

A CONCEPTUAL APPROACH TO FACILITATE JOINT CREATION INTERACTIONS OF PRODUCT DESIGN PROCESSES

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ABSTRACT

Collective knowledge structures for co-creation can be achieved by a process of collaborative argumentation, organized in knowledge structures, and represented by knowledge models. In previous empirical tests carried out to collect and select innovative ideas from users and employees, an aggregation of ideas of individual contributions, but not a true collaborative creation based on those ideas, was observed. In our approach we propose a process for the collaborative construction of arguments, and a knowledge structure based on the integration of arguments in Knowledge Component Models and Knowledge Metamodels. Finally, we conclude that the work carried out to understand the interactions that take place in the social construction of knowledge structures helps us to comprehend co-creation and goes further than the simple collection of ideas, contributing to a quantity reduction of unconnected information, to the improvement of the quality of proposals, and to understand, not only *what* is proposed by users, but also *why* those proposals are important to them.

INTRODUCTION

Co-creation has been defined as a social process of collaboration between producers and users, in order to generate value for users (Humphreys et al. 2009). As a social process, co-creation constructs knowledge through social interaction. Social Constructionism (Berger & Luckmann 1966) proposes that humans interacting together create mental representations that become their knowledge of reality. Co-creation as a collaborative process between producers and users

generates a special opportunity to construct knowledge structures, such as arguments, by means of Collaborative Argumentation (Andriessen 2006). Finally, co-creation that generates value for users requires understanding the components of user value in order to improve the value proposition offered by producers.

Based on a traditional definition of knowledge (Davenport & Prusak 2000) and developments in social knowledge creation (Berger & Luckmann 1966), in the context of this article, knowledge

is defined as a combination of framed experience, socially constructed reality, values, contextual information, and expert insight that is applied in the mind of the person that possesses the knowledge. This knowledge can be jointly created between producers and users.

Our research problem is to understand the interactions that take place in the social construction of knowledge structures between producers and users. In our approach we propose a process for the collaborative construction of arguments. In this process, a group of human agents work together, using Toulmin's Argument Model (Toulmin 1958), to represent their knowledge about a specific subject. Additionally, using Henderson and Clark's model (Henderson & Clark 1990) we propose another two types of knowledge models to be constructed by the group of human agents. The first one is the Knowledge Component Model, defined as the knowledge structure of the core arguments, and the way in which they are implemented in a particular component. The second one is the Knowledge Metamodel, defined as the knowledge structure of the ways in which the Knowledge Component Models "Are integrated and linked together into a coherent whole" (Henderson and Clark 1990).

The conceptual approach presented in this paper contributes mainly to: (1) A reduction in the quantity of un-

connected information and to the improvement of the quality of proposals obtained from joint creation activities; this is achieved by incorporating the concepts of knowledge structures and knowledge integration; (2) Understanding not only what is proposed by a user, but also why that proposal is important to users; this is achieved by the incorporation of the argument as a basic unit of the knowledge structures. Previous literature has not examined these elements regarding co-creation processes.

Our research methodology begins with the results of real experience, presented in the context section. We begin with a concise review of the existing co-creation literature, which provides insight into three methods in which users participate in product development. The objective research is then based on the findings on the literature review. Finally, a conceptual model is proposed and conceptually validated. We include directions for further work, particularly the validation and implementation of the model, based on empirical tests.

CONTEXT

Before to propose the conceptual model developed in this study, we examine the real applicability of the practice of producer-user relationship through information collected by a trial project of a telecommunication company intended to foster innovative ideas from costumers.

The data collection process used in the company’s trial project comprised the following phases: (1) Focus selection, (2) Invitation to participate, (3) Submission of ideas related to the focus of the trials, (4) Commenting on submitted ideas in order to generate interactions that contribute to improving submissions, (5) Improvement of ideas to take account of comments made by other participants, and (6) Vote for favorite ideas. An adapted Internet Toolkit (Piller & Walcher 2006) was used to support the process. Two trials were active for one month, the selection of winning ideas was performed by a committee in the first test, and by participants voting in the second test. The following conclusions emerged from the trial project: (1) In a month, the number of ideas exceeded by 300%

