Negotiation Environment and Protocols for Collaborative Service Design

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Abstract. During the last decade, in manufacturing and service industries, collaboration among small and medium enterprises (SMEs) has focused on competencies and resources sharing as an approach to both create new competitive environments, as well as to achieve agility to rapidly respond to new market demands. Also, with the increasing level of customization of products and services required by customers, the notion of co-creation of products and business services leads to an increase of collaboration with customers and local suppliers. In this context, this paper presents an approach based on a negotiation support environment that structures the design of new business services under a collaborative perspective. The adopted protocol to facilitate interaction among the multi-users in the negotiation dialog is described.

Keywords: Collaborative Networks, Negotiation Support Environment, Business Services, Co-Design, Co-Creation, Negotiation Protocol.

1 Introduction

Due to market unpredictability and new requirements, companies and organizations need to adapt themselves to maintain competitiveness. One option is to move from the "traditional enterprise" concept to a new business paradigm where enterprises can strategically access to each other's markets by joining competences and sharing skills and costs, resulting in a new collaboration structure of enterprises. The collaborative network concept is increasingly adopted to support organizations and companies in this change of paradigm, as it can provide agility and survival mechanisms that facilitate companies to survive to market turbulences [1]. Nevertheless, there are some obstacles, for example: how to find or choose the right partners; lack of common or standard formats for basic profile of organizations; how to define and reach agreements for roles and responsibilities of each partner and of course how to predict associated collaboration risks.

Another important aspect that requires attention is the increasing demand from customers for highly customized products. Therefore, one tendency for manufacturers is to associate business services to the products they offer [1]. From a collaborative perspective, these services are designed and created by multiple stakeholders to meet

the individual customer's needs and/or requirements. This also brings the need to follow some service design methodology, which typically is a non-structured approach. In this context, the European research project GloNet was carried out with the aim to design, develop and deploy an environment to facilitate networks of SMEs to collaborate and achieve highly customized service-enhanced products [2]. The interaction with the customer and local suppliers is fundamental and leads to the notion of co-creation of products and business services. For the formation of such networks, one important requirement is the existence of an established negotiation process to improve the generation of agreements that facilitate collaboration and lead to the governing rules and principles of the consortium during its operation phase [3].

Considering this background context [4] that supports and fosters the creation of dynamic virtual organizations (VOs), the research question addressed by this work is:

How can an electronic negotiation support environment increase the agility in the process of successfully creating dynamic virtual organizations?

An important motivation for this work is that by contextualizing the design of a new business service in a collaborative environment, it can also use the same negotiation support environment mechanisms to reach agreements, as the ones that are used for the VO creation process [5, 6, 7].

2   Relationship to Cloud-based Solutions

Cloud computing provides its users with different levels of solutions in the form of services: infrastructure, platform, and software as a service. Depending on the user requirements, it provides services based on a distributed and parallel processing, improving reliability, storage capacity, and service efficiency [8] when compared to traditional solutions. In the existing market volatility, it is crucial for companies to guarantee that their applications and services are always accessible. So, through a cloud-based solution companies can, in principle, reduce their costs [8, 9], as they don't have to keep complex private infrastructures.

While in the manufacturing and services industry the trend is to move towards a global networked economy, cloud-based solutions potentiate collaboration platforms to support the establishment and operation of the involved enterprise networks [10]. Considering the co-design of new business services where different and diverse stakeholders intervene in the process to achieve new business services design, the cloud-based solutions appear with relevance once they can facilitate the development of new collaborative processes [10]. This work is developed in such context and builds on top of a cloud-based collaboration platform [11].

3   Context and Related Areas

To contextualize the negotiation support for service co-design and related negotiation protocol, this section gives a brief overview of the literature.

Business services and composite business services. A business service refers to an organized set of added value activities from a business perspective [12], considering issues such as the delivery conditions, service level agreements, period, availability, etc. [1]. It corresponds to the service provided to the customer, and can be implemented by manual services and/or software services whose flow can be modeled through business processes. Also, business services provided to the customer can be composed of several atomic business services [10]. In such situation, service providers of each business services can together form a virtual organization to deliver the composite business through a new entity that is the service integrator (that acts as the service provider of the composite business service) [13].

