A unified model of the co-creation process

Christopher Durugbo [a,*], Kulwant Pawar [b]

[a] Department of Management, University of Bristol, Bristol BS8 1TN, United Kingdom
[b] Nottingham University Business School, University of Nottingham, Nottingham BS8 1TN, United Kingdom

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ABSTRACT

Co-creation is a pro-active strategy for enabling firms to create value through co-opting consumer competences. Several studies have conceptualised factors for characterizing the co-creation process. A few propose methodologies for co-creation. However, only a handful have so far analysed co-creation in a manner that emphasises the role of existing value or formalised the co-creation process with a view to adding rigour to research/practice and providing insights into activities – leading to increased success of co-creation.

This article proposes a unified model for co-creation that integrates functions for strategising supplier–consumer involvement based on existing value-in-exchange and value-in-use and for selecting co-creation techniques. A step-by-step approach to using the unified model is then presented and applied through two collaborative projects within a semiconductor company. The article concludes by discussing the implications of the model for research and practice.

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1. Introduction

1.1. Research background

Traditionally, the *received view* i.e. employing scientists and engineers as proxies for end-users, as shown in Fig. 1, offered the main means for capturing customer needs (Kotonya & Sommerville, 2002; Rossi & Tuunanen, 2004). At an organisational level, the view also created design situations in which the needs of users were 'thrown over the wall' and users were only actively involved after the completion of the design process (Reich, Konda, Monarch, Levy, & Subrahmanian, 1996). The received view was also hindered by a lack of direct customer involvement or knowledge of customer needs and willingness-to-pay. Users assumed the role of 'validators', remain passive during design, and were used as test-subjects for exchanging information with designers to improve the functionality and usefulness of products (e.g. Roberts, Baker, & Walker, 2005). Thus, the main role for users was to offer feedback on product use, personal experience and market research for enabling managers to act as proxies.

In contrast, actively involving stakeholders in the customisation, personalisation and invention of solutions is the focus of the *co-creation view* (e.g. Bogers, Afuah, & Bastian, 2010; Foxall, 1986; Jenkins, 2006; Sunikka & Bragge, 2012; Von Hippel, 2005). In this approach, the 'single-inventor perspective' is replaced by a knowledge flow (inflow and outflow) process between stakeholders as partners (Bogers & West, 2012). Products, services and experiences are developed jointly by companies and their customers (Ramaswamy, 2009; Visser & Visser, 2006) through collaboration that extends beyond organisational boundaries and integrates entities external to the firm (Sawhney, Verona, & Prandelli, 2005). ollaboration means working together in team(s) to achieve a common goal and irrespective of geographical separation (Beyerlein, Freedman, McGee, & Moran, 2003; Boh, Ren, Kiesler, & Bussjaeger, 2007). This goal is often beyond the capabilities of the participants involved in the collaboration and requires participants to closely work together and communicate based on durable relationships with a view to pooling expertise/resources and standardising operations. By adopting a collaborative approach to involving customers in processes to capture customer needs, firms can maintain competitiveness based on differentiation achieved through knowledge of customer needs and cost leadership that understands and minimises costs associated with product-life cycles and new product development (Altun, Dereli, & Baykasoğlu, 2013; Pawar, Forrester, & Glazzard, 1993; Wang, Ohsawa, and Nishihara (2012); Yan, Ye, Wang, & Hua, 2010). Yet, how co-creation is actually conducted still poses a fundamental question for research and practice (Parjanen, Hennala, & Konsti-Laakso, 2012).

1.2. Aim of article

The aim of this article is to propose a conceptual model for descriptively characterising the co-creation process and assessing

* Corresponding author. Tel.: +44 (0) 117 33 10520.
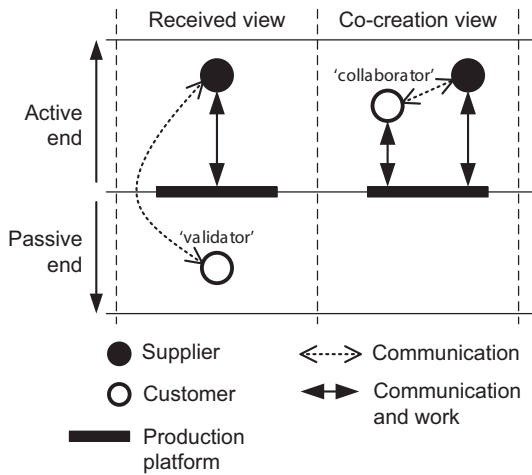 E-mail address: christopher.durugbo@bristol.ac.uk (C. Durugbo).

Fig. 1. A comparison of the received and co-creation views.

co-creation methodologies. Although normative models aid in making judgements about what to do when facing process problems, the focus on a descriptive model was made with a view to understanding "the nature of the problem (in this case, the co-creation process) before we try to correct it" (Koehler & Harvey 2004, p. 20). Using literature, the proposed descriptive model formalises the relationship between co-creation involvement strategies and the selection of co-creation technique during the co-creation process. Whereas insights into co-creation involvement will improve the experiences of stakeholders (Payne, Storbacka, & Frow, 2008), the effectiveness of co-creation is enhanced by better understanding of the co-creation process (Banks & Potts, 2010; Prahalad & Ramaswamy, 2004) and technique selection factors (Hickey & Davis, 2004). Furthermore, co-creation as a research area is still at an early stage (Zhang & Chen, 2008) and there is a need to formalise the co-creation process and to assess methodologies that apply techniques for involving customers in co-creation. This is because formalising and assessing methodologies adds rigour to research/practice and provides insights into activities – leading to increased success of processes (Hickey & Davis, 2004). The benefits of formalising methodologies are evident in literature where mathematical reasoning has been applied in areas such as requirements elicitation (Hickey & Davis, 2004) and user participation (Durugbo, 2012). Within the context of co-creation research, diagrammatic reasoning is commonly used to characterise roles and relationships (Andreu, Sánchez, & Mele, 2010; Gebauer, Johnson, & Enquist, 2010). The relevance of this article to research and practice is therefore two-fold: firstly it introduces a conceptual model that descriptively characterising the co-creation process, and secondly it applies the use of the model for assessing co-creation methodologies.

1.3. Co-creation: an overview

Co-creation lies in the pioneering works by Chesbrough (2003) on open innovation, Von Hippel (2005) on user-led innovation and 'customer-active paradigm', and Jenkins (2006) on participatory and convergence culture. These works reflect a variety of academic and industrial perspectives that have shifted the focus of innovation from a single organisation to distributed processes and arrangements that co-opt multiple stakeholders in value networks (Bogers & West, 2012; Sawhney & Prandelli, 2000). Significantly, co-creation processes are instigated as a learning strategy that enables organisations cope with increasing market demands (Di Tollo, Tanev, Davide, & Ma, 2012; Payne et al., 2008). Knowledge and

information acquired during the learning process is used to improve customer experience (Rowley, 2007) and to drive the innovation process for new service development (Edvardsson, Kristensson, Magnusson, & Sundstrom, 2012; Matthing, Sandén, & Edvardsson, 2004) or new product development (Sawhney et al., 2005). Thus, the main output from the co-creation process is value that is dependent on the use of services (Vargo, Maglio, & Akaka, 2008) and experiences of customers (Prahalad & Ramaswamy, 2004). In some cases, such as in the aviation sector, co-creation is viewed as a useful avenue for improving environmental sustainability through knowledge exchanges between individual passengers (consumers) and airlines (producers) (Gössling, Haglund, Kallgren, Revahl, & Hultman, 2009). Then again, co-creation has been criticised as an avenue for exploiting customers to generate 'a new source of surplus value' (Ritzer & Jurgenson, 2010).