the results of a year using the company’s traditional method, which allows the submission of ideas on diverse topics, followed by annual selection by a special committee. This improvement is associated with the focus on specific topics instead of the diverse topics of the traditional method, and to the short lapse of time, which incentivizes user inputs. (2) The principal motivation of participants is winning the contest. They prefer to contribute new ideas instead of working with ideas already submitted. As a consequence, joint work between participants was scarce, and contributions from other people in the form of comments were not used to improve proposals. (3) Selection of winning ideas through mechanisms such as selection committee and direct voting by participants raised doubts about the quality of the selection procedure. Piller and Walcher (2006) identified that users tend to make a selection based on their needs, while experts make a selection with more technical emphasis. Also, the quantity of ideas makes it difficult to review them all before voting or selecting. (4) The information contained in the non-winning ideas is lost, the large quantity of ideas makes it difficult to consider them all, as a lot of company resources would be required to do so.

From a producer perspective, a better option is an approach that produces more complete and elaborated con-

cepts, integrating different proposals, instead of a large number of disperse and unconnected ideas. It is expected that collaborative work will achieve better results than aggregation of individual work. Information about user value is expected to be collected from the concepts proposed and from interactions between participants. Another aim is the identification of user expectations that can be addressed by the producer.

Our research methodology begins with the analysis of the results of the real experience described in the previous paragraphs. A literature review was carried out on co-creation approaches and concepts, and three methods in which users participate in product development. Then the research problem was formulated, based on the findings of the literature review. Next, the conceptual model described in this paper was proposed. Further work to be conducted includes the continued development and testing of the model, and the execution of empirical tests.

**LITERATURE REVIEW
CO-CREATION APPROACHES**

In the book *The Third Wave* Alvin Toffler (1980) introduces the concept of “Prosumer”. The Prosumer is a user that is willing to produce for his own consumption when available products do not address his needs and requirements. The co-creation concept integrates the work of the Prosumer in

Approach	Source	User involvement
Mass Customization	(Davis 1987)	User participation in personalization of products, taking advantage of mass production technology
Value Co-production	(Ramírez 1999)	User participation in producer’s value chain, performing activities previously reserved for the producer
Marketing Co-creation	(Sheth et al. 2000)	User participation in the definition of marketing mix fields
Knowledge Co-creation	(Sawhney & Prandelli 2000)	User-producer interactions as a source of knowledge generation
Value (Experience) Co-creation	(Pralhad & Ramaswamy 2000)	Users and producer creation of valuable and personalized experience
Co-design	(Sanders & Stappers 2008)	User participation in design activities.
Crowdsourcing	(Howe 2006)	User communities perform duties previously restricted to the producer
Co-innovation	(Mannervik & Ramírez 2007)	User participation in innovation cycle activities.

Table 1: Co-creation approaches.

product development activities. For example, Erik Von Hippel (1986) characterizes a type of Prosumer called lead user, and proposes ToolKits (von Hippel 2001) as the tools to work with lead users in activities intended to identify future needs of normal users.

Other co-creation approaches presented in Table 1 illustrate different conceptualizations of user involvement in joint creation activities, from idea generation in co-innovation (Mannervik & Ramírez 2007), to experiences with products or services in experience co-creation (Prahalad & Ramaswamy 2000). This shows the need for further work to clarify the meaning of the co-creation concept and the focus of these user-producer interactions. Nevertheless, we can associate co-creation approaches to specific stages of the innovation chain. We also identify the need to work with knowledge in all of these stages.

METHODS IN WHICH USERS PARTICIPATE IN PRODUCT DEVELOPMENT

Three methods described in the scientific literature were studied to identify user participation. One of the methods studied is open source projects. Feller

Name	Open Source (S. Sharma et al. 2002)
Description	Open source software development process
Participants	Developers and users
Steps	(1) Problem discovery (2) Finding volunteers for tasks (3) Solution Identification (4). Code development and testing (5) Code change review (6) Code commit and documentation (7) Release management
Tools	E-mail, Newsgroups, CVS
User participation	Users can participate in each step, according to their capacities and reputation. When different options are available, a central group makes a selection.

Table 2: Open Source Method.

and Fitzgerald (2000) describe this projects method as a massive and parallel code development and debugging that involves decentralized, cooperative and free contributions from individual developers.