GloNet co-Creation Network. One of the GloNet project assumptions is that if networks of SMEs are supported by an environment that facilitate collaboration, then they can achieve highly customized service-enhanced products [2]. Here the notion of co-creation networks appears as a concept that is based on collaboration between manufacturers, customers, and members of customers' community [1]. These networks aim to co-design and co-innovate value-added services for products when new promising business ideas emerge [14]. Also, an analysis of the IT implementation requirements of those business applications can be performed [15].

Service Design. This is an interdisciplinary area that emerged as a contribution to a changing context from the growing economy of the services sector and the traditional culture of design [16]. Service design integrates relevant stakeholders in the design of services through some methodological approach [17]. Service design aims at designing user-oriented services making them useful, effective and different from existing ones. It potentiates co-creation between the different users of a service, and the providers [18]. In the different service design activities, especially in co-creation, not all stakeholders need to be involved at the same time; they can be involved just in the specific moments or situation in which they take part [19], which applies to the co-creation and co-design case of GloNet. There are a number of methods and tools for service design that have been emerging [20], some of which can be found in http://www.servicedesigntools.org/.

Negotiation Protocols. In negotiation processes it is fundamental that a protocol is defined so that an agreement can be achieved. The negotiation process includes several interactions that are based on the exchanging of some arguments and opinions on the form of dialogues [21]. The dialogues that take place can include some form of argumentation in favor or against certain statements [22]. Depending on the context, the arguments used can be constructed from a knowledge base in an argumentative system [23], or from a rule-based system [22]. Typically protocols for negotiation based on argumentation can be found in agent systems where agents have a certain level of intelligence and at some point have to make their options and create some arguments [24,25]. In these cases, although there are already some agent communication languages such as ACL, KQML, etc., that try to cope with some of the requirements for negotiation [26], there are still open issues, namely the existence of some limitations in multilateral negotiation when compared to one-to-one bilateral negotiations [25].

4   Research Contribution and Innovation

According to the different natures of collaborative networks, namely virtual organizations (VOs), the formation process of new VOs for collaboration can be diverse. Nevertheless, as illustrated in Fig. 1, typically, involved processes include some common steps, that go from the new business or collaboration opportunity (BO/CO) discovery, to the formation of the new consortium to rapidly respond to it [5]. Although the selection of the adequate partners to form the consortium is of extreme relevance, the consensus that is reached among them is of no less importance once it can serve as the basis for the operating principles of the VO. Therefore, if the process of reaching and negotiating agreements among participants can be supported by an ICT environment, then the entire process of VO formation and negotiation can become smoother [5,6,7]. When designing a new business service (BS), a team of interested stakeholders already exist (acting like a VO) with the aim of reaching agreements on the design requirements of the new BS.
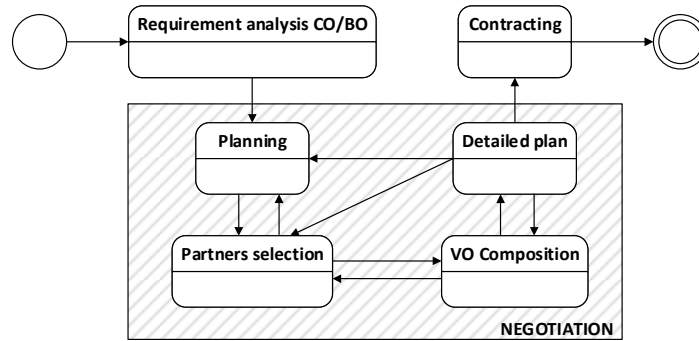

Fig. 1. VO formation process.

In line with the previous assumptions and with the research question mentioned in section 1, the hypothesis that supports the current research work is:

The process of creating dynamic virtual organizations can become more agile if an appropriate electronic negotiation wizard environment is established with the necessary soft modeling characteristics to structure and conduct the entire negotiation process, making it traceable, reducing the collaboration risks, and managing the participants' expectations. Moreover, the negotiation environment should be customizable according to different collaboration levels, either in terms of commitment or in terms of duration.