Numerous examples of real-world applications of co-creation (by firms such as Microsoft, Cisco IKEA Sony, Microsoft, TiVo, Apple, Dell, eBay, Disney, Coca-Cola, Steelcase, Osram, Alcatel-Lucent, Toyota Scion, Endemol, Aloft, and Mazda) also offer support for the emerging reality that costumer–company interactions are gradually acting as the locus of value creation during the innovation process (see for instance, di Tollo et al., 2012; Kohler, Matzler, & Füller, 2009). In these applications, the co-creation process involves customers as part of the value chain i.e. as an individual that adds value to a service or product (Prahalad & Ramaswamy, 2004; Vargo et al., 2008). Co-creation also fosters an attitude in which consumption is closely connected to production (Etgar, 2008; Ritzer & Jurgenson, 2010) and can be sponsored by firms or initiated and supported by consumer communities (Foxall, 1986; Foxall & Johnston, 1987; Zwass, 2010).

In spite of the widely acknowledged benefits or value of the co-creation process (e.g. Prahalad & Ramaswamy, 2004; Vargo et al., 2008; Zwass, 2010), limited participation poses a significant problem for the success of co-creation, and insights into co-creation participation have shed the spotlight on experiences that motivate customers to physically and virtually submit ideas (Füller, Hutter, & Faullant, 2011). Other scholars have focused on challenges of geographical proximity or personal interaction to identify brokerage functions for facilitating co-creation (Parjanen et al., 2012). The question of whether different types of customers are required and willing to take part in co-creation has also driven researchers to explore creativity components of co-creation (Füller, Matzler, Hutter, & Hautz, 2012). These insights have enabled collective creativity – creative activity that originates from collaborating and contributing individuals – to be emphasised for stimulating participation during co-creation (Füller et al., 2011; Parjanen et al., 2012). Furthermore, the co-creation process is dependent on the willingness and openness of customers for involvement in working together and co-opetition (a neologism of cooperation and competition) (Hutter, Hautz, Fueller, Mueller, & Matzler, 2011). Level of involvement of customers have been categorised according to: persuasion of customers through adverts and promotions (customer engagement), collaborative work for new service development or new product development (co-design), technology use for ordering, buying and exchanging resources (self-service), solving problems for themselves (problem solving) and creating experiences (customer experience) (Gebauer et al., 2010; Prahalad, 2004).

1.4. Related work

Generally, descriptions and frameworks of co-creation have so far focused on characterising generic and domain-specific needs of co-creation in relation to elements such as encounters, suppliers and customers, as summarised by Table 1. These frameworks have been used in empirical studies within a wide range of industry sectors such as health (Gill, White, & Cameron, 2011), retail (Oh & Teo,

Table 1
Conceptual models of co-creation.

Source	Domain	Characterisation of co-creation	Conclusions
Fujioka (2009)	Retail industry	Capability-based to enable retailers and customers interact at points of contacts for retailer profit and customer satisfaction	Interactions that stem from co-creation require analogue and digital communications as well as novel management techniques
Tynan et al. (2010)	Luxury goods	Customer-focused to reflect possibilities for utilitarian, symbolic, hedonic, relational and cost forms of value that may self- or outer-directed	Co-created value involves complex interactions and dialogues that require novel networks
Prahalad and Ramaswamy (2004)	Generic	Experience-focused to capture necessary global resource networks and thematic communities that foster dialogue, access, transparency and risk-return (DART)	Focusing on interactions enables firms to realise new sources of competitive advantage
Miyake (2003)	Human–computer interaction	Intelligence-focused to reflect the search for and emergence of relevant solutions in relation to the completeness/incompleteness of solutions	Coherence between interfaces for co-creation are necessary for co-creation processes involving the use of technologies
Zwass (2010)	Generic	Governance-focused to reflect the importance of incentivising co-creators and using information technology to support tasks	Co-creation challenges the traditional boundaries between play and work as well as the nature of production
Gentile et al. (2007)	Generic	Experience-focused to describe value proposition/realisation for companies and value perception/expectation of customers	Successful co-creation requires consideration for emerging tendencies and behaviour of customers
Payne et al. (2008)	Generic	Process-focused for customer, supplier and encounter processes	Successful co-creation depends on core competencies such as learning and knowledge
Vargo et al. (2008)	Generic	Service-focused to describe how service systems access, adapt and integrate resources	Co-creation requires the involvement of two or more service systems as determined by value-in-context for delivering value-in-use
Zwick et al. (2008)	Generic	Governance-focused to reflect the shift from the factory to society and the reconfiguring of marketing for free and unpaid consumer labour processes	Co-creation reconfigures the social relations of production and offers a means of customer interaction through 'modes of relating'
Mascarenhas et al. (2004)	Generic	Customer-focused to emphasise the importance of involving customers as part of value chains	Managing co-creation requires considerations for how target customers can be progressively involved
Ueda et al. (2008)	Manufacturing	Value-focused to emphasis the role of information for realising integrated products and services	Co-creation involves an analysis of existing things and synthesis of new artefacts
Andreu et al. (2010)	Retail	Process- and role-focused to emphasise the importance of matching supplier–customer value-creating processes with value-facilitating and value-creating roles. Integrates roles from Grönroos (2008) and generic process described in Payne et al. (2008)	Benefits of co-creation are realised based on supplier–customer interactions for access to knowledge and resources
Grönroos (2008)	Generic	Role-focused to emphasise the importance of facilitators and creators during supplier–customer interactions	An analysis of roles during co-creation aids in developing and formulating value propositions
Hutter et al. (2011)	Generic	Community-focused to stress competitive and contributions behaviour that generate ideas and comments during design contests.	In design contests, collaborative and competitive behaviour are stable over time and the behaviour of co-creators is dependent on their structural positions in the community network
Edvardsson et al. (2012)	Service development	Service-focused to shed light on how customers can be integrated through obtaining use information	Use situations and resource context play important roles in shaping the dynamics of value co-creation for services
Nuttavuthisit (2010)	Generic	Consumer-focused to stress practices of participation and creation for self benefits or for the benefits of a wider set of consumers	The presence of choice, complement, cause, and communality plays an important role in determining consumers' co-creative practices
Gebauer et al. (2010)	Transport	Activity-focused to describe possibilities for customer engagement, co-design, problem solving, customer experience and self-service. Integrates Grönroos (2008) and activities described in Prahalad (2004)	Co-creation increases the success of operations through co-opting customers for knowledge sharing about experiences

