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# Electronic Negotiation Support Environment in Collaborative Networks

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**Abstract.** In the current economic turbulence, it is crucial for companies and organizations to attain strategic alliances to respond to new business or collaboration opportunities. Besides the importance of understanding the structures and requirements of such alliances, it is also of extreme importance that the process of negotiation to create those alliances is properly modeled so that the elements that constitute the alliance agreements are accurately represented and the involved risks are mitigated. With this aim, this paper outlines the main requirements of an electronic negotiation support environment in a collaborative network, including a brief analysis of how it can help in reducing the risk potential, considering the relevance of the expectations of the involved partners, and highlighting the importance of a technological support environment.

**Keywords:** collaborative networks, negotiation environment, agreement, risks.

## 1 Introduction

As a result of the persistent market instability, companies and organizations have to continuously adapt their operating principles to search, face and act in response to new business or collaboration opportunities in order to survive and remain competitive in the global market. Therefore, to promptly respond to such business or collaboration opportunities, and because companies and organizations might not be able to provide all needed competencies by themselves, they will have to collaborate with their peers. In this context, the possibility of rapidly forming virtual organizations to respond to a business or collaboration opportunity gives companies an expression of agility and survival mechanisms in face of this market turbulence. That is why the topic of collaborative networks (CNs) appears as significantly promising because if the enterprises or the organizations share a common interoperable infrastructure, common operating principles, common cooperation agreements, and a base of trust among them, then their ability to rapidly form a virtual organization (VO) is increased [1].

Nevertheless, to form a VO, besides the important and classical task of selecting the adequate partners with the most suitable competencies to form a consortium able to respond to the requirements of the business or collaboration opportunity (BO/CO), it is also of extreme importance to have a robust and reliable negotiation environment that supports the potential VO partners in achieving agreements during the VO creation process, reducing the amount of time spent in this process [2]. These VO agreements will then be the basis for the governing principles of the VO during its operation phase.

Considering a virtual organization breeding environment (VBE) [3] context, that supports and fosters the creation of dynamic VOs, one important question is how can the VO creation process be improved with the aid of a negotiation methodology and environment, especially when dealing with market turbulence, low success rate, and natural delays in negotiation.

Therefore, the main research question that emerges is:

*How can an electronic negotiation support environment increase the agility in the creation process of successful dynamic virtual organizations?*

One important motivation is to contextualize the VO creation process in the VO breeding environment (VBE), making use of all its infrastructures and functionalities. Furthermore, understanding each partner's motivation and expectations when entering into a collaboration process can be of extreme importance in order to prevent unnecessary risks during collaboration.

## 2 Contribution to Value Creation

The time and amount of resources consumed during the VO creation process whenever a business or collaboration opportunity is acquired, give a good indication of the level of agility of a collaborative network, being the *agility*, the quality or state of the organization of being able to have a quick resourceful and adaptable response. To achieve that agility, it is essential that some requirements are provided to its members, namely in terms of common infrastructures, governance models and rules etc. For that, the existence of a VO breeding environment context, enables a partial fulfillment of those requirements.

Also, due to the heterogeneous contexts of the VO breeding environments that usually companies or organizations belong to, it is possible to create value among VBE members if there exists an electronic negotiation support environment that contributes to boost the participation in consortia creation making use of soft modeling techniques to promote the desired characteristics, namely in terms of collaboration structure, risks, duration, trust, and potential partners expectations.

Moreover, as a contribution to value creation, this work intends to provide a basis to increase agility for the creation of successful dynamic virtual organizations providing an electronic negotiation support environment that is sustained by conceptual, modeling and technological support. The table below includes some of the topics/ requirements to consider in such electronic negotiation support.

