an associated Co-Creation Cost is generated for the firm.
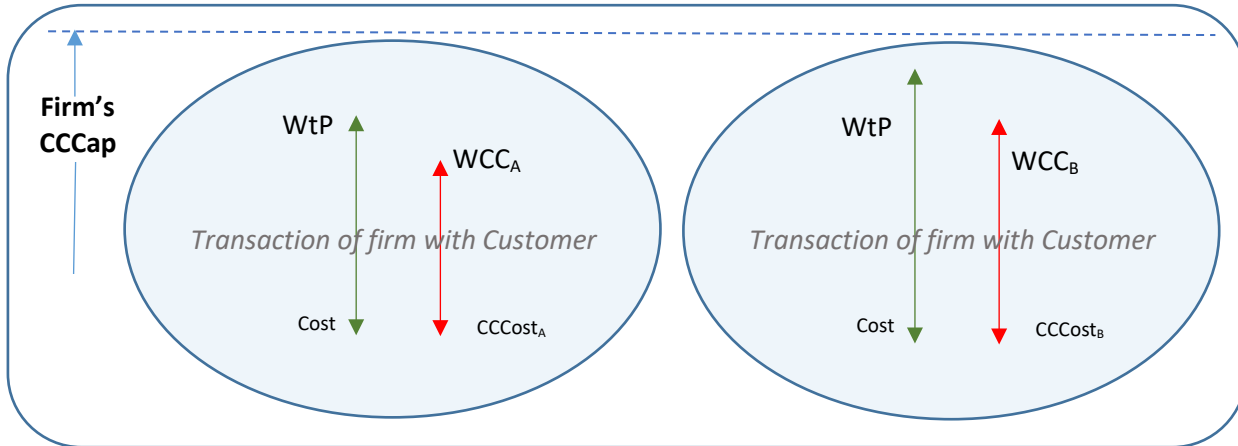
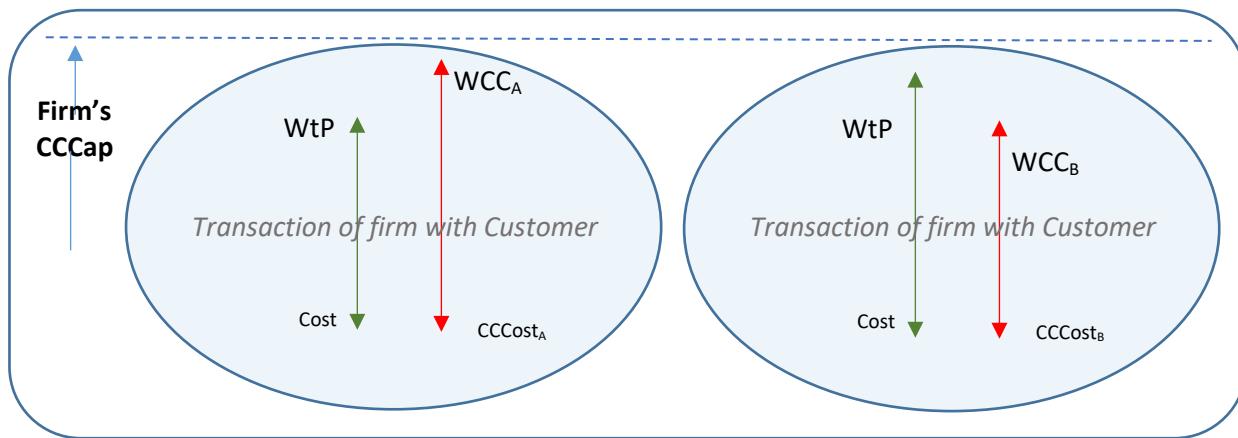Figure 4a: A simple game of one firm and two customers

Figure 4b: A simple game of one firm and two customers

In Figure 4a, Customer B has a higher Willingness to Pay as well as Willingness to Co-Create than Customer A[2]. Unit cost is fixed, however, Co-Creation Cost varies with WCC. According to Brandenburger and Stuart (1996), the firm will decide which customer to choose based on the higher Willingness to Pay, thus customer B will be preferred. However, not only the customer's Willingness to Pay but his Willingness to Co-Create and the associated Co-Creation Cost should be considered for maximum value creation. Consider for instance the case of Figure 4b: in this case, Customer B has a higher WtP but a lower WCC than Customer A. Again, Customer B will

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[2] On the basis of the phenomenological assessment of value in S-D logic (Vargo and Lusch 2008), different customers may evaluate the same value proposition in a different way.

be chosen by the firm since he has the highest WtP. Nevertheless, in such a case the firm may actually lose value, as we will demonstrate when we construct a game from this example later on.

A few things are worth noting before we proceed. In our market ecosystem model, firms join bearing unique *value propositions*, in an attempt to attract customers of unique *value dispositions*. Explicitly, a value proposition consists of the actual bundle offering of the firm *and* its co-creation proposition, i.e. the compilation of the co-creation activities a firm facilitates (which compose its co-creation capacity). Value propositions should of course consider the whole supply network, as well as the needs of the targeted customers (Cova and Salle 2008), since they depend on the operant resources of both customers and suppliers. A value disposition on the other hand consists of the customer's Willingness to Pay for the firm's bundle offering *and* his co-creation value disposition, namely his unique Willingness to Co-create.

Furthermore, at the micro level of analysis, the core elements of our model are in accordance with the value creation mechanism as visualized by Grönroos and Voima (2013). Specifically, our model's fundamental element of the firm's Co-Creation Capacity may be considered an attribute of the provider value creation sphere, where the provider produces resources and processes to be used for the production of real value. The Willingness to Pay may be considered a proxy of the value-in-use for the customer[3], and thus an attribute of the customer sphere, where independent

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[3] In cases where customer co-produces to lower the price, WtP+WCC is a more accurate proxy of value-in-use. Notice also that value-in-use is accumulated through experiences over time and cannot be assessed before usage (Grönroos and Voima 2013). A more precise formation would be that the Willingness to Pay (or WtP+WCC in co-production) represents the customer's prediction of value-in-use he can get from the offering before usage. In this respect, Soman (2003) talks about the predicted and the experienced utility of an experience: predicted utility is the prospective evaluation of the experience's value- which may be expressed by the WtP (or WtP+WCC in co-production) in our context, whereas experienced utility is its retrospective evaluation- the value-in-use. The prospective evaluation may of course differ from the

creation of value happens and no direct interactions and co-creation exist. Lastly, the Willingness to Co-Create may be considered a property of the joint sphere, where value is co-created upon direct interaction of the firm with the customer and is inextricably linked to the customer's willingness to co-create.