2010), tourism (Prebensen & Foss, 2011), sports (Zagnoli & Radicchi, 2010), telecommunications (Matthing et al., 2004), aviation (Gössling et al., 2009), manufacturing (Zhang & Chen, 2008), automotive and pharmaceutical (Sawhney et al., 2005). Generic frameworks have also been proposed to characterise dichotomies that distinguish between: customer contributions and behaviour (Hutter et al., 2011), use situations and resource context in service development (Edvardsson et al., 2012), consumer practices during co-creation (Nuttavuthisit, 2010). Other themes modelled include capability (Fujioka, 2009), customer (Tynan, McKechnie, & Chhuon, 2010), experience (Gentile, Spiller, & Noci, 2007; Prahalad & Ramaswamy, 2004), intelligence (Miyake 2003), governance (Zwass, 2010; Zwick, Bonsu, & Darmody, 2008), service (Vargo et al., 2008), value (Ueda, Takenaka, & Fujita, 2008), roles (Andreu et al., 2010; Grönroos, 2008) and activities (Gebauer et al., 2010). These themes aim to describe attributes of co-creation for use in improving the co-creation process in terms of customer interactions at points of contacts, completeness/incompleteness of solutions, incentivising

co-creators, and using information technology to support tasks. However, these attributes are built on the premise of co-creation as a process made up customer, supplier and encounter processes, as discussed in Payne et al. (2008). Andreu et al. (2010) extended the description of co-creation by combining value-facilitating and value-creating roles proposed by Grönroos (2008). In Gebauer et al. (2010) the roles proposed by Grönroos (2008) are combined with co-creation activities for customer engagement, co-design, problem solving, customer experience and self-service, as proposed by Prahalad (2004).

An analysis of these studies suggests two important lacunas: a lack of emphasis on the importance of existing value in the process for co-creation between suppliers and customers and the limited treatment of formalised views that descriptively characterise the co-creation process in a manner that reveals the interplay between customer, supplier and encounter domains. Existing value is typically analysed as part of value creation (Ueda et al., 2008) and firms may focus value on exchange (value-in-exchange) or

use (value-in-use) (Payne et al., 2008). This existing value plays a key role in shaping the interactions and transactions that occur between customers and suppliers. Valuable services may generate positive feedback from consumers whereas valueless services or services with diminishing value could cause firms to initiate encounters such as marketing campaigns and sales interactions (e.g. Füller et al., 2011; Payne et al., 2008).

As a first step towards addressing these gaps, this article proposes an approach for formalising the co-creation process in a descriptive manner that explicitly defines the key role of existing value. The model is also extended to integrate technique selection during co-creation. This is because selecting appropriate techniques, such as workshops, story boarding and prototyping, for use in involving customers is an important factor for the co-creation process. The focus of the proposed approach is to conceptualise a unified model – a description that integrates aspects of a concept – of the co-creation process. Unified models have been used in research to characterise processes such as knowledge creation (Nonaka, Toyama, & Konno, 2000), requirements elicitation (Hickey & Davis, 2004) and relational exchange (Palvia, 2009). Similarly, this article concentrates on formally characterising the co-creation process so as to enhance understanding of the nature of knowledge creation and to manage such a process effectively. In other to accomplish this, the unified model is based on a combination of diagrammatical and mathematical reasoning to visually represent and aid in the analysis of co-creation techniques. This article, seeks to contribute to existing literature by shedding light on the co-creation process through a conceptual framework that defines the key role of existing value.

discusses the implications of the proposed model for academia and industry.

2. Research methodology

Fig. 2. A model of co-creation.

3.3. Strategising co-creation participation

Participation (p_i) is defined here as the activities that stakeholders perform for co-creation i.e. persuading customers through adverts and promotions (customer engagement), collaboratively working for new service development or new product development (co-design), using technology for ordering, buying and exchanging resources (self-service), problem solving by customers (problem solving) and creating experiences (customer experience) (Gebauer et al., 2010; Prahalad, 2004). The fulfilment of these activities depends on the levels of involvement from customers and suppliers i.e. the psychological state of participants such as attitude, importance and personal relevance (Barki & Hartwick, 1989). This level of involvement determines the success of innovation with customers and has been emphasised by researchers in terms of highly motivated states, comfort and competence of customers to provide valuable contributions (Füller et al., 2011; Kohler et al., 2009; Schuhmacher & Kuester, 2012; Zwass, 2010). For stage i of the co-creation process, an involvement strategy function (*involve*$_i$) can be defined as:

$$involve_i(v_i, \varepsilon_i) \rightarrow p_i \in A_i \subseteq A \qquad (7)$$

A_i is the set of decision-making, communication and work activities (from all possible activities A) for enabling participation at stage i of the co-creation process. These activities occur inside (insitu) or outside (exsitu) 'use situations' when resources are integrated, operated on with a specific intention to create value, and the focus with the co-creation process is to capture information from users insitu or exsitu (Edvardsson et al., 2012). Decisions-making involves generating choices based on rules and procedures, communication entails establishing 'commonness' (Schramm, 1954) through the exchange of verbal, written and electronic messages, and work means mental or physical human activity that is goal-oriented. ε_i is an *organisational constraint* at i that determines the level of involvement in terms of scope (role of participants, magnitude or size), time (duration and period), performance (format and coverage) and cost (monetary value that is a function of time, scope and performance i.e. *cost* = $f(time, scope, performance)$). Researchers have observed that these kinds of constraints limit the number of customers in customer–firm interactions (Parjanen et al., 2012). The *cocreate*$_i$ function can be updated for each stage i of the co-creation process using Eq. (7) as follows:

$$cocreate_i \left(n_i, \overbrace{involve_i(v_i, \varepsilon_i)}^{p_i}, v_i, t_i \right) \rightarrow v_{i+1} \qquad (8)$$

Similarly, Eq. (2) can updated for each stage i of the co-creation process using Eq. (7) as follows:

$$cocreate_i \left(n_i, \overbrace{involve_i(v_i, \varepsilon_i)}^{p_i}, v_i, t_i, \overbrace{dia_i(T_i, A_i)}^{\varphi_i} \right) \rightarrow v_{i+1} \qquad (9)$$

3.4. Prescribed steps for using the unified model

Following Hickey and Davis (2004), the unified model of co-creation is proposed as an approach for characterising any co-creation methodology M_j as built up from n stages. This can be formalised as follows:

$$M_j = cocreate_1, cocreate_2 \ldots cocreate_n \qquad (10)$$

Using Eqs. (2), (4), and (7), the *cocreate*$_i$ function can be updated for each stage i of the co-creation process as follows:

$$cocreate_i \left(n_i, \overbrace{involve_i(v_i, \varepsilon_i)}^{p_i}, v_i, \overbrace{select_i(v_i, \chi_i, T_i)}^{t_i}, \overbrace{dia_i(T_i, A_i)}^{\varphi_i} \right) \rightarrow v_{i+1} \qquad (11)$$

This function models the involvement strategy, customer/supplier dialogue and technique selection as part of the co-creation process.

For co-creation methodologies, four steps are prescribed, through the outlined functions of Sections 3.1–3.3. These steps describe how analysts can model the co-creation of value between suppliers and customers using Eqs. (1)–(11). In each step, parts of the function are considered.

1. *Need analysis*: examine purpose of co-creation in relation to customer needs n_i.
2. *Participation scope*: outline the span for participation p_i during the co-creation process in relation to possible participation activities A_i and participation constraints ε_i. At this point, encounters are assessed for establishing agreement φ_i during co-creation.
3. *Value status*: apply the outlined p_i in determining *a priori* value v_i i.e. the existing or known value and differentiate these from the unknown ones.
4. *Technique assignment*: determine technique (t_i) according to known techniques T_i and selection constraints χ_i.