**Table 1.** Requirements for electronic negotiation support.

<i>Main Requirements for electronic negotiation support</i>	
Conceptual Support	<ul style="list-style-type: none"> <li>- Collaboration risks reduction and risks sharing among the involved partners in order to reach agreements. This also relates to the impact that a problem in a task performed by one partner can cause in the whole VO.</li> <li>- Past collaboration between organizations with 'levels' of success.</li> </ul>
Modeling Support	<ul style="list-style-type: none"> <li>- Evaluation of the main requirements for a negotiation framework to enable the creation of successful dynamic VO.</li> <li>- Participants' expectation management that deals with the motivation of the organizations in collaborating, and the consequences that some disappointments might have.</li> <li>- Different levels of participation in collaboration, either in terms of individual participant commitment in the collaboration, and/or in terms of individual participant collaboration duration (i.e. individual participation commitment vs. temporal participation), which certainly has different forms of treatment in terms of negotiation.</li> </ul>
Technological Support	<ul style="list-style-type: none"> <li>- Design and development of a basic agreement negotiation wizard (WizAN) to achieve important results (focused negotiation, authenticity, eNotary services, etc.).</li> <li>- Available technologies with the required characteristics for the negotiation wizard environment.</li> </ul>

### 3 Related Literature

The most relevant area for this work is the collaborative networks discipline with special relevance for the virtual organizations (VOs) creation and their related environments, namely the VO breeding environments (VBEs). Also the electronic negotiation and contracting areas are of the most importance for this work. Some other related areas are also considered. Therefore, in the next subsections a brief outline and discussion on these areas is presented.

*VOs and their Related Environments.* During past research on collaborative networks, the VO creation process has received considerable attention. However, most of the proposals and developments were aimed at designing a fully automated process and frequently based on a set of simplistic assumptions.

The Virtual Organization paradigm constitutes one of the first manifestations of the collaborative networks. Being the concept developed and applied in several domains and areas, many contributions for the characterization and modeling of the paradigm can be found in the literature, as exemplified by [1, 4-6]. The main idea behind this concept is basically of a temporary consortium of enterprises and/or organizations, geographically dispersed, that strategically join their competencies to rapidly respond to a business or collaboration opportunity.

Nevertheless, in face of a new business opportunity, when the window of opportunity is short and in order to support the rapid formation of a virtual organization (VO) it is necessary that enough information is available about potential partners and that they are ready and prepared to participate in such collaboration. For

this, there are certain criteria to be considered for a group of organizations rather than for a single organization, such as the existence of a common interoperable infrastructure, common operating rules, common cooperation agreement, and a base trust level among the organizations. Therefore, an approach is to consider that dynamic VOs are mostly created in the context of a VO Breeding Environment (VBE) [1, 7-9].

Moreover, in order to promptly respond to a business / collaboration opportunity, the VO creation process has to be well defined. However, given different market situations, this process has to be set to provide solutions for two distinct cases: (i) when there is already an acquired business opportunity and the objective is to guarantee a consortium to fulfill the opportunity requirements; or (ii) when it is necessary to go through a quotation process before having acquired the business opportunity [10]. Nevertheless, in both cases, the process of establishing a virtual organization can be quite complex, where several items have to be addressed. Although the most addressed topic in past works is the partners' selection, it is also of great importance to consider the commitments and agreements that have to be established among partners so that a VO can be properly created. In this context, negotiations and agreement or contract establishment appear as a major issue for virtual organizations namely during their creation and their potential evolution phases.

***Negotiation and Contracting.*** Negotiation is an iterative communication and decision-making process between two or more parties who seek a consensus decision and cannot apply unilateral actions to achieve their objectives [11, 12].

In collaborative environments, due to the heterogeneous background, context, and cultures, a negotiation processes can involve a transversal, multi- and interdisciplinary approach. It is therefore necessary to have a holistic view of the problem, making use of multiple methodologies and paying attention to the practical details [13]. A negotiation process can rely on several mechanisms such as: auctions, game theory, intelligent agent mechanisms, etc. [14]. Nevertheless, such process is often conducted by human actors that in the last instance are the ones responsible for decision-making. Although some works try to insert some automation into the negotiation process [15, 16], this continues to be a rather difficult issue.

Focusing on the internal consortium agreement, its relevance is to establish the necessary clauses to regulate the consortium behavior, governing rules and principles during the VO operation phase. Therefore, special attention should be put into e-contracting forms as they can capture and describe the rights and duties of all VO partners [17], as well as specification of penalties to apply to those that do not satisfy the agreement [18]. Furthermore, the legal and contractual issues associated to each contract/agreement concentrated on the ICT perspective can be found in [19, 20].

Moreover, the advances in the negotiation domain stem from the use of information systems and communication media to support negotiation processes and decisions. For example, Negotiation Support Systems (NSS) provide varying levels of structured communications and decision support; and offer both dispute resolution mechanisms (i.e. dealing with infringements of existing contracts) as well as contract formation services (i.e., creating new agreements) [11].