Last but not least, our model may further reflect the destructive process of value ("value co-destruction"), as described in Plé and Chumpitaz Cáceres (2010) and Echeverri and Skålén (2011), by allowing for negative values for WCC. For instance, if the customer discredits the reputation of the firm to others through negative WoM, WCC should be considered negative, not equal to zero, to reflect destructive value. WtPs alone cannot reflect destruction of value, thus systems based on WtPs are quite limiting as well, as far as this point of view is concerned.

Let us now model the simple example demonstrated in Figure 4b using cooperative game theory[4] to better understand how value is appropriated among players in this case. A simple cooperative game of one firm f, two customers c_1 and c_2 and numerous suppliers $s_{1...}s_n$ is set. Customer c_1 has Willingness to Pay WtP_1, and Willingness to Co-Create WCC_1 for the offering of the firm. Respective values for customer c_2 are $WtP_2 = WtP_1 + a$, and $WCC_2 = WCC_1 - b$, where $a,b > 0$, thus, as narrated earlier, customer c_2 has a higher WtP but a lower WCC than customer c_1.

retrospective evaluation; nevertheless, it constitutes a satisfying prospective proxy of real value most of the times.

[4] We follow Brandenburger and Stuart's (1996) rationale and use cooperative game theory instead of non-cooperative, as we share the belief that in a market transaction, rather than procedures handling, it is the coalition forming among stakeholders and the firm that is important; we are mostly interested in addressing how much power the actors have when interacting under a "free form" view of competition. Such requirements call for cooperative game theory (Brandenburger 2007; Brandenburger and Stuart 1996). Furthermore, we use the Core (Brandenburger 2007, p.7) as the basic mechanism for value appropriation and analysis of the game, as it embodies competition among players and we thus argue that it better emulates dynamics in a market interaction than other relevant mechanisms.

Opportunity Cost is c for all suppliers. The firm has sufficient CCCap for both customers and can serve only one customer. For simplicity reasons, we assume that the co-creation cost and the co-creation opportunity cost are negligible. We also consider the WCC and WtP of the customers exogenous to the game.

The analytical solution of the game is included in Appendix A.

Overall, although $WtP_2 > WtP_1$, in the cases where b>a we are actually losing value if the firm chooses customer c_2 instead of c_1, on the basis of his higher WtP. In specific, if the firm considers WCC - as it should, when deciding who to serve, value is appropriated among players as follows: the firm gets between Y+a-b and Y and the customer c_1 between 0 and b-a, where Y= WtP_1 + WCC_1 - c (exact values appropriated are a matter of bargaining between the customer and the firm). Customer c_2 and the suppliers get no value at all, as expected.

In the case now the firm doesn't consider WCC in order to decide which customer to serve, it decides based solely on the WtP of the customers. Then, when b>a, and following a similar calculation process as in Appendix A, we find that the *value considered* when ignoring WCC is appropriated as follows: the firm gets between [Y-WCC_1, Y-WCC_1+a] and customer c_2 between [0, a]; customer c_1 and the suppliers get zero value. In such a case, even if the whole $WCC_{2 =}$ WCC_1-b value (that actually exists, although not considered) goes to the firm, the firm will appropriate value between [Y-b, Y+a-b] (while before it was between [Y+a-b, Y]). In conclusion we see that, there is a range of a,b values (when b>a in specific), where there is an actual cost (between 0 and b, b>0) for the firm's erroneous action not to consider the WCCs of the customers when deciding which customer to serve.

Propositions of Co-Creation Strategies

Using game theory, we can set a number of complex games among firms, customers and suppliers to demonstrate the value appropriated by each player in the cases of different firm co-

creation capacity, customers with different WCC and different co-creation costs. This way, we may identify cases where the firm acquires a positive added value, i.e. the firm enjoys superior value compared to its competitors. We note here that we elaborate on value creation adopting a firm view, although the model can be seen from the customer's, supplier's or other stakeholder's view as well. We next identify a number *of differentiating co-creation strategies*, which may offer a competitive advantage to the firm that enacts them. These co-creation strategies are presented below in the form of theoretical propositions and will be further exhibited through respective games and a prominent case study.

1. Increasing a firm's Co-Creation Capacity: we argue that a firm may enjoy surplus value relative to its competitors by enhancing its S-D orientation, along with upgrading infrastructure (e.g. online platforms, call centers, etc.) that is necessary for facilitating additional co-creation activities. S-D orientation is defined in Karpen et al. (2012) as consisting of six strategic S-D capabilities, namely individuated, relational, ethical, empowered, developmental, and concerted interaction capability. Karpen et al. (2015) provide empirical indications of the effect of S-D capabilities on a number of customer- and firm-related performance metrics, as well as their strategic importance in constituting a competitive advantage for firms. An example of an individuated S-D capability is Amazon's process of analyzing search and purchase patterns of customers to better understand an individual's interests, thus being able to make meaningful recommendations to customers or provide personalized notifications (Karpen et al. 2012). Another example of an empowered S-D capability is Microsoft's strategy to receive feedback from its users in order to fix bugs, update its knowledge base, and also continuously notify users on updates that improve the functionality of their software applications (Romero and Molina 2011).

By increasing its CCCap, the firm may attract new customers, who have the ability and willingness to co-create more value with the firm, thus generating surplus value. These customers

may be looking for more personalized, customizable value bundles, opening new niche markets for the firm that can further price these co-creation activities at a premium. An improved position of the firm vis à vis its competitors can be also explained through operant resources: in order to increase its co-creation capacity, the firm collaborates with its supply chain partners to access the operant resources it lacks; it further gains access to new operant resources and knowledge growth from new customers. According to the S-D logic, the acquisition of additional operant resources is a fundamental source of competitive advantage.

Nevertheless, as previously discussed, not all value offerings are suitable for considerable CCCap investments (e.g. standardized offerings) and diminishing returns of such investments should be also considered. In such cases, the 'more is better' dogma may actually decrease performance, as Das et al. (2006) stress. We thus suggest that a firm should increase its CCCap taking into account the value offering suitability for co-creation and the diminishing returns of co-creation investments. We then form the following proposition:

Proposition 1: A firm may acquire a competitive advantage by increasing its co-creation capacity. The value offering suitability for co-creation and the diminishing returns of co-creation investments should be taken into account.