It is important to reemphasise that these steps can be repeated for subsequent $i + 1$ stages of an iterative co-creation process. To apply the unified model for analysing co-creation, an industrial example of a case company from industry will now be presented and analysed.

3.5. Application of the unified model: case study of a microengineering firm

The case company is based in the United Kingdom and operates within the high-tech semiconductor domain with 20 staff for the delivery of microfluidic and microoptical solutions that are protected by 9 patents. Products delivered by the case company include microlens arrays for flat panel displays, and lab-on-a-chip microfluidic devices for industrial automation, cell analysis and drug delivery. These products are supported by services as business-to-business (B2B) solutions for customers that are mainly original equipment manufacturers (OEMs) or academic institutions. For this article, two projects (presented as pseudonyms for confidential purposes) in which the case company collaborated with its geographically dispersed customers are considered: *AlliProj* and *CustProj*. The choice of the case company was made because participation for innovation is a key feature of small and medium enterprises (SMEs) within high-tech firms (Trumbach, Payne, & Kongthon, 2006) and is a well-established process in projects involving geographically dispersed organisations (Boh et al., 2007).

Technology firms were the focus of this case study due to their 'central position in modern economies' (Grinstein & Goldman, 2006), and semiconductor firms have been identified as important sources of rich details about technology firms (Chou, Huang, Jahn, & Kuo, 2010). In addition, the two collaborative projects were chosen because – as indicated by the Company Director – they offered the most significant instances of where the case company's participated in supplier–customer collaboration processes to co-create services.

3.5.1. Case study method

The case study focused on task analysis which is a standard and systematic approach for studying and describing cases (Kirwan &

Ainsworth, 1992). Its selection for use in the study was made due to the focus of task analysis on data collection and description for steps and actions of tasks and processes. Interviews with company staff, to gather information on co-creation steps and actions, formed the basis of the data collection phase of this task analysis. In total, semi-structured interviews were conducted with 10 engineering and non-engineering staff involved co-creation processes. These interviews lasted 30 to 90 min *via* face-to-face and telephone conversations at the request of interviewees.

The interviews followed an exploratory approach that centred on gathering qualitative data for formulating and defining problems (Marshall & Rossman, 1999). This approach was favoured because it aided in addressing the 'what' and 'how' questions of the co-creation process. In this regard, an interview protocol was drawn up to capture: (i) nature and stages of a recently completed or on-going co-creation process, (ii) the participants and forms of participation to achieve process goals, (iii) applied methods for co-creation, and (iv) value, outcomes and/or benefits of the process.

Transcripts of the interviews were then analysed in line with an interpretivism epistemology "to understand phenomena through assessing the meanings that people assign to them" (Orlikowski & Baroudi, 1991, p. 5). To accomplish this, the proposed model was used as the starting point. The co-creation processes associated with the two studied projects were then described according to how participants understood them. The idea behind this analysis was to synthesise and compare, from the transcripts, the co-creation methodologies at the heart of each project.

3.5.2. Case 1: service action for mass customisation (AlliProj)

AlliProj was a four year international project that involved ten partner companies and universities for eliciting 'proactive requirements' i.e. requirements based on long-term product strategies, with a view to providing services for next generation technologies and systems. The purpose of *AlliProj* was for a consortium to explore convergence challenges of silicon and polymers. The existing scenarios for convergence of silicon and polymers, at the time,

were relatively immature, so the partners were selected on the basis of common interest. The case company's role was to explore microfluidic materials for use by partners (i.e. customers). Seven of the partners were potential customers for the case company and the other two partners were a consultancy firm and a software company. Co-creation within *AlliProj* centred on a workshop for making decisions on how end-users could be supported. The workshop involved five stages: (1) problem statement, (2) idea bouncing, (3) solution selection, (4) concept definition, and (5) implementation development. The workshop was held on 3 occasions (i.e. $j = 3$). Using the proposed unified model, the co-creation stages ($i = 5$) can be described as follows:

1. *Need analysis*: the purpose of co-creation was *co-design* for a new service to act as a one-stop solution for companies to standardise end-user products, and the needs of the case company's customers were refined through the first four stages n_1 to n_4.
2. *Participation scope*: participation p was different for all stages even though it was influenced by common participation constraints ε_1 for the workshop. Dialogues are performed during the solution selection stage for deciding on a set of possible solutions from the generated ideas. This refined the initial consensus a priori reached on goals φ_1, to consensus reached following dialogue φ_2.
3. *Value status*: technological and process value in v_1 to v_5, varied as knowledge of individual competences of partners are translated into collective service action plans.
4. *Technique assignment*: the technique t for co-creation stages centred on the use of group discussion for discovery and design (face-to-face exchanges (m^{dis})) and textual/diagrammatical representations (rich diagrams and log files ($\boldsymbol{m^{des}}$)) i.e. $t = \{m^{dis}, \boldsymbol{m^{des}}\}$. The second, fourth and fifth stages were however subject to selection constraints χ_1, χ_2 and χ_3 for applicable techniques T_1, T_2 and T_3 because they introduced additional techniques (such as the use of whiteboards) and varied according to the level of maturity for the project and the predefined cause of action (i.e. the project plan).
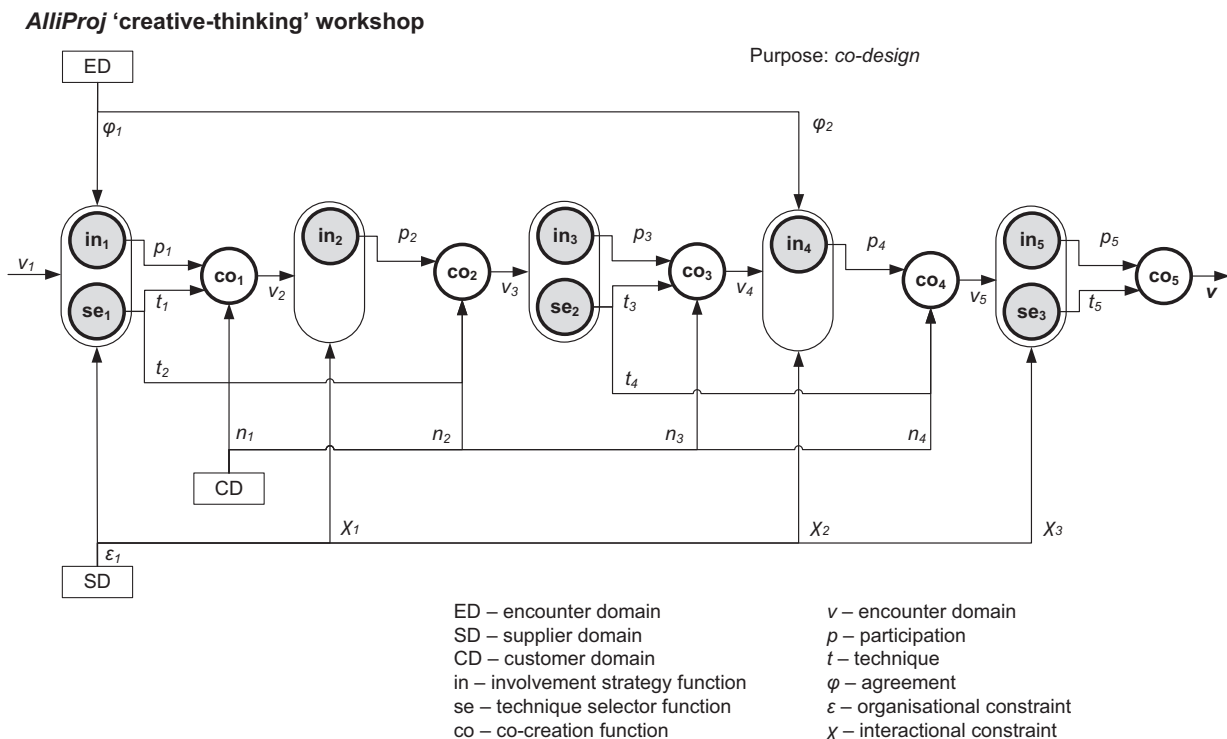