Open source projects begin with a personal idea or need, "A personal itch" (Raymond 1999). Work is not assigned, but is taken and implemented by volunteers, and there is no project plan, schedule or list of deliverables (Mockus et al. 2000). There is no explicit design at the system level, nor a detailed design; code developing is what encourages participants' collaboration (Vixie 1999).

Piller and Walcher (2006) propose a method and a web-based toolkit for collecting ideas from users for product development. These authors identify several elements that require further attention by administrators and researchers, including: Tool usability, interaction methods, idea pre-screening methods, user involvement in evaluation of ideas, procedures for idea formulation, and tools for collaborative creation of ideas.

Another method has been developed by The Virtual Innovation in Construction project, Its goal is to create an information and communications technologies "ICT supported methodology VICMET to involve building end user in a creative innovation process together with building designers, to capture and formulate end-user needs and requirements on buildings and their functionality" (Christiansson et al. 2008). A conclusion of this work establishes that "There is a need to further develop ontologies, functional building descriptions, and sequential methodologies to support a creative design in an open innovation environment" (Christiansson et al. 2008).

It is noted that in each of the methods described in Tables 2, 3 and 4, where there are different options, a designated group takes a decision or makes a final selection. There is a lack of processes that allows users to work on: (1) Integration of different contributions, (2) creation of new and better options when different perspectives between the user and producer are present, (3) idea formulation, and (4) user participation in evaluation of ideas. These important processes in joint creation ac-

Name	Idea Collection (Piller & Walcher 2006)
Description	Method to collect product development ideas from users
Participants	Users and company experts
Steps	(1) Interviews with managers and experts (2) Prototype (3) Tests (4) Selection of participants (5) Contribution of ideas (6) Evaluation of ideas by a group of company experts (7) Awards.
Tools	Toolkit
User participation	User takes part in submission of ideas. Idea selection is made by a group of company experts.

Table 3: Idea Collection Method.

Name	Vicmet (Christiansson et al. 2008)
Description	Virtual innovation in construction with user participation
Participants	Designers and users
Steps	(1) Anthropology and applied ethnography (2) Context selection (3) Functional building systems design (4) Functional building subsystems consolidation (5) Component building systems solutions (6) Component building systems requirements (7) Building component systems design solution (8) Construction (9) Requirements fulfillment evaluation
Tools	VIC SPACE Platform
User participation	Users don't participate in functional building subsystems consolidation.

Table 4: Vicmet Method.

tivities need further development, and the work on collective construction of knowledge structures represents an advance in that direction.

USER VALUE

Co-creation “is initiated by the firm to generate value for customers” (Humphreys et al. 2009). Therefore, a knowledge structure describing user value is the first objective of the application of our approach. The components of user value are described in the following paragraphs.

One of the main figures of scholasticism, Pierre Olivi (1248-98), proposes three fundamental sources of value “Scarcity (a relative quantity), utility (an objective want- satisfying power), and desirability (a subjective desire to gratify satisfactions)” (cited in Letiche 1969). Adam Smith (1776) describes two different meanings of the concept of value. In his theory of value, Value in Use was referred to as “the utility of some particular object”, and Value in Exchange was defined as “the power of purchasing other goods which the possession of that object conveys”. Throughout the industrial revolution, economic and marketing practices followed the concept of value in exchange, leading to the prevalence of Product Centered Paradigm (Vargo & Lusch 2004). The advent of a services economy encountered difficulties with Product Centered Paradigm, so Services Centered Paradigm based on Value in Use emerged; in the new paradigm “Goods are best viewed as distribution mechanisms for services, or the provision of satisfaction for higher-order needs” (Vargo & Lusch 2004). Addis and Holbrook (2001) analyze two types of features of a product; utilitarian features provide Value in Use or Utilitarian Value, and hedonic features provide Experience or Hedonic Value. These types of value remind us of the sources of value proposed by Pierre Olivi; utility and desirability.