2. Increasing customers' WCC: we argue that increasing existing customers' willingness and ability to co-create, in relation to associated co-creation cost, forms another strategy that may differentiate the firm from its competition, as it provides access to additional operant resources straight from the customers. Strategically, customers are highly important for a firm's success (Priem, 2007) and contribute greatly to value generation from an S-D perspective (Vargo and Lusch 2008). In the same spirit, the string of literature of operant resources (Möller 2006; Normann and Ramírez 1993; Vargo and Lusch 2008) and coproduction (Lusch et al. 2007; Prahalad and Ramaswamy 2004a) supports the rationale that customers should be able to actively contribute to the development of resources; they should be empowered by the firm to be able to

influence the value processes and outcomes through contributing with their own capabilities, knowledge and direct feedback about their needs and desires. These are valuable operant resources for the firm acquired straight from its customers, which may help the firm gain a competitive advantage according to the S-D logic.

Increasing customers' willingness and ability to co-create in relation to associated co-creation cost can be achieved through a number of ways: a) by lowering the firm's co-creation cost, e.g. by identifying more efficient ways to conduct co-creation activities; b) by increasing the customer's co-creation benefits, e.g. upgrading customization options for the customer (Handrich and Heidenreich 2013), lowering fees and costs for the customer that co-creates, or enhancing other societal or knowledge benefits that may derive from co-creation and are considered important for the customer (Füller 2010; Nambisan and Baron 2009); c) by lowering other customer's co-creation costs, e.g. customer effort and personal information sharing (Handrich and Heidenreich 2013), by offering for example training and easier procedures to the customer or by facilitating easier and more secure personal information sharing. For instance, Apple enables customization by allowing its customers to personalize their devices and download content through the iTunes interactive platform, according to their individual preferences and desired experiences (Romero and Molina 2011). Moreover, technology companies like Microsoft and Epson Print Academy invest in lowering customer effort through offering online training series and live events to customers so as to improve their skills and knowledge (Karpen et al. 2012).

We then form the following proposition:

Proposition 2: A firm may acquire a competitive advantage by increasing its customers'
Willingness to Co-Create in relation to the associated Co-Creation Cost (i.e. increasing
WCC/CCCost).

More subtle but also notable are the co-creation strategies on lowering other competing firms' co-creation capacity and their customers' willingness to co-create. These are briefly presented below:

3. Lowering other firms' Co-Creation Capacity: Impeding competitors from offering co-creation activities similar to those offered by the firm itself may "monopolize" these co-creation activities and encourage customers looking for them to flock the firm. This can be done, for instance, through issuing proprietary Intellectual Property (IP) (e.g. patents and trade secrets, as well as copyrights for creative services) and soft IPs (open source, creative commons, etc.) for the exclusive use of co-creation platforms and tools so that rivals are restricted from utilizing them. Andersen and Sureka (2012) provide evidence on how using soft, as well as proprietary IPs can stimulate dynamics of innovative co-creation methodologies for market growth, like networking with suppliers and users, formal partnerships, and community interactions. Accordingly:

Proposition 3: A firm may acquire a competitive advantage by lowering other firms' co-creation capacity.

4. Lowering other firms' customers' WCC: Managing to affect the WCC level of other firms' customers also constitutes a strategic opportunity for firms**.** This can be done in a variety of ways. First, through lowering customization options for competitive firms' customers by developing respective "security valves" for important co-creation activities, e.g. issuing exclusive patents. In other words, firms may limit these customers' choices through securing their own inventions/technologies used in co-creation activities from getting copied by rivals. Second, they can do so by increasing customer effort, costs, and information sharing for customers wishing to migrate to other firms (e.g. by setting high switching costs). In this respect, Kambil et al. (1999) argue that co-creation itself can "lock-in" customers to the product or service of the firm. For instance, as customers customize web services and create their own home pages and content, or manage e-portfolios through specific websites and social platforms, they create content assets tied

to those platforms and are therefore unlikely to migrate to rivals due to high switching costs. Apple, which through its specialized interactive devices and customizable software provides high level of co-creation with its customers, has taken the "locking-in" rationale a step further. Apple's business model is designed in such way to "drive consumers into its ecosystem and then lock them in through high switching costs" (Montgomerie and Roscoe 2013, p. 291). This is achieved through a multi-channel integration platform across devices using legal and technological means as well as persistence on a lack of interoperability. For this purpose, Apple developed a specialized operating system (Apple's iOS) and applications so that the content created with Apple devices can only be played on Apple hardware. This business model allows Apple to "own the consumer" (Montgomerie and Roscoe 2013), imposing high switching costs for those who wish to migrate to other companies. Accordingly:

Proposition 4: A firm may acquire a competitive advantage by lowering the Willingness to Co-Create for the customers of competitors.

Using games to demonstrate Co-Creation Strategies

We will now demonstrate the co-creation strategies discussed above using games. For this purpose, we will use *biform games*, a hybrid non-cooperative - cooperative game model proposed by Brandenburger and Stuart (2007). The non-cooperative part of a biform game initially models the strategic moves and choices of the players. At a following stage, the cooperative part of the game models the resulting market interaction and the broader market context. This approach suits the games of interest in our context best. Specifically, we need to first model the choice of the firm to put into practice one of the co-creation strategies described above. Then, we model the interplay among the firm and its stakeholders that results from the market interaction.

1. Increasing a firm's Co-Creation Capacity: We have 2 firms, f_A and f_B, with co-creation capacity cc (which means they can serve customers with WCC up to cc); the firms can serve one

customer each. There are numerous customers (denoted by c_1, …, c_n) and numerous suppliers (denoted by s_1, …, s_n). Customers have WtP = wp and WCC = varying from cc up to cc' for the offerings of both firms, where cc' > cc. Opportunity Cost is oc for all suppliers. Firm f_B is thinking to invest in co-creation capacity and has to decide whether to increase its CCCap to cc', in order to attract customers with higher WCC = cc', with an upfront cost of uc. For simplicity reasons, we assume that the co-creation cost and the co-creation opportunity cost are negligible. We also consider the WCC and WtP of the customers as exogenous to the game. The game in this case is presented in Figure 5.