Fig. 4. Co-creation process model for the *AlliProj* workshop.

Using these data, the formalised co-creation functions within *AlliProj*, shown in Fig. 4, can be expressed as follows:

For Stage 1,

$$cocreate_1(n_1, involve_1(v_1, \varepsilon_1), v_1, \{m^{dis}, m^{des}\}, \varphi_1) \rightarrow v_2$$

For Stage 2,

$$cocreate_2(n_2, involve_2(v_2, \varepsilon_1), v_2, select_1(v_2, \chi_1, T_1), \varphi_1) \rightarrow v_3$$

For Stage 3,

$$cocreate_3(n_3, involve_3(v_3, \varepsilon_1), v_3, \{m^{dis}, m^{des}\}, dia_i(T_1, A_1)) \rightarrow v_4$$

For Stage 4,

$$cocreate_4(n_4, involve_4(v_4, \varepsilon_1), v_4, select_2(v_4, \chi_2, T_2), \varphi_2) \rightarrow v_5$$

For Stage 5,

$$cocreate_5(n_4, involve_5(v_5, \varepsilon_1), v_5, select_3(v_5, \chi_3, T_3), \varphi_2) \rightarrow v \quad (12)$$

From Eq. (12), the co-creation function for the methodology of the *AlliProj* workshop can be expressed as:

1. *Need analysis*: purpose of co-creation in this methodology is for *problem solving*, and customer needs (i.e. requirements) n_1 during acquisition were refined through stages of idea generation n_2 and elaboration n_3.
2. *Participation scope*: participation and participation constraints differ for all stages. p_1 involves activities performed by technical leads from both companies. During p_2 individuals are co-opted from both companies on a case-by-case basis, and p_3 involves activities performed by authorised representatives from the case company and the participating client company. However dialogue during the second stage centred on exchanges between technical leads that modified consensus reached prior to initiation φ_1, to consensus reached during completion φ_2.
3. *Value status*: economic and information value v_1 to v_3, varied as the completed activities are realised from outlined scope and context of the involvement.
4. *Technique assignment*: t for stage two centred on exchanging virtual prototypes (master drawing sets and checklists) as a means of testing designs (virtual prototyping (m^{des})) i.e.

$$\left[cocreate_5 \begin{pmatrix} n_4, involve_5(v_5, \varepsilon_1), cocreate_4(n_4, involve_4(v_4, \varepsilon_1), \\ cocreate_3(n_3, involve_3(v_3, \varepsilon_1), cocreate_2(n_2, involve_2(v_2, \varepsilon_1), \\ cocreate_1(n_1, involve_1(v_1, \varepsilon_1), v_1, \{m^{dis}, m^{des}\}, \varphi_1), \\ select_1(v_2, \chi_1, T_1), \varphi_1), \{m^{dis}, m^{des}\}, dia_i(T_1, A_1)), \\ select_2(v_4, \chi_2, T_2), \varphi_2), select_3(v_5, \chi_3, T_3), \varphi_2 \end{pmatrix} \right]_j \rightarrow v \quad (13)$$

The major strengths of the workshop-based approach to co-creation were the emphasis on collective action of co-creators and face-to-face interactions that enable individuals to sit informally and talk freely about mostly technical problems. These benefits however came at the expense of financial costs for organising the workshops and laboured discussions on some factors which the Company Director of the case company considered 'trivial' in nature.

3.5.3. Case 2: participative elicitation of system needs (CustProj)

CustProj is a 6 month project involving the case company as a supplier and an American client company as a customer for the joint development of a fingerprint scanner for use in homeland and border security. The key part of the project involved engaging the participating client company in eliciting reactive requirements that meet the immediate needs of end-users of the fingerprint scanner. Co-creation for *CustProj* involved three main stages: (1) collaborative acquisition of requirements, (2) idea generation, and (3) elaboration of solution. These stages are repeated (in j steps) as master set drawings are developed and refined based on a strict system of 'counter issuance' in which communications of changes are approved by authorised representatives from the case company (Chief technical officer and 2 senior engineers) and the participating client company (business manager and systems engineer). So far, the co-creation stages have been iterated 11 times to create 'version K' of the master drawing set. However, the involvement of the customer in co-creation only took place on 7 occasions (i.e. j = 7). Other iterations originate within the case company due to emerging system needs and insights into end-user needs. The role of the case company was to deliver optical components that were further developed and built into a large system. Using the proposed unified model, the co-creation stages (i = 3) can be described as follows:

$t_2 = \{m^{des}\}$. At stage three, the technique selected was constrained by χ_1 i.e. the preferences of technical leads for additional techniques in relation to a set of applicable techniques T_1.

Using these data, the formalised co-creation functions within *CustProj*, shown by Fig. 5, can be expressed as follows:

For Stage 1,

$$cocreate_1(n_1, p_1, v_1, t_1, \varphi_1) \rightarrow v_2$$

For Stage 2,

$$cocreate_2(n_2, involve_1(v_2, \varepsilon_1), v_2, \{m^{des}\}, dia_1(T_1, A_1)) \rightarrow v_3$$

For Stage 3,

$$cocreate_3(n_3, p_2, v_3, select_1(v_3, \chi_1, T_1), \varphi_2) \rightarrow v \quad (14)$$

From Eq. (14), the co-creation function for the methodology of the *CustProj* dialogues can be expressed as:

$$\left[cocreate_3 \begin{pmatrix} n_3, p_2, cocreate_2(n_2, involve_1(v_2, \varepsilon_1), cocreate_1(n_1, p_1, v_1, t_1, \varphi_1), \\ \{m^{des}\}, dia_1(T_1, A_1)), select_1(v_3, \chi_1, T_1), \varphi_2 \end{pmatrix} \right]_j$$
$$\rightarrow v \quad (15)$$