Therefore, a negotiation support environment is also expected to facilitate and boost the participation in business service design allowing its participants to collaborate in a co-creation environment, reducing the potential collaboration risks, and supporting different levels of collaboration. Given so, the main mechanisms for the negotiation support environment are, on one hand, to support negotiation for the classical VO formation that includes: negotiation towards the selected partners; negotiation details with partners; and negotiation with the customer; and on the other hand, to support negotiation in co-design and co-innovation.

Service Design Methodology. To design new business services, a service design methodology has been adopted [7]. This methodology identifies and defines the needed services and their interactions with the customer, and their nature. The methodology is summarized in Table 1.

Table 1. Service Design Methodology in co-creation teams.

Service Design steps	Description
Identify needed service	Brainstorming exercise involving an analysis of the needs and characteristics of the customer.
Design touchpoints diagram	To identify user interaction points with the service.
Design blueprint diagram	To describe the nature and the characteristics of the service interaction to verify, implement and maintain it. It includes: temporal order, timings, and line of visibility (denoting what the customer sees and *back-office*).
Storyboard / storytelling	Representation of use cases, through a series of drawings or textual description put together in a narrative sequence, which illustrates a sequence of events such as a customer journey.
Service prototyping	Involving the selection, assembly and integration of the various service components (atomic services).

For the current research work, the aim is to use this service design methodology and adapt it to a philosophy of co-design where new business services can be designed in a collaborative environment involving multiple stakeholders and the customer.

Although a number of methods and tools are available for some aspects of services design [20], most of them are based on simple manual methods. Therefore the proposed environment supports the collaborative process of the different stakeholders in some steps of the adopted methodology.

Service Co-design Negotiation Support System. Being the service co-design negotiation support system (CoDeN), intended to provide a collaborative environment for the design of new business services where the various involved participants can reach agreements on what needs to be decided, for the developed system it is assumed that the needed service is already identified and the relevant stakeholders (participants in the negotiation process) are previously defined. The negotiation process is guided by defined templates that follow the described service design methodology for the design of touchpoints and blueprint diagram, also addressing the identification of the business service related stakeholders mapping.

Besides the important roles of customer and involved participants (co-creation team), also, to conduct the entire negotiation process, the role of co-creation team mediator is introduced (acting like the classical VO Planner). Therefore, to properly model the core processes involved in co-design, the main actors with the correspondent roles are identified in Table 2 and the correspondent dependencies between them are illustrated in Fig. 2 using the i* modelling framework.

Table 2. Actors and roles in co-creation teams.

Actor	*Role*
Co-creation Team	The Co-creation Team represents all the involved actors within the collaborative space aimed for co-design of services. These actors are essentially the VO Partners and the Customer.
Co-creation team mediator	The Co-creation team mediator is the VO partner responsible to conduct the entire co-design process. He acts similarly to the VO Planner in generic VOs.
VO Partners	The VO Partner is part of the co-creation team, and, gives support for the service co-design and co-innovation according to its knowledge and skills.
Customer	The Customer is also part of the co-creation team, and together with the VO Partners plays an important role in the service co-design once his satisfaction must be attained. He maybe also responsible for providing the services requirements and for giving feedback during the collaboration processes.
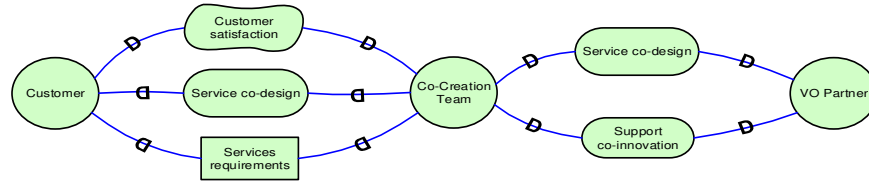
Fig. 2. Strategic dependency model for co-design.

Negotiation Protocol. The process of reaching consensus among the various participants, besides being guided through the negotiation environment, has to follow a determined protocol in order to be effective. In this specific case, a logical language was followed [22] to define the negotiation protocol that is used to specify when a determined decision can be made by an intervenient of the process. Therefore, the negotiation protocol is used to specify when a particular *move* can be made in the course of the negotiation dialogue [21], being *move* here understood as the statement and/or decision that a participant can make.