The analytical solution of the game is presented in Appendix B. In both cases, customers and suppliers get zero value (as expected). In the status quo case, firm B does not increase its co-creation capacity; in this case, firms A and B are identical and each gets a value of wp+cc-oc = Y. When firm B increases its co-creation capacity, though, it appropriates a value of Y+Δcc-uc whereas firm A still gets a value of Y, where Δcc=cc'-cc. In this second case, if Δcc>uc or cc'>cc+uc, in other words if the new WCC attracted is greater than the old one plus the upfront cost, firm B appropriates more value than its competition; this means that, if CCCap is increased in relation to the upfront cost, firm B attracts customers with higher WCC that raise the total value generated and offer extra value to the firm. This intuitive example demonstrates that by increasing its co-creation capacity, a firm may acquire a competitive advantage towards competition, as articulated in Proposition 1.
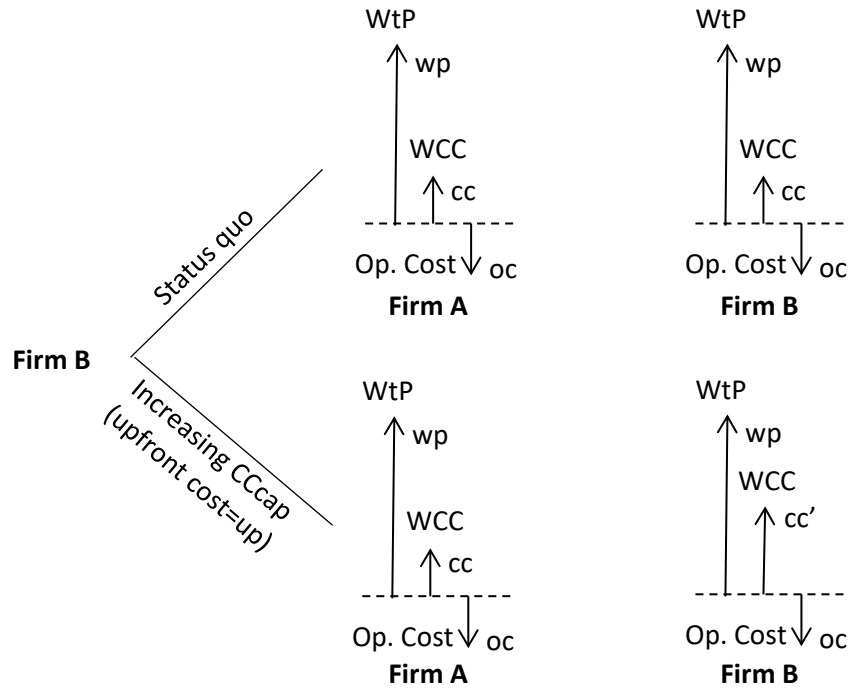
Figure 5: Increasing a firm's co-creation capacity biform game

2. Increasing customers' WCC: This is quite a similar biform game. We have 2 firms f_A and f_B with adequate co-creation capacity. The firms can serve one customer each. There are numerous customers (denoted by $c_1, \ldots, c_n$) and numerous suppliers (denoted by $s_1, \ldots, s_n$). Customers have the same wp, and the same cc for the offerings of both firms. Opportunity Cost is oc for all suppliers. Firm f_A may increase the WCC of its customers to $WCC_A = cc'$, facing an upfront cost of uc. We again assume that the co-creation and opportunity costs are negligible and consider the WCC and WtP of the customers exogenous to the game. Schematically, the game is as follows:
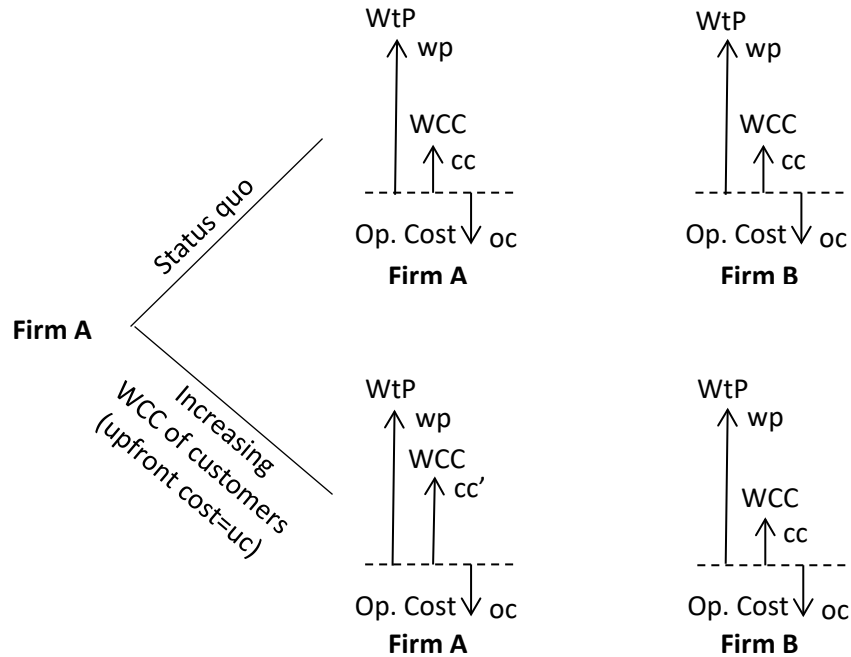
Figure 6: Increasing WCC of customers biform game

This game is reduced to the previous game. In both cases, customers and suppliers get zero value.

In the status quo case, firms A and B are identical and each gets a value of Y. When, however,

firm A increases the WCC of its customers, it gets a value of Y+Δcc-uc, whereas the value of

firm B is still Y. As before, if cc'>cc+uc, i.e. if WCC is increased in relation to the co-creation

cost, firm A appropriates more value than its competition. This example demonstrates that by

increasing its customers' WCC, a firm may acquire a competitive advantage, which is our second

proposition. In a similar manner, the final two propositions may be demonstrated as well;

examples are omitted for the sake of brevity.