By adopting telephone conversations and emails exchanges, communication costs are minimised, when compared to co-creation in *AlliProj*, in spite of the high number of iterations during co-creation. Selection of participants during the different stages of co-creation also ensured pertinent information was exchanged and minimal points of contacts were created to avoid confusion and loss of focus. The weakness of this approach was reduced interaction between system developers from both companies that resulted in a mismatch and ambiguity in system/end-user requirements on two occasions. Time difference between geographical locations of
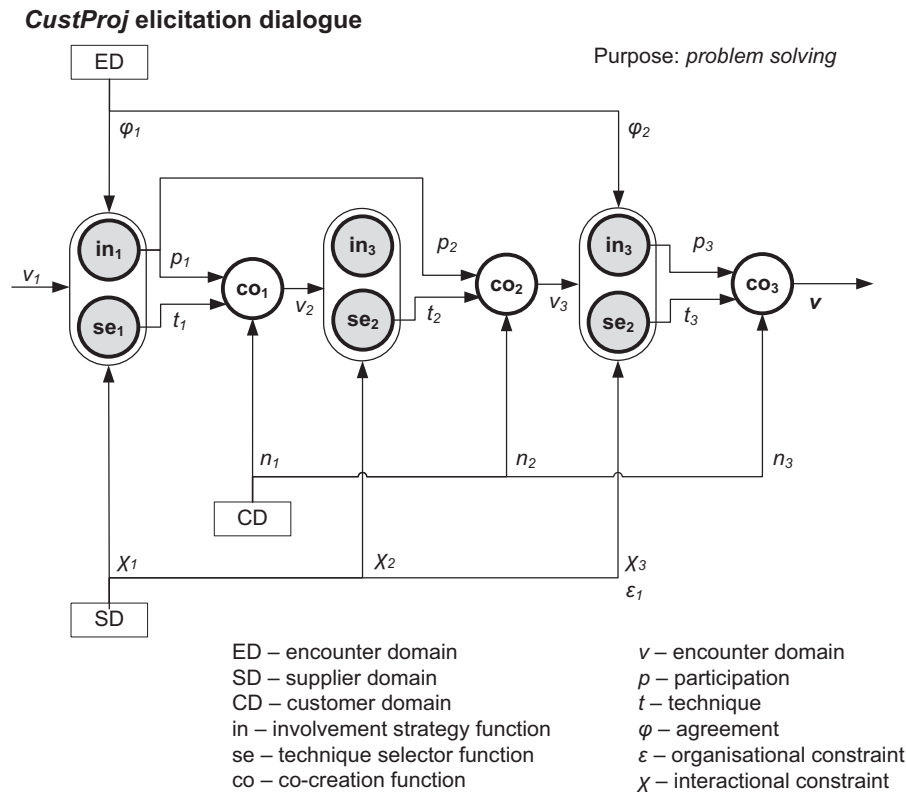
Fig. 5. Co-creation process model for the *CustProj* dialogue.

co-creators was also a challenge that required co-creators to modify working patterns to maintain interactions. According to the case company's Chief Technical Officer, due to the eight hour difference between the United Kingdom and the United States, his counterpart at the client company had to work outside office hours to make conference calls.

4. Discussion

The modern customer is increasing informed, connected, empowered, and active (Prahalad & Ramaswamy, 2004; Zwick et al., 2008), and co-creation is a domain-independent management strategy that reflects this trend. Although, co-creation resonates in ideas of open innovation and distributed innovation (e.g. Perks, Gruber, & Edvardsson, 2012; Schirr, 2012), its dominant use in academia and industry has focused on supplier–customer collaboration processes that are iterative for realising evolving customer needs. However, to prescribe a course of action to remedy problems in a process, there is a need to systematically describe the process (Koehler & Harvey, 2004). This process description offers an important avenue for researchers and practitioners to better formulate normative and prescriptive models for describing the logic of co-creation, for confronting participation problems of co-creation and for opening up new areas of research that prescribe new innovation models and innovation management approaches.

Along these lines, a unified model has been proposed to formalise the co-creation process in terms of involvement strategy and technique selection. Involvement refers to the psychological state that is required for activities to be performed by participants (Barki & Hartwick, 1989) and in the co-creation process these activities are determined by the supplier–customer encounters (Payne et al., 2008), and dialogues that enables people to work together (Durugbo, Hutabarat, Tiwari, & Alcock, 2011; Pawar et al., 1993).

The selection of techniques in the co-creation process must therefore consider the preference of key participants such as analysts and users (Hickey & Davis, 2004), and organisational constraints in terms of scope, time, resources and cost. The unified model was also applied through two collaborative projects (*AlliProj* and *CustProj*) within a semiconductor company. The modelled co-creation methodologies of the collaborative projects are compared in Table 2. The implications of the proposed model for researchers/practitioners are explored in the next subsections.

4.1. Implications for research

For researchers, the unified model offers a mathematical approach to complement existing conceptual models, presented in Table 1, that diagrammatically characterise roles and relationships for co-creation processes. Research centred on co-creation roles analyses co-creation processes in relation to how value is facilitated and created (Grönroos, 2008) while research focused on co-creation relationships examines forms of values, interactions that lead to value creation and customer involvement (Prahalad, 2004; Prahalad & Ramaswamy, 2004; Vargo et al., 2008; Yan et al., 2010). In both areas, processes that co-create value are a common unit of analysis that are associated with customer, supplier and encounter domains (Payne et al., 2008). However, the focus of the unified model has been to formalise the co-creation process in a manner that explicitly defines the key role of existing value and of functions for customer involvement and technique selection. The formalisation is done mathematically to reveal mathematical properties for performing further analysis such as process optimisation and network analysis. This enables the unified model to act as a scale on which different researchers and practitioners can evaluate their co-creation methodologies, as shown through Eqs. (12)–(15). This ability to act as a benchmark for methodologies could also be extended for comparative analysis

Table 2
Comparison of the modelled co-creation methodologies of the collaborative projects (*AlliProj* and *CustProj*) within the case company.

	AlliProj workshop	*CustProj* dialogue
Co-creation situation	Instant; physical (co-creators taking part in co-design workshops)	Periodic; virtual (co-creators in separate countries interact through the Internet and telephony)
Mode of interaction	Face-to-face communication and textual/diagrammatical representations	Telephone calls and conferences, virtual prototypes, and log files
Participation from company	Research and manufacturing sections	Research section
Level of involvement	Problem-solving	Co-design
Focus of process	Orientating and empowering customers in the use of technologies	Involving customers in requirements acquisition
Basis of co-creation	Types of customers involved and close relationships between producers and customers	Depth of the information provided by client company
Co-created value	Technological and process value for optical component and Customer experience for manufacturing	Economic and information value for optical component

of industry practice in terms of co-creation processes, co-creation participation and co-creation techniques.

The characterisation provided by the unified model could also be applied by researchers to refine existing research models and theories. As shown through the conceptualisation of the unified model, co-creation requires awareness and knowledge on customer needs, organisational constraints and dialogues to reach agreements on aspects such as level of customer involvement, costs, and benefits. Key challenges that could stem from this awareness include understanding the relationship between: (i) level of customer involvement and technique selection strategies, (ii) costs and consensus during co-creation, (iii) organisation constraints and the transformation of existing value to co-created value, and (iv) dialogues and co-creation relationships (i.e. individuals working on common or different activities).