Procedures for e-contracting and negotiation are also important in relation to the ISO 9000 certification as they can ensure clearly defined and repeatable procedures

within the CN as a whole, and not only within the companies or organizations that are members of a CN [21].

Progress in this area during the last years has highlighted a number of important topics that need to be considered when developing processes and methodologies for negotiation and e-contracting, including Contract Models, Ontology, Contract Framework, Electronic Institutions, Digital Signature, etc.

#### 4 Research Contribution and Innovation

The proposed negotiation environment aims to contribute in the domain of the creation of dynamic virtual organizations making the process more agile in the virtual organizations breeding environment context.

The main reason why it is important to have a consistent negotiation support environment for the formation of VOs in response to business or collaboration opportunities is essentially to improve the entire process of establishing the VO agreement that will regulate the main behavior of the consortium during the operation phase. Therefore, it is of extreme importance to make a comprehensive analysis of the important characteristics that such support environment shall involve. As mentioned, due to the heterogeneous contexts of the VO breeding environments that usually companies or organizations belong to, the problem solving and decision making processes of an electronic negotiation support shall use soft modeling techniques to support its desired characteristics, namely in terms of collaboration structure, risks, duration, trust, and potential partners expectations. Thus, the hypothesis adopted for this 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.*

The main outcome from the negotiation process will be the VO consortium agreement that will induce the governing rules and principles of the consortium during its operation phase. The agreement shall include the rights and duties of all partners involved, but can also include, for example, some sections on intellectual property rights, partners' benefits and shared risks.

For this significant topic on collaborative networks, besides establishing proper models, effective conceptual and technological support must be provided. Consequently, some detailed questions arise, such as the ones represented in Table 2:

**Table 2.** Detailed Research Questions.

<i>Questions</i>	<i>Topics to be addressed</i>
Which process/framework?	<ul style="list-style-type: none"> <li>- Collaborative environments/networks</li> <li>- Contract framework</li> <li>- Electronic negotiation and institutions</li> <li>- Different VO creation processes</li> </ul>
How should the negotiation process be modeled?	<ul style="list-style-type: none"> <li>- Collaborative problem solving</li> <li>- Contract Models</li> <li>- Electronic negotiation ontology / taxonomy</li> <li>- Characterization of risks and failures in collaboration</li> <li>- Creation of organizational strategies for collaborative risk reduction</li> <li>- Definition of different levels of partnership / responsibilities</li> <li>- Establishment of formal methodologies in collaborative consortia modeling</li> <li>- Establishment of the desired automatic level of a negotiation environment</li> </ul>
What are the main characteristics of a negotiation wizard?	<ul style="list-style-type: none"> <li>- Negotiation support services</li> <li>- Digital signatures</li> <li>- Notary services (Auditing &amp; certifications)</li> <li>- Rules/suggestions for risk reduction</li> <li>- Expectations management</li> <li>- Customizable environment</li> </ul>
What are the promising technologies to be applied in a negotiation wizard?	<ul style="list-style-type: none"> <li>- Multi-agent systems</li> <li>- Security protocols</li> <li>- Standards (eg. LegalXML)</li> </ul>

The negotiation environment is then intended to provide computer-assisted support to the process of negotiation and reaching agreements during consortia creation enhancing the efficiency and effectiveness of both the process and the outcome, together with the flexibility of human intervention in decisions.

Such environment shall also focus its attention on indentifying how concerns on conflict-related collaboration risks avoidance can be supported. The dynamics of the negotiation process and the necessary support functionalities will then be influenced by factors such as the character of the involved organizations, their expectations regarding the collaboration opportunity, affective aspects, the adopted governance principles, and also the historic traces of past collaborations. For that, it is necessary to further develop conceptual models, as well as prototypical tools to make proof of the support concepts.

Towards achieving the aimed contribution as a final result of this work, it is relevant to briefly mention some preliminary work that has already been performed, namely:

- Characterization of the dynamic virtual organization creation process,
- Identification of the main requirements of a negotiation wizard and proper mechanisms for negotiation depending on different contexts, and
- Implementation of a first negotiation wizard prototype.