Sustainability of competitive advantages gained

Initiating a discussion on the *sustainability of competitive advantages* acquired through the co-

creation strategies described above is, without a doubt, of particular interest for academics and

practitioners alike. Barney (1991) argues that, in order for a firm to gain a sustainable competitive

advantage, strategic resources should be heterogeneous and immobile. Then, *First-Mover*

advantages (that may be acquired by a firm when it puts into practice the first two co-creation strategies, i.e. increasing its Co-Creation Capacity or its Customers' WCC), and *Entry/ Mobility Barriers* (that may be achieved through the last two co-creation strategies, i.e. lowering other firms' Co-Creation Capacity or other firms customers' WCC) may actually result in a sustainable competitive advantage. However, not all firm resources hold the potential of sustained competitive advantages, as Barney (1991) stresses. In order to lead to sustainable competitive advantages, a firm resource must be valuable, rare, perfectly inimitable, and finally, it must not have equivalent substitutes. We hereby argue that, under heterogeneity and immobility of resources, a firm enacting the co-creation strategies proposed above may acquire new operant resources in the form of tacit competences and knowledge, which may be rare and difficult to imitate, and result in a sustainable competitive advantage due to the *causal ambiguity* involved and the *social complexity* of the strategic resource. In this respect, Pine et al. (1995) stress that as firms focus on the interactions with their customers, the more these firms communicate with the customers, the better able they are to provide value bundles according to their customers' specific preferences and needs. Furthermore, as discussed earlier, Kambil et al. (1999) argue that as customers co-create with a firm they get "locked-in", building high switching costs. Therefore, it gets more difficult for competition to break those switching costs or imitate the firm's strategy and take away its customers. Also, Whiteley and Hessan (1996) argue that when a firm engages customers and listens to their needs it may easily identify the processes that need to be optimized and those that do not add any value to the customers and thus increase its efficiency. Brodie et al. (2013) posit that customer engagement may result, among others, in increased customer satisfaction and loyalty, and Sweeney et al. (2015) find that as a customer undertakes activities that demand more effort, his satisfaction increases. Along a similar vein, Vega-Vazquez et al. (2013) empirically show that there is a positive relationship between co-creation and customer satisfaction that leads to customer loyalty. Such a strategic resource is therefore characterized by high social complexity and may lead to a sustained competitive advantage.

Last but not least, the very nature of the operant resources acquired through the co-creation strategies (skills and knowledge of customers, competences and expertise from partners) contributes to the argumentation for the sustainability of the competitive advantages gained. Madhavaram and Hunt (2008) suggest that through co-creation, firms form complex, interconnected, relation-specific operant resources. These are bundled with firms' internal resources, resulting to rising switching costs for customers, barriers for imitation from competitors and ultimately enhanced sustainability of firms' competitive advantages.

The above amplify the importance of incorporating the value co-creation strategies presented here into the firm's strategic arsenal, to enhance the firm's performance, as well as its prospects for success in the long run. A prominent case study following, aims to showcase and reinforce the above arguments in an empirical context.

The case of Giffgaff: a case study on applying the co-creation strategies

Giffgaff is a UK mobile company that was launched in 2009 by O2/Telefonica and uses the network infrastructure of its parent company. Giffgaff was originally initiated as "an experiment" and has since then been established as "a network run by its customers" (Burn-Callander 2015) and "a different kind of mobile model" (Rogers 2017): Giffgaff's customers can order just a free SIM card for any phone and then package a flexible "goodybag" service bundle; Giffgaff doesn't own physical retail stores or traditional call centers; it has instead invested in creating a strong online presence and an active customers' community.

These strategic choices seem to have borne fruit over the space of these past years, as Giffgaff has achieved a long list of astonishing accomplishments: although it was the last of the "virtual" operators to come to a very mature market, it has been established as a major telecoms player, having overtaken almost 160 others (Rogers 2017, Burn-Callander 2015); according to a 2016

independent research, the brand has been nominated as the UK's favourite mobile network[5]; it has further received a number of important awards, including the Which? Best Telecom Services Provider award in 2014[6] and two top prizes for mobile Network of the Year (for three consecutive years in a row) and Best SIM-only Network in the recent uSwitch Mobile Awards[7].

Giffgaff differentiates itself from other network operators through deploying its core corporate strategy upon the notion of co-creation with its customers and nurturing a highly engaged community of loyal customers, namely Giffgaff members. Giffgaff is actually a Scottish word meaning "for mutual benefit" and its motto can be best described as a "co-creation mantra": as Giffgaff's CEO stresses, "*we work in collaboration with our members to help run the business, grow the business, improve the business*" (Fairman 2017), *"....we are driven by a belief that working with our members is better than trying to be a normal business"* (Burn-Callander 2015).

In practice, a mixed co-creation strategy is utilized, formed of the two "First-Mover" co-creation strategies presented earlier, to develop practices and activities aiming at engaging members. In order to motivate customers and raise their willingness to co-create, Giffgaff has issued a mixture of customer motivation schemes as well: it incentivizes members to engage actively by giving them points through its PayBack scheme; these points convert to cash. Most importantly, there are other non-tangible incentives cultivated as well, like intrinsic motives relating to membership loyalty and affiliation (Rogers 2017); customer satisfaction and recognition; and greater personalization of products, as well as a direct form of advocacy (Baumgartner 2015). The incorporation of co-creation strategies in Giffgaff's strategic portfolio is demonstrated below, through reflecting upon three distinct Giffgaff practices.

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[5] http://www.marketforce.com/good-call-study-reveals-uk%E2%80%99s-favourite-mobile-phone-network
[6] https://en.wikipedia.org/wiki/Giffgaff#cite_note-10
[7] https://www.uswitch.com/mobiles/news/2017/02/three-and-giffgaff-triumph-at-this-year-s-uswitch-awards/
https://www.uswitch.com/media-centre/2016/02/big-four-networks-outclassed-as-giffgaff-is-crowned-mobile-network-of-the-year-at-the-uswitch-mobile-awards/

Practice #1. Implementing members' ideas

Raising its CCCap: Giffgaff initiated Giffgaff Labs, which is the virtual community to which members can post their feedback in the Idea Exchange. Community members can vote and comment on submitted ideas and the best ones are driven through the submission process to be assessed by Giffgaff (Baumgartner 2015). The most popular idea submitted by a Giffgaff customer in 2014 was implemented for example: "The ability to start your goody bag early". A goody bag is a predefined service bundle (voice, text, data, etc.) of the choice of the customer and the idea implemented allows for its modification any time, whereas before adjustments could not be made until months end (Baumgartner 2015).

Raising the WCC of its customers: Apart from the possible personalization gains in case their idea materializes for members who are willing to contribute, monetary incentives are also offered to these contributors, aiming at raising their WCC. Intrinsic motives are further cultivated in respect to the feeling of belonging to an active community, as members can actively vote for the best idea. Furthermore, recognition and satisfaction of members are reinforced through raising the visibility of customers' contributions, e.g. through highlighting online specific member ideas, as well as offering timely and well-structured idea feedback to members. All these activities target at raising customers' WCC.

Practice #2. Developing an online community for members' mutual support

Raising its CCCap: Giffgaff has designed a broad and highly interconnected media eco system through "my Giffgaff", a mobile app that is available on all major mobile platforms (Baumgartner 2015). A "community" component is included, which facilitates members' participation to the Giffgaff fora and Idea Lab. Customer feedback, support and ideas are then accumulated from various social media, online forum and website resources to an integrated platform with systematic categorization and stage reporting during development (Baumgartner 2015).