The unified model also offers a useful starting point for researchers to explore interaction/performance factors (such as network characterisation) that contribute to 'optimal participation of customers in the co-creation process' or 'effective identification and selection' of participating customers. Examples of these factors include: number and type of users, possible spatial and temporal location of users/technologies/equipment, as well as network configuration, costs, service, restriction and growth. Related studies of network characterisation for collaboration have been conducted within the information sciences and human–computer interaction domains to empirically and theoretically demonstrate that 'exclusive collaborations' are the most effective and productive (Durugbo et al., 2011). Within the context of customer involvement, the optimal level for customer participation could be theoretically modelled through dichotomies and schemes for classifying participation such as committing whole or partial users and direct vs. indirect involvement of participants. Table 3 highlights some of the strengths and the weaknesses of the unified model.

From a theoretical perspective, the study builds on the dominant collaborative view of co-creation which researchers have expressed through themes that are capability-, customer-, governance-, intelligence-, value-, role-, process-, service-, and community-focused, as summarised in Table 1. Specifically, the proposed model is consistent with prior conceptualisations of co-creation (Andreu et al., 2010; Gebauer et al., 2010) that are value oriented. However, unlike previous studies of co-creation, this research explicitly defines the key role of existing value and technique selection during co-creation. This perspective is in line with information systems literature (Hickey & Davis, 2004) and shapes the interactions and transactions that occur between customers and suppliers (Füller et al., 2011; Payne et al., 2008).

4.2. Implications for industry

For practitioners, the unified model offers an analytical tool for co-creation process planning and management. This is because the 'snap-shot' of relations between involvement strategy, technique selection and dialogue functions defined as part of the unified model could be used by firms to review the desired logical flow against the actual implementation for use in configuring segmentation and orientating dialogues. These areas are now discussed.

4.2.1. Configuring co-creation segmentation

By 'co-creation segmentation', the authors of this article mean a sub-set of co-creation activities influenced by factors that cause co-creators to apply existing value based on the value-facilitating and value-creating roles that characterise the co-creation factors. For instance, in co-creation for services on a ship, expert users (such as deck personnel and ship crew) are required for safety critical systems whereas passengers could take part in co-creating hospitality services such as cruise activities and experiences. Similarly,

Table 3
Strengths and weaknesses of the propose model of co-creation.

	Strengths	Weaknesses
Suitability	Suitable for diagrammatical reasoning that reflects the flow of co-creation processes and the formalisation that represents this flow	May not be suitable for complex network reasoning to explain aspects such as cognitive behaviour or contribution of co-creators
Presentation	Presents a descriptive process model	Limited in its ability to prescribe remedies to anomalies or enhancements to activities
Focus	Process-driven with emphasis on the role of existing value and technique selection during co-creation	Lacks coverage of roles, agents and determinants of co-creation
Perspectives	Highlights the customer, supplier and encounter domains that contribute to co-creation	Limited in its understanding of the networks associated with value-creating processes
Detail	High-level of abstraction that captures the main logic at the heart of co-creation	Limited in detailing and giving a low-level account of the individual communications and interactions that distinguish case-by-case instances of co-creation
Application	Aid in comparing and bench-marking methodologies	Lacks support for decision making and selecting appropriate activities, co-creators or techniques

co-creation involving manufacturers of structures and original equipment manufacturers (OEMs) may lay emphasis on reaching agreements whereas co-creation consisting of companies and end-users of products could be governed by organisational constraints.

Using the unified model, firms could visualise co-creation segmentation in terms of attributes, domains and functions that contribute to co-created value. As shown in the application of the unified model, co-creation segmentation in methodologies can vary according to marked emphasis on customer involvement for *AlliProj* and on a blend of customer involvement and technique selection for *CustProj*. However, Figs. 4 and 5 show that in both cases, dialogues played a central role half way through the co-creation stages. For proposed methodologies, the level of co-creation segmentation is reflected in the degree of specificity and generality of the co-creation methodologies. For instance, the SCPS methodology (Roberts et al., 2005) specifies how co-creation can be based on workshops to bring customers together to solve problems (discovery and design). Similarly, in the CusI methodology (Matthing et al., 2004) customers are engaged through the use of diaries and the physical prototypes (discovery and design). The CoPP methodology (Etgar, 2008) on the other hand generalises how co-creation can be structured to involve customers.

In practice, co-creation segmentation may cause the weighting of functions to vary in terms of process timing, resource use, organisational costs, and so on. This could cause the co-creation process to be dominated by specific activities such as dialogues between customers, justification of techniques to OEMs, and planning for customer involvement. Practitioners are therefore required to carefully consider how functions evolve during co-creation and how relationships within functions emerge during co-creation stages. These considerations are necessary for understanding and providing environments to aid customers in customising their interactions and experiences (such as during sport teams, matches and events (Zagnoli & Radicchi, 2010)). Knowledge of domain

interactions for co-creation segmentation is also required for forming new relationships, and for improving cognition and innovation in stable and well established domains. This is because studies have shown that organisational personnel may no longer explicitly consider behavioural constraints in situations that are routine or familiar (Rasmussen, Pejtersen, & Goodstein, 1994). Rather, patterns of previously successful behaviour are simply invoked for solving problems. Intuitively, this supports continuity in operations but may impact on creativity and innovation especially if the behaviour is passed onto successive generations of organisational personnel.

4.2.2. Orientating co-creation dialogues

As earlier mentioned, existing knowledge of decision-making, communication, work activities and applicable techniques govern how encounters are made possible to reach agreements or consensuses. The level of consensus may be positive (concord), negative (discord) or neutral (impasse). It is for this reason that the quality of encounters needs to be enhanced to improve acceptance by customers (Newman & Robey, 1992). During the co-creation process, dialogues therefore play an important role in democratising the co-creation process and for creating a sense of liberation (Ritzer & Jurgenson, 2010) and ownership (Pawar et al., 1993). For instance, as shown in Fig. 6, the dialogue function may be connected to technique selection or to involvement strategies in a co-creation process. These connections are characterised by a high level of uncertainty such as during enhancement innovation where customers are co-opted and used as a means of driving 'innovation into finer and finer elements of details' (Moore, 2005). Furthermore, dialogues in the co-creation process could be useful for getting the buy-in of customers and for building trust, confidence and transparency during co-creation.