CONSTRUCTION AND INTEGRATION OF KNOWLEDGE STRUCTURES

There are three major schools of thought about knowledge creation. From the point of view of rationalism, knowledge is discovered by reasoning. On the other hand, empiricism em-

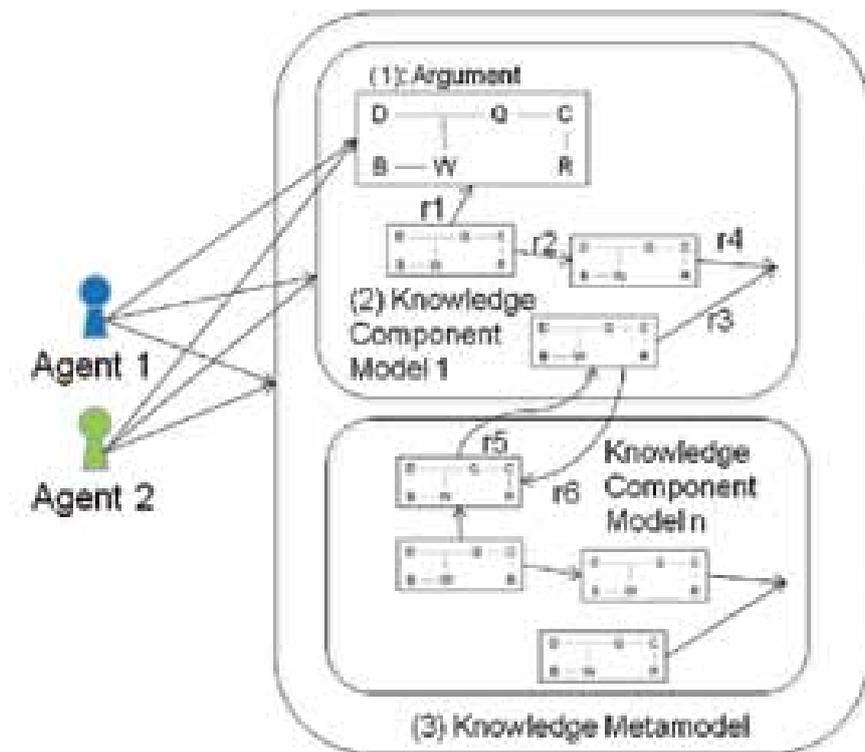


Figure 1: Knowledge Structure Construction Process: (1) Argument Construction; (2) Using a set of arguments a Knowledge Component Model is Constructed; (3) Using a set of Knowledge Component Models, a Knowledge Metamodel is constructed.

phasizes that knowledge comes from experience. And there are combinations of rationalism and empiricism, such as logical positivism that recognizes formal knowledge and empirical knowledge (Hjørland 2005). Other perspectives challenge traditional thinking about knowledge creation. From a social perspective, knowledge is constructed through social interaction, Symbolic Interactionism (Mead 1934) places a special emphasis on communicative interactions, *meaning* is created “with the adjustment to one another of the acts of different human individuals within the human social process” (Mead 1934). Social Constructionism (Berger & Luckmann 1966) proposes that humans interacting together create mental representations that become their knowledge of reality; the process is described as three moments: (1) Externalization: The rapid outflow of human physical and mental activity into the world; (2) Objectivation: The experience of the world, the reality, created by externalization, and (3) Internalization: In the course of socialization, the world as it is experienced is internalized and interpreted (Berger & Luckmann 1966).

From the perspective of psychology, social interactions allow the acquisition of knowledge by the individual (Vygotsky 1934). Once created, knowledge is organized in knowledge structures or schemes, like scripts, goals and plans (Adelson & Black 1986). These knowledge structures can be represented using knowledge models, and can be used to work on, and share knowledge with other humans during social interactions, following the moments of externalization, objectivation, and internalization. This collective construction of knowledge is achieved by a process of collaborative argumentation (Andriessen 2006) intended to improve the arguments of others. In our approach, the first knowledge representation to be constructed is an argument. Arguments have been widely used for knowledge representation (Bentahar et al. 2010), knowledge representation for problem solving (Clark 1990), and knowledge representation for agreement seeking (Morge & Routier 2007). Using Toulmin’s Argument Model (Toulmin 1958), different participants collaborate to construct arguments using their knowledge



Figure 2: Components of the Social construction of Knowledge Structures.

about a specific subject.