Raising the WCC of its customers: Giffgaff never ran a call center but instead invested in its members' self-organization and support, offering monetary incentives, as well as cultivating intrinsic motives relating to customer empowerment and membership loyalty: members are urged to answer queries online, offer advice to help other members and contribute with feedback about products, pricing and support; the community votes on the best answers so the best ones rise to the top; members are also self-policing, and flag inappropriate content; last, they recruit new members to the network and get extra points in return.

Practice #3. Members as 'empowered employees': extending firm's capacity

Raising its CCCap: there are cases where Giffgaff has extended its capacity and supply chain through cocreated activities suggested, implemented and facilitated by its members, who act as company's partial employees or partners: when e.g. Apple launched the iPhone 4, Giffgaff didn't know that it came with a different-sized SIM card. Giffgaff's SIM didn't fit into the new phone and it would have taken at least two to three months to change the supply chain to produce new specialized SIMs. An effective and quick solution was at the time offered by Giffgaff members: using stamping converters that neatly cut the existing SIM cards down to size, a few members set up an online store called Microgaff. Giffgaff forwarded requests for micro SIMS to Microgaff and thus managed to respond timely to customers' emerging demands (Burn-Callander 2015, Fairman 2017).

Raising the WCC of its customers: monetary gains, combined with strong community as well as customer empowerment motives were activated for the members who set up Microgaff. Giffgaff's co-creation culture and strategic orientation both inspired and allowed its members to embark to this win-win endeavor of extending the firm's capacity to address a problem in a timely manner.

In respect to the discussion of sustaining the competitive advantages gained, Giffgaff's case is a notable example that when firms invest in cultivating a vibrant community of members willing to interact and share ideas and knowledge with each other, customer loyalty is achieved. This became evident back in 2012, when Giffgaff's entire network suffered a major service failure, as it went down after water was accidentally poured on a server. O2 stumped up a £350,000 compensation pot, offering customers affected the option to take a share, give it to charity, or invest money back to the network to build better systems. Around 20% of the customers agreed to the latter option, and very few actually left the company (Burn-Callander 2015). This observation is particularly important, especially in an industry where customer attrition is severe; upgrading customers to loyal members through deploying focalized co-creation strategies may thus assist towards creating long-lived customer relationships, reducing customer turn-over and sustaining competitive advantages.

Conclusively, a number of inferences can be drawn from the Giffgaff case. Some of these include:

- Deploying a co-creation strategy as a core part of the brand identity may provide the necessary means to differentiate effectively and successfully, especially when entering a mature market. Possible reasons may be that knowledge from customers increases speed to market and potentially lowers product development costs; a more satisfying overall customer experience is achieved (Baumgartner 2015); and real brand loyalty is cultivated (Rogers 2017).

- Using a mixed co-creation strategy to both attract new customers and increase current customers' WCC may reinforce the competitive advantage gained even more.

- Following a strategy heavily based on co-creation may further succeed in sustaining the competitive advantage gained, mainly due to the "socially complex", "tacit", intrinsic customer motives involved, e.g. community affiliation, satisfaction and loyalty.

- Introducing tangible incentives strongly increases customers' motivation (Baumgartner 2015). However, their blending with other types of incentives e.g. intrinsic/ psychological, social etc. is necessary for a successful co-creation strategy that will prove sustainable in the long run.

Moving to the network level of analysis

Our work can further be extended to address more complex market relations at the network level. In the basic dyadic model presented before, firms join the market ecosystem with value propositions of various CCCaps, aiming to attract customers; customers join bearing individualized value dispositions for the firms' value propositions, of different WtPs and WCCs, as well as associated costs and co-creation costs. As discussed, supply chains are traditionally represented by a supplier-buyer dyad. As we move to the network level of analysis, our model's dyadic firm-customer depiction may as well apply to all supplier-buyer relationships throughout the supply network. Maas et al. (2014) stress however that network formations go beyond the sum of these dyadic relationships, due to indirect links. According to Wilhelm (2011), network dynamics can be addressed by including *horizontal supplier–supplier relations* to supplier-buyer dyads, thus forming triadic constellations. Supplier–supplier relations are therefore conceptualized by Wilhelm (2011) as the missing link in order to transit to the network level of analysis. These relationships can present varying competitive and/or cooperative linkages among parties, and current literature emphasizes on the determinative role of the buyer on such relations and the importance of network centrality (Wu et al. 2010; Wilhelm 2011). It is therefore imperative that further research be conducted to understand how actors co-create in such supplier-supplier relationships and triadic constellations.

Alignment of co-creation across the supply network is also crucial, we believe, towards achieving effectiveness at the network level. In the cases of co-creation misalignments, tensions in the supply network may be developed, leading to operational inefficiencies, ineffective and ultimately disrupted supply chain relations. We thus argue that in effective supply networks, co-

creation propositions and dispositions should be aligned throughout. If for example a supplier A wishes to increase his Co-creation Capacity in order to attract buyers of higher WCC, he needs to be backed up by his own suppliers B and C; a higher CCCap towards A's buyers results to a higher WCC towards his own suppliers B and C, who will help A build his higher CCCap; B and C should then have (or acquire) an adequate CCCap on their side to back A up and so on, which ultimately means that WCCs and CCCaps of all actors down the supply network should be aligned for maximum efficiency. Supply Chain Management literature has long been reflecting upon the Supply Chain Integration (SCI) of a firm with its suppliers and customers, a concept considerably resembling to the co-creation notion among suppliers and buyers of the supply network. In brief, SCI is about the idea of collaboration among supply chain actors aiming to provide maximum value to the customer (Flynn et al. 2010). Its relation with performance has long been discussed as well (e.g. Flynn et al. 2010; Germain and Iyer 2006; Das et al. 2006; Stank et al. 2001). Though results in the literature are inconsistent[8], there are studies indicating that integrating with supply chain partners relates to performance (Wong et al. 2013; Flynn et al. 2010; Chen et al. 2004) and that firms that exhibit both customer and supplier integration outperform others significantly (Devaraj et al. 2007; Frohlich and Westbrook 2002) – attesting to the positive effect of co-creation alignment throughout the supply network. We therefore posit that co-creation alignment across the supply network forms a promising future research path as well.