Using the unified model, management staff may assess the forms of management systems for co-creation dialogues and success. These systems could be based on single or multiple verbal,
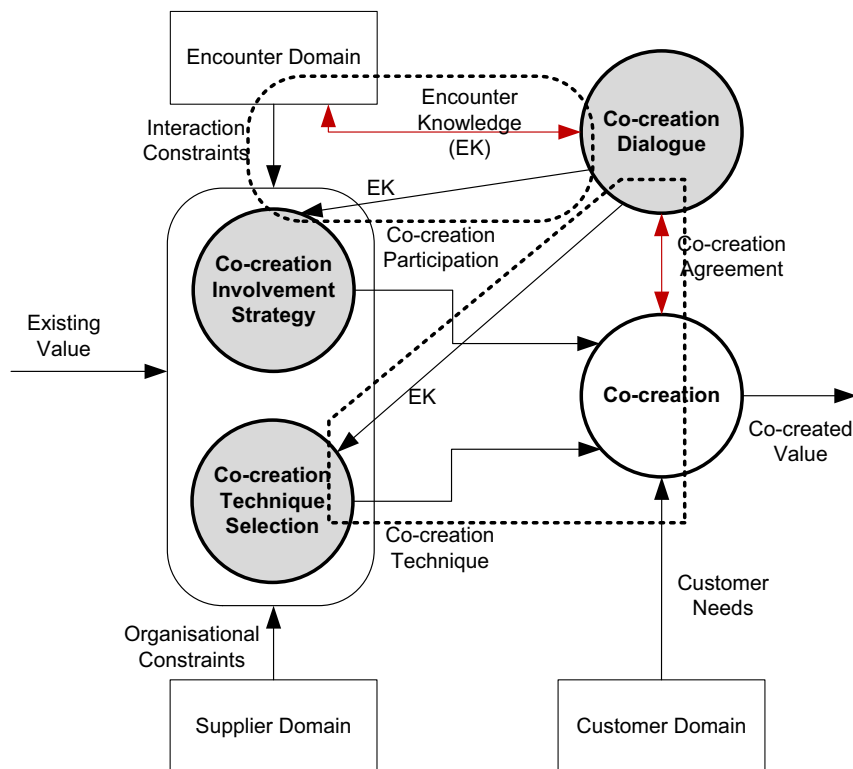

Fig. 6. Co-creation process model showing two instances (dotted lines) of potential 'co-creation stalemate'.

face-to-face, written, electronic, and artefact forms. In other situations where large samples of co-creators are involved, groupware technologies could be used to facilitate dialogues over the internet. If there is a high degree of uncertainty in the co-creation process, then the use of artefacts and face-to-face interactions are desirable. This is because face-to-face interactions reflect the richest form of communication according to the media richness theory (Daft & Lengel, 1986). Similarly, in cases where co-creation factors require users to be immersed i.e. participate in real life situations, then customers may act as inventors immersing themselves in activities and reversing the conventional 'single-inventor perspective' of innovation (Bogers & West, 2012).

However in practice, the co-creation function may become locked in a stage loop where groups of participants negotiating on a course of action may reach a 'co-creation stalemate', as shown in Fig. 6, when neither an agreement nor disagreement has been reached on a course of action. In the figure, bidirectional links from the dialogue function causes iterations within a co-creation stage. This could occur when knowledge from encounters or agreements causes co-creators to question involvement strategies and selected techniques. To move from a locked stage to the next stage, participants may decide to proceed nonetheless and be disillusioned by the previous stage or lack confidence in successive stage. For practitioners, a 'dynamic version' of the model is therefore needed to proactively detect potential situations that could lead to equivocations and to reactively offset stalemates through a set of mitigation strategies. Examples of these strategies include the use of different sets of participants for co-creation stages, multiple working groups and different design environments. An 'operational version' of the unified model is also needed to understand co-creation networks, entities and relationships. This is important for identifying the preferred route of customers for involvement during co-creation to ensure workload is balanced. To do this, each network and scenario needs to be treated on a case-by-case basis to cope with different requirements of customer participation for organisations (such as businesses, charity organisations and political groups), as well as inter-organisational activities and arrangements such as value-nets and supply chains.

5. Conclusions

Co-creation has emerged, in recent years, as an important management strategy for enabling firms to be innovative. Interest in co-creation is motivated by the awareness that customer competencies can be co-opted during encounters (two-way interactions and transactions) between customers and suppliers for enhancing firm competitiveness. However, in spite of a burgeoning literature on the conceptualisation of co-creation, little has been done to formalise the co-creation process and to assess methodologies that apply techniques for involving customers in co-creation. This article attempts to offer insights into the co-creation process through a conceptual framework that defines the key role of existing value. It describes a study that conceptualises a unified model of co-creation and applies the model in a case study of a high-tech semiconductor firm to capture, compare and formalise methodologies of co-creation processes.

The article makes three main contributions. First, it provides a critical review of existing literature on co-creation within the context of conceptualisations that researchers have proposed to characterise co-creation structure and behaviour. It highlights the limited research on the importance of existing value in the process for co-creation between suppliers and customers and the limited treatment of formalised views that descriptively characterise the co-creation process in a manner that reveals the interplay between customer, supplier and encounter domains. Second, the article pre-

sents a conceptualisation of co-creation as an amalgamation of functions for *customer involvement* and *technique selection* as determined by customer, supplier and encounter domains. With insights from a case firm, the article makes a third contribution in the form of factors for reviewing involvement strategy, technique selection and negotiation functions. The key benefits and impact of the unified model centres on the potentials of the unified model for acting: as a benchmark for methodologies to compare industry practice, as a groundwork approach for planning and managing the co-creation process, and as an algorithmic foundation for the development of environments and management systems for regulating dialogues.

Generally, this research proposes a unified model for formalising the co-creation process in terms of: knowledge of the characteristics of customer needs, knowledge acquired from supplier and customer learning during encounters, knowledge of the links between the characteristics of existing customer needs, customer involvement and co-creation technique selection, and knowledge of the existing and co-created value. Four steps for assessing co-creation methodologies were also prescribed; beginning with an analysis of the purpose of co-creation in relation to customer needs, followed by decisions of the scope of participation. The third step assesses the status of existing value in relation to scoped participation, and the fourth step determines techniques to be used for co-creation. The phenomena of 'co-creation segmentation' and 'co-creation stalemate' associated with attributes, domains, functions, and levels of uncertainty due to dialogues within the unified model were also presented and discussed. These challenges revealed the need to enhance the usability of the model and the role of existing value for co-creation. The varied formulations and representations of the methodologies suggest that co-creation is a process that can be realised through a wide range of permutations and combinations. There is therefore a need to complement the model as a groundwork approach with ontology to categorise and characterise methods, number of participants and other factors required for co-creation segmentation. As a starting point, the connections between supplier–customer encounters, group formation and consumer practice could be conceptualised and analysed through future empirical studies.

For this research, the main goal has centred on proposing a conceptual model for descriptively characterising the co-creation process and assessing co-creation methodologies. In addition, the research has attempted to formalise methodologies of co-creation processes within a high-tech semiconductor case firm. The research is therefore limited to the analysis of a single case and could be complemented by future cross-sector analyses that investigate trends across industrial sectors. Expert and decision systems for supporting participation and negotiation are needed to enhance how value can be realised from co-creation processes. This could potentially involve the use of techniques such as Analytic Network Process (ANP) and Technique for Order Performance by Similarity to Ideal Solution (TOPSIS). Additional considerations for implementation and the reengineering of co-creation processes could spur research into the development of ontological and networked designs using technologies such as Mark-up Languages and applets. The proposed model also concentrates on customer–supplier involvement based on an existing value. Consequently, there is a need to explore some fundamental questions such as: is co-creation always relevant or useful? What win scenarios ("win" for suppliers, "win–win" for supplier–customer, "win–win–win" for supplier–customer-environment, and so on) are possible in co-creation? Further research could also explore contingency measures and coping strategies to deal with changes in customer behaviour and non-deterministic characteristics of component lifetime distribution. These factors can be used as 'research lenses' to expose possible research directions for co-creation studies. For instance,

exploring the orientation of dialogues raises research questions under themes such as "user perception of (*a priori*) value in co-creation" that could impact on participation among customers and occurrence of co-creation stalemates.

Acknowledgments

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