Although there are different protocols for negotiation, and different defined *moves* for different scenarios [25], the benefit from the used protocol is that it is generic and can be used when addressing different negotiation contexts. Therefore, the adopted protocol relies of the following *moves*:

$$M_{(N)} = \{request(N), refuse(N), accept(N), withdraw(N)\}$$

and

$$M_{(NT,K_{NT})} = \{propose(NT, K_{NT}), refuse(NT), accept(NT), counterpropose(NT, K_{NT}), withdraw(NT)\}$$

being:

- $M_{(N)}$ the set of moves allowed to participate in the negotiation of a new business service design (where N stands for the specific negotiation); and

- $M_{(NT,KNT)}$ the set of moves allowed to participate in the negotiation of a specific topic/template (where *NT* represents the negotiation topic, and K_{NT} represents the content of *NT*).

The defined moves consider that, in some occasions in VO formation negotiations, for each negotiation topic only a subset of participants are involved and can even be replaced by others [6, 7]. That is why the moves $refuse(NT), accept(NT)$ are considered. In the co-creation case (in the main focus of this paper), all participants are requested to participate in the design of all templates (diagrams). So the participants' interaction with the system reduces the $M_{(NT,KNT)}$ to the following:

$$M_{(NT,K_{NT})} = \{propose(NT, K_{NT}), counterpropose(NT, K_{NT}), withdraw(NT)\}$$

being all other moves made internally by the system.

While participants can make several of the mentioned moves in the course of a negotiation dialogue, they have to do it in a pre-determined way. They may even have to wait for the other participants' moves so that actions can be made accordingly. For example, an evident restriction is that a participant cannot accept to participate on a negotiation process without the Team Mediator requesting his participation in advance. Table 3 summarizes some of the pre- and post-conditions to some moves.

Table 3. Pre- and post- conditions for the negotiation protocol.

m1: *request(N)*	**pre**: no condition **post**: *accept(N), refuse(N)*
m2: *accept(N)*	**pre**: *request(N)* **post**: other moves are consequence of certain triggers
m3: *refuse(N)*	**pre**: *request(N)* **post**: no moves may occur from the participant that *refuse(N)*
m4: *withdraw(N)*	**pre**: *request(N)* followed *by refuse(N)*; or *refuse(NT)* on the negotiation of a specific topic **post**: no further move
m5: *propose(NT)*	**pre**: *accept(N)* **post***: accept(NT), refuse(NT), counterpropose(NT,K_{NT})*
m6: *accept(NT)*	**pre**: *propose(NT)* **post**: other moves are consequence of certain triggers
m7: *refuse(NT)*	**pre**: *propose(NT)* **post**: no moves may occur from the participant that *refuse(NT)*
m8: *counterpropose(NT,K_{NT})*	**pre**: *propose(NT)* **post**: maybe followed by *propose(NT)*
m9: *withdraw(NT)*	**pre**: *propose(NT)* **post**: maybe followed by a *withdraw(N)*

Fig. 3 illustrates the relation of the described moves in reference to the Team Mediator's possible states.
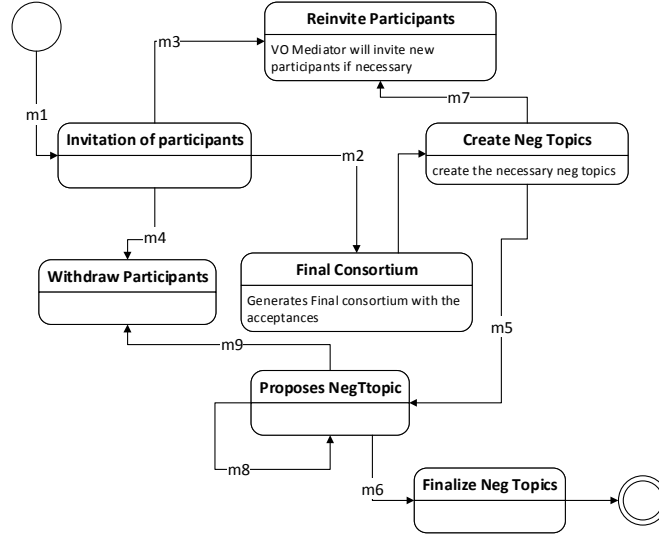
Fig. 3. Team Mediator states and related negotiation moves.