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[8] We believe that such inconsistencies may emerge because SCI does not consider all aspects of co-creation by definition –thus incomplete SCI constructs are developed, comprising of a limited number of co-creation activities only, probably leading to inaccurate results. Also, SCI has been researched upon a linear supplier - manufacturer - customer G-D logic; modern transactions are much more complex than that.

Conclusions and future research

This paper serves a dual orientation; a conceptual and a practical one. A theoretical component is accommodated comprising the basis of this work, as we extend the Value-based Strategy view under the S-D logic, and propose a novel conceptual platform for simulating market interactions in the service ecosystem. This is driven by the realization that, although co-creation of value and the S-D logic paradigm are leading concepts in modern business, they are underexplored in extant literature. We attempt to make a number of contributions to this direction: first, the importance of co-creation in service ecosystems is highlighted and the value stemming from co-creating activities is featured as a key determinant of the market interaction process. It is further demonstrated how the customer's willingness to co-create and the firm's co-creation capacity play a fundamental role when it comes to value generation in a market context. Moreover, we focus on the macro insights of value co-creation and attempt to augment our understanding of the phenomenon in a macroscopic manner, on a dyadic (basic) as well as on a network level, simulating a wider market ecosystem.

There is also a plethora of empirical implications spawned, with important practical relevance as demonstrated through the case study analyzed: first and foremost, the model allows for the identification of four value co-creation strategies, for managers to include in their strategic arsenal and aim for sustainable competitive advantages. Fundamentally, it is being pointed out that firms may choose to differentiate not only on the basis of their basic value offering but on the basis of their co-creation offering as well. It's being implied that organizations should strive for a unique value co-creation proposition, which should accompany the firm's offering in comprising its overall value proposition. The firm's value co-creation proposition may actually prove to be an important point of differentiation and a competitive advantage for firms. Furthermore, there is no one-fits-all solution when it comes to customers. Among others, customers come with different WCC when looking for a market offering; to get more value, firms should either aim to attract

customers of high WCC or amplify existing customers' WCC, of course considering their CCCap and the co-creation cost involved. Last, it is being implied that the sustainability of competitive advantages is embedded into the notion of co-creation, due to the high levels of tacit knowledge and social complexity of the operant resources entailed.

As with any study, this work comes with a number of limitations. In constructing our model, we made certain simplifications and abstractions that were adopted from the Value-based Strategy and further facilitate the utilization of game theory to model interactions and subsequently detect differentiating co-creation strategies. In specific, we assumed a rational choice (rather than a behavioral) solution model of "unrestricted bargaining" (Levinthal 2011), an assumption that diverges from more behavioral approaches. Future research should thus consider behavioral studies on the matter. Also, an economic view of value was adopted for representing the customer's Willingness to Pay, Willingness to Co-Create and the firm's Co-Creation Capacity, which doesn't consider other value variants, like relational value, etc.; more qualitative approaches may address this issue in the future.

From a methodological point of view, one needs to consider other empirical extensions, and enrich this work with empirical research of broader scale aiming to the generalizability of results. Furthermore, the proposed model can be greatly enhanced through the use of simulation techniques. Although there are limitations related to the construction of simulation models, significant value lies in the generalizations emerging from these models, especially when combined with empirical research to test the simulated generalizations. For example, experimental design, as well as qualitative models could be utilized to further explore the strategies of co-creating value with the customers.

We also noted earlier that, in our model, the service system is observed at a specific point in the service experience cycle (Chandler and Lusch 2015), which is prior to the customer's engagement and the initiation of the service experience. Nevertheless, the time dimension and the system's

evolution as time goes by are very important: How does WCC change throughout the service experience and how can we influence this evolution? What changes in future repeated service experiences of the same customer with the firm? Future work should extend the basic model framework to include a market transaction time-dimension, as in the work of Chandler and Lusch (2015).

Moreover, as already discussed, network dynamics, buyer-supplier-supplier triads and co-creation alignment form another promising research strand. It is therefore important to research on how value propositions address the entire supply chain (Lusch 2011) rather than the dyad. Value creation is, however, inherent in the relationship of the firm with other stakeholders as well within a service ecosystem. In this respect, Garcia-Castro and Aguilera (2015) draw from the work of Brandenburger and Stuart (1996) to propose an enlarged conceptual framework on value creation and appropriation, which further considers other critical stakeholders apart from customers, suppliers and the firm. Their framework can also be extended on the basis of the rationale presented here, to include the value co-creation notion among the firm and its other stakeholders.

In continuation of Manuela's et al. (2013) work on the relationship of WCC with customer satisfaction, it would be also interesting to study the relationship between WCC and other customer-related performance indicators, such as commitment, repurchasing intentions, perceived value, etc. Future work should further investigate whether the firm's CCCap (or alternatively, an organization's S-D orientation, as defined in Karpen et al. (2012)) and the customer's WCC are related, and in respect to different contexts: For example, do higher levels of firm co-creation capacity encourage customers to further co-create with the firm?

Lastly, when constructing our games, we considered the WCC and the WtP as exogenous to the game– i.e. independent from each other and other game parameters, which, as discussed, is

actually the case in a number of contexts. The relationship between customers' WCC and WtP requires further attention: for contexts where WCC relates to WtP, respective market interactions can be modelled, taking the endogenous WCC and WtP relationship into account. In such cases, it would be interesting to study the elasticities of the WCC-WtP relationship within different contexts: In which contexts, for example, are customers with a similar WtP more willing to co-create? What are the context parameters that may affect the elasticity of this WCC-WtP relationship? Such questions may be important for product/service design researchers and practitioners alike.

Appendix A

Solution of a simple game

A simple cooperative game of one firm f, two customers c_1 and c_2 and numerous suppliers $s_{1...}s_n$ is set. The finite set of players of the game is $N = \{f, c_1, c_2, s_1,...,s_n\}$. Suppliers are identical, from now on denoted by s. Customer c_1 has Willingness to Pay WtP_1, and Willingness to Co-Create WCC_1 for the offering of the firm. Respective values for customer c_2 are $WtP_2 = WtP_1 + a$, and $WCC_2 = WCC_1 - b$, where a,b > 0. Opportunity Cost is c for all suppliers. The firm has sufficient CCCap for both customers and can serve only one customer. For simplicity reasons, co-creation cost and the co-creation opportunity cost are negligible. WCC and WtP of the customers are exogenous to the game.