A basic argument model contains three components. (1) Claim: A statement or proposition about the subject under construction. This is the equivalent of an idea in a traditional idea contest, but here it also represents other elements of a knowledge structure, such as, a relationship between two statements or propositions (r1 ... r6 in Figure 1). (2) Data: Evidence and facts that support the claim; and (3) Warrant: The link between the data and the claim, stating how the claim has been derived from the data. A complete argument model includes three more components: (4) Backing: Statistics, experiences, research that support or confirms the warrant; (5) Rebuttal: Conditions or situations where the statement is not appropriate, pertinent or important; (6) Qualifier: An indication of the force or confidence of the claim. Components 2 to 6 include information about user context, preferences, experiences, and user value expectations provided by users. And information about producer resources, capacities, value offers, and assumptions about user preferences provided by producer employees. An interaction protocol (Morge 2005) guides participants through the process of argument construction, facilitating the process and motivating interactions. Using Henderson and Clark's model (Henderson and Clark 1990) we propose another two types of knowledge models to be constructed by the group of human agents; see Figure 2. The first one is the Knowledge Component Model, defined as the knowledge structure of the core arguments and the way in which they are implemented in a particular component. Using a set of arguments, a Knowledge Component Model is constructed, identifying relations be-

tween arguments. An interaction protocol guides participants through the process of Knowledge Component Model construction. The second knowledge model to be constructed is the Knowledge Metamodel, defined as the knowledge structure of the ways in which the Knowledge Component Models are integrated and linked together into a coherent whole (Henderson and Clark 1990). The Knowledge Metamodel is constructed by the identification of the relations between Knowledge Component Models and arguments. Again, an interaction protocol guides the users through the process of Knowledge Metamodel Construction, also known as the Knowledge Integration Process. Based on Linn (2000) definition, the knowledge integration process is described as the process of linking, connecting, distinguishing, organizing, and structuring Knowledge Component Models in a Knowledge Metamodel. Important knowledge creation opportunities take place when different perspectives come into view in argument construction activities or in knowledge integration activities. These opportunities require the formulation of a new argument that represents a better perspective for both the users and the producer.

CONCLUSIONS

The conceptualization and practice of co-creation has been advancing due to the work of various authors and companies. Different options for co-creative work between users and producers are still under development, with a variety of enabling aspects requiring special attention. The literature review revealed the need to develop interaction methods, procedures for idea formulation, and procedures for user involvement in idea prescreening and evaluation. It is noted that in each of the methods described, where there are different options, a designated group takes a decision or makes a final selection. There is a lack of processes that allow users to work on the integration of different contributions and the creation of new and better options when there are different perspectives between users and producers.

A co-creation definition involves the concepts of social interaction, and collaboration. Social interaction is an important source of knowledge for the

individual and society and contributes to creation of reality. Collaboration, and specifically collaborative argumentation, facilitates the construction of knowledge structures. Based on these concepts, social construction using collaborative argumentation, interaction protocols and knowledge integration processes can contribute to co-creation processes by facilitating the interactions of participants in the construction of knowledge structures. The knowledge structures composed of arguments, Knowledge Component Models, and a Knowledge Metamodel can be used to describe a co-created object or concept required in product design processes; for example, knowledge structures of user value.

This paper contributes to the concept and practice of co-creation with a conceptual approach that facilitates: (1) A quantity reduction of unconnected information and the improvement of the quality of proposals obtained from joint creation activities; this is achieved by incorporating the concepts of knowledge structures and knowledge integration, (2) Understanding, not only *what* is proposed by a user, but also *why* that proposal is important to users; this is achieved by the incorporation of the argument as a basic unit of the knowledge structures. (3) Facilitating interactions between participants by proposing the incorporation of interaction protocols. These elements were absent from the literature we reviewed about co-creation.

Further work includes the detailed specification of the model to be tested and the execution of empirical tests of the proposed approach using human agents, in order to identify the impact of this approach compared to current practice. This approach also needs to be applied to the different stages of the innovation chain that require knowledge from users.

Co-creation with large groups in a virtual environment would require other elements, including norms, conventions, and motivation. Further exploration of mechanisms that address these issues, such as the reputation system proposed by Muller (2006), is also required.

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