Implementation and Validation. For the described work, a software prototype has been developed in order to check the feasibility of the proposed concepts. The prototype system was implemented in JAVA, with the VAADIN framework, and allows the generation of general information on the co-creation consortium, as well as to upload supporting documentation. For the negotiation of the templates of diagrams to guide the new service design, functionalities are also available and cope with the described negotiation protocol. The main output is a generated .pdf document that includes a summary of all the information that is generated in the course of negotiation. Fig. 4 illustrates the involved concepts and prototype usability for a general scenario.
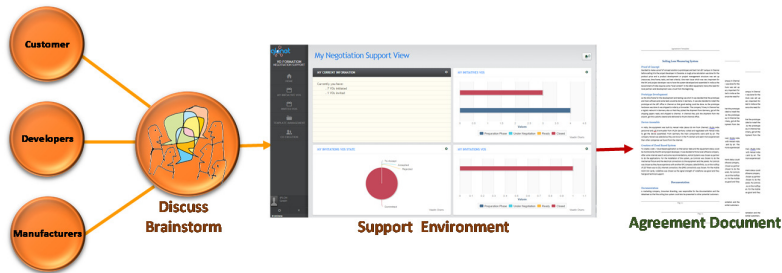

Fig. 4. CoDeN usability.

Being the present work part of a PhD work, the validation process is mainly through peer validation but also through the participation on the mentioned European research project GloNet. Also, close interaction with end-users in the solar energy

domain is being done to perform a more accurate analysis of the achieved results. Through these means, some of the concepts and preliminary results have already been positively validated.

5   Conclusions and Further Work

In the work presented in this paper, the aim is to have a negotiation environment to support networks of SMEs in the form of co-creation teams to achieve agreements on the design of new business services. For this purpose, a negotiation support environment has been developed and briefly summarized, highlighting the main requirements and approach. Also, the adopted negotiation protocol to specify the adequate rules was also detailed. In this case, what is intended is not to have an artificial agent system acting on behalf of organizations, but to have the human actors interacting with the system and following the adopted protocol. Therefore, one of the challenges in the definition of the protocol is to ensure that it can easily be followed and accepted by all involved stakeholders.

References

1. Camarinha-Matos, L. M., Macedo, P., Ferrada, F., & Oliveira, A. I. (2012). Collaborative Business Scenarios in a Service-Enhanced Products Ecosystem. In Collaborative Networks in the Internet of Services (pp. 13-25). Springer Berlin Heidelberg.
2. Camarinha-Matos, L.M., H. Afsarmanesh, and B. Koelmel, Collaborative networks in support of service-enhanced products, in Adaptation and Value Creating Collaborative Networks. 2011, Springer. p. 95-104.
3. Rabelo, R. J., Costa, S. N., & Romero, D. (2014). A Governance Reference Model for Virtual Enterprises. In Collaborative Systems for Smart Networked Environments (pp. 60-70). Springer Berlin Heidelberg.
4. Di Maio, P. and J. Ure. An open conceptual framework for operationalising collective awareness and social sensing. in Proceedings of the 3rd International Conference on Web Intelligence, Mining and Semantics. 2013: ACM.
5. Oliveira, A.I., L.M. Camarinha-Matos, and M. Pouly, Agreement negotiation support in virtual organisation creation–an illustrative case. Production Planning & Control, 2010. Vol.21(2): p. 160-180.
6. Oliveira, A. and L. Camarinha-Matos, Electronic Negotiation Support Environment in Collaborative Networks, in Technological Innovation for Value Creation. 2012, Springer. p. 21-32.
7. Oliveira, A. I., & Camarinha-Matos, L. M. (2014). Negotiation Support for Co-design of Business Services. In Collaborative Systems for Smart Networked Environments (pp. 98-106). Springer Berlin Heidelberg.