Let u: P(N) $\rightarrow$ R be a characteristic function calculating the value created by different combinations of players in the game. Then:

$$u(\{f\}) = u(\{c1\}) = u(\{c2\}) = u(\{s1\}) = ... = u(\{sn\}) = u(\{c1,c2\} = u(\{c1,s\}) =$$

$u(\{c2,s\}) = 0$, and

$$u(\{f,c1,s\}) = \mathbf{WtP_1} + \mathbf{WCC_1} - \mathbf{c} = \mathbf{Y} \quad u(\{f,c2,s\}) = WtP_1 + WCC_1 - c + a - b$$

$$u(N) = \begin{cases} \text{WtP}_1 + \text{WCC}_1 - c, & \text{if } b \geq a \\ \text{WtP}_1 + \text{WCC}_1 - c + a - b, & \text{if } b < a \end{cases}$$

Overall, although $\text{WtP}_2 > \text{WtP}_1$, there is a range of a,b values, in specific **when b>a**, where:

$$u(\{f, c1, s\}) > u(\{f, c2, s\}),$$

which in such case means we are losing overall value if the firm chooses customer c_2 instead of c_1 on the basis of his higher WtP.

When b>a:

Then $u(N) = \text{WtP}_1 + \text{WCC}_1 - c = Y$, and value is appropriated among players as follows:

Consider an allocation $x \in R^n$ and $T \subseteq N$, then $x(T) = \sum_{j \in T} x_j$. According to the Individual Rationality and the Marginal - Contribution Principle (Brandenburger, 2007, p. 3-5), for each player it should apply: $u(\{j\}) \leq x_j \leq u(N) - u(N \setminus \{j\})$ **(A)**

Resulting to:

$$0 \leq x_f \leq Y, \; x_s = 0$$

$$0 \leq x_{c2} \leq Y - Y \Rightarrow x_{c2} = 0$$

$$0 \leq x_{c1} \leq Y - u(\{f, c2, s\}) \Rightarrow 0 \leq x_{c1} \leq b - a \text{ (A1)}$$

In the Core, allocations must satisfy: $x(T) \geq u(T)$, for all $T \subseteq N$ **(B)**

and $x(N) = u(N)$ **(C)**

$$\textbf{(C)} \Rightarrow x_f + x_{c1} = Y \text{ (C}_2\text{)}$$

$$\textbf{(B)} \Rightarrow x_f + x_{c1} \geq Y \text{ and } x_f + x_{c2} \geq Y + a - b \xrightarrow[(C2),(A1)]{}$$

$$0 \leq x_{c1} \leq b - a \quad \textit{and} \quad Y + a - b \leq x_f \leq Y$$

Appendix B

Solution of Increasing a firm's co-creation capacity biform game

The finite set of players of the game is $N = \{f_A, f_B, c_1,...,c_n, s_1,...,s_n\}$. Customers and suppliers are numerous and identical, denoted respectively as c and s. The two f_A and f_B firms have co-creation capacity cc (which means they can serve customers with WCC up to cc); the firms can serve one customer each. Customers have WtP = wp and WCC = varying from cc up to cc' for the offerings of both firms, where cc' > cc. Opportunity Cost is oc for all suppliers. Firm f_B has to decide whether to increase its CCCap to cc', with an upfront cost of uc. We assume that the co-creation cost and the co-creation opportunity cost are negligible. We also consider the WCC and WtP of the customers exogenous to the game. The biform game is depicted in Figure 5.

Let u: $P(N) \rightarrow R$ be a characteristic function calculating the value created by different combinations of players in the game.

Consider further an allocation $x \in R^n$ and $T \subseteq N$, then $x(T) = \sum_{j \in T} x_j$. According to Individual Rationality and the Marginal - Contribution Principle, for each player it should apply: $u(\{j\}) \leq x_j \leq u(N) - u(N\setminus\{j\})$ **(A)**

In the Core, allocations must satisfy: $x(T) \geq u(T)$, for all $T \subseteq N$ **(B)**

and $x(N) = u(N)$ **(C)**

Then:

In Status quo:

$$u(\{f_A\}) = u(\{f_B\}) = u(\{customers\}) = u(\{suppliers\}) = u(\{customers, suppliers\} = 0,$$

and

$$u(\{f_A, c, s\}) = u(\{f_B, c, s\}) = \textbf{wp+cc-oc} = \textbf{Y} \qquad\qquad u(N) = 2Y$$

Value is appropriated as follows:

(**A**) $\Rightarrow$ $0 \le x_{fA} \le Y, \;\; 0 \le x_{fB} \le Y, \;\; \boldsymbol{x_s = 0,} \;\; \boldsymbol{x_c = 0}$

In the Core:

(**C**) $\Rightarrow$ $x_{fA} + x_{fB} = 2Y$ (**C1**)

(**B**) $\Rightarrow$ $x_{fA} + x_c + x_s \ge Y$ and $x_{fB} + x_c + x_s \ge Y \xRightarrow[(A),(C1)]{} \boldsymbol{x_{fA} = x_{fB} = Y}$

<u>In Increasing CCCap</u>:

$$u(\{f_A\}) = u(\{f_B\}) = u(\{customers\}) = u(\{suppliers\}) = u\{customers, suppliers\} = 0 \text{ and}$$

$$u(\{f_A, c, s\}) = \text{wp+cc-oc} = \text{Y} \quad u(\{f_B, c, s\}) = (\text{wp–oc})+\text{cc'-uc} = \text{Y-cc+cc'-uc} = Y + \Delta cc - uc,$$

where $\Delta cc = cc'\text{-cc}$ $\qquad\qquad\qquad \boldsymbol{u(N) = 2Y + \Delta cc - uc}$

Value is appropriated as follows:

(**A**) $\Rightarrow$ $0 \le x_{fA} \le 2Y + \Delta cc - uc - (Y + \Delta cc - uc) \Rightarrow \boldsymbol{0 \le x_{fA} \le Y}$ (**A1**)

(**A**) $\Rightarrow$ $0 \le x_{fB} \le 2Y + \Delta cc - uc - Y \Rightarrow \boldsymbol{0 \le x_{fB} \le Y + \Delta cc - uc}$ (**A2**)

(**A**) $\Rightarrow$ $\boldsymbol{x_s = 0, \; x_c = 0}$

In the Core:

(**C**) $\Rightarrow$ $x_{fA} + x_{fB} = 2Y + \Delta cc - uc$ (**C1**)

(B) $\Rightarrow x_{fA} + x_c + x_s \geq Y$ and $x_{fB} + x_c + x_s \geq Y + \Delta cc - uc \xrightarrow[(A1),(C1)]{} x_{fA} = Y$

$x_{fB} = Y + \Delta cc - uc$

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