8.   Ma, N., Yuan, M., & Cao, G. (2014, January). Integration of Digital Campus Resources Based on Cloud Computing. In Proceedings of the 2012 International Conference on Cybernetics and Informatics (pp. 1957-1963). Springer New York.
9.   Ostermann, S., Iosup, A., Yigitbasi, N., Prodan, R., Fahringer, T., & Epema, D. (2010). A performance analysis of EC2 cloud computing services for scientific computing. In Cloud Computing (pp. 115-131). Springer Berlin Heidelberg.
10. Camarinha-Matos, L. M., Afsarmanesh, H., Oliveira, A. I., & Ferrada, F. (2014). Cloud-Based Collaborative Business Services Provision. In Enterprise Information Systems (pp. 366-384). Springer International Publishing.
11. Surajbali, B., Bauer, M., Bär, H., & Alexakis, S. (2013). A Cloud–Based Approach for Collaborative Networks Supporting Serviced-Enhanced Products. In Collaborative Systems for Reindustrialization (pp. 61-70). Springer Berlin Heidelberg.a
12. Brentani, U., Innovative versus incremental new business services: different keys for achieving success. Journal of Product Innovation Management, 2001. 18(3): p. 169-187.
13. Camarinha-Matos, L. M., Afsarmanesh, H., Oliveira, A. I., & Ferrada, F. (2013). Collaborative Business Services Provision. In ICEIS (2) (pp. 380-390).
14. Camarinha-Matos, L. M., Ferrada, F., Oliveira, A. I., & Afsarmanesh, H. (2013, October). Supporting product-servicing networks. In Industrial Engineering and Systems Management (IESM), Proceedings of 2013 International Conference on (pp. 1-7). IEEE.
15. Yang, S., S. Zhang, and L. Kong. Research on the cooperative decision of business application needs in IT governance. in Computer Supported Cooperative Work in Design (CSCWD), 2012 IEEE 16th International Conference on. 2012: IEEE.
16. Sangiorgi, D. (2009, April). Building up a framework for Service Design research. In 8th European Academy of Design conference (pp. 415-420).
17. Mager, B. and T. Sung, *Special issue editorial: Designing for services.* International Journal of Design, 2011. **5**(2): p. 1-3.
18. Sandberg, F. Co-creating collaborative food service opportunities through work context maps. in Proceedings of 3rd Service Design and Service Innovation conference, ServDes. 2012: Linköping Electronic Conference Proceedings, 67, Linköping, Sweden: Linköping University Electronic Press.
19. Sanders, E.B.-N. and P.J. Stappers, Co-creation and the new landscapes of design. Co-design, 2008. 4(1): p. 5-18.
20. Wild, P.J., *Review of Service Design Methods*, in *IPAS project deliverable I15.6.* 2009, University of Cambridge: Cambridge.
21. Moschoyiannis, S., Krause, P., Bryant, D., & McBurney, P. (2009, June). Verifiable protocol design for agent argumentation dialogues. In Digital Ecosystems and Technologies, 2009. DEST'09. 3rd IEEE International Conference on (pp. 630-635). IEEE.
22. Caminada, M., & Amgoud, L. (2007). On the evaluation of argumentation formalisms. Artificial Intelligence, 171(5), 286-310.
23. Prakken, H. (2010). An abstract framework for argumentation with structured arguments. Argument and Computation, 1(2), 93-124.
24. Aknine, S., Pinson, S., & Shakun, M. F. (2004). An extended multi-agent negotiation protocol. Autonomous Agents and Multi-Agent Systems, 8(1), 5-45.
25. Wang, G., Wong, T. N., & Wang, X. (2014). A hybrid multi-agent negotiation protocol supporting agent mobility in virtual enterprises. Information Sciences, 282, 1-14.
26. Beer, M., D'inverno, M., Luck, M., Jennings, N., Preist, C., & Schroeder, M. (1999). Negotiation in multi-agent systems. The Knowledge Engineering Review, 14(03), 285-289.