***Dynamic virtual organizations creation process.*** In order to promptly respond to a business or collaboration opportunity, the virtual organization creation process has to be well defined [22]. However, given different market situations, this process has to

be set to provide solutions for two distinct cases: (i) when there is already an acquired business opportunity and the objective is to guarantee a consortium to fulfill the opportunity requirements; or (ii) when it is necessary to go through a quotation process before having acquired the business opportunity.

Being the VO creation process triggered by a business or collaboration opportunity identified during the operation phase of a VO breeding environment (VBE), then contrary to the VBE, the VO is supposed to be a short-term organization, meaning that it will only have its lifecycle for the necessary period of time that corresponds to its creation, execution of the planned project, and dissolution [23, 24].

Inside the VBE it is then necessary to find the adequate competences to fulfill the BO/CO. Nevertheless, although the VO partners are primarily selected from the VBE members, there might be the case of lack of skills or capacity inside the VBE, so other organizations can be recruited from outside the VBE boundaries [3]. Being this the case, it shall be necessary to ensure that the new organizations are rapidly integrated in the new environment. Nevertheless, in terms of negotiation, supplementary in functionalities for conflict-related risk avoidance support are foreseen.

Hence, the VO creation process is summarized in Table 3 that briefly specifies the simplified process for the VO creation for the three distinct phases (preparatory planning, consortia formation, and VO launching) when there is already an acquired business / collaboration opportunity [25].

**Table 3.** VO creation phases.

<i>VO Creation Phase</i>	<i>Main Focus</i>
Preparatory planning	BO/CO identification and characterization Who? Where and how? Which patterns of collaboration? How to structure the VO? Any initial template model?
	Rough VO planning
Consortia formation	Partners search and suggestion Who? Where? Which criteria? Which base information? Profiles? Decision support?
	Detailed VO planning Who? Negotiation process? Contract, rules, templates? Agreements?
VO Launching	Contracting Common infrastructure?
	VO setting up Governing principles? Detailed plans?

With regards to the specific topic of the creation of virtual organizations, the aimed innovation relies on having an integrated approach/system environment where the manager can be assisted along the whole process, starting at the reception of the BO/CO till the VO configuration and launching.

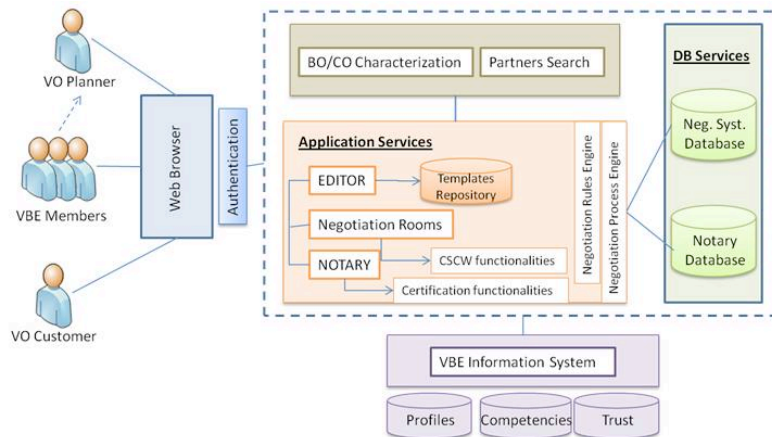
**Main requirements of a negotiation environment.** Similarly to the traditional business relationships, the virtual organization also relies on the notion of contract and collaboration agreement among its members. As a hypothesis, and based on



previous works, it is agreed that standard paper contracting is often slow and requires the involvement of many human actors in all negotiation phases of a VO. Therefore, in order to enable a fast contracting process, an electronic representation of contracts and agreements is fundamental because it can provide a faster and cheaper solution than standard contracting.

Through interaction with various end-users networks, various critical negotiation activities were identified [2, 25]:

- Reaching agreements concerning coordination aspects: for instance, who will be responsible for the VO;
- Reaching agreement concerning the sharing of risks among the involved partners. It also relates to the amount of impact that a problem in a task performed by one partner can cause in the whole VO. Moreover, agreement about the amount of budget retained to cope with possible problems is needed;
- The contract should follow a basic set of standard templates: It is important to depart from common templates, selected for each kind of BO/CO, and extend the selected template to cope with the detailed agreement specifications using “add-on” clauses;
- Reaching agreements on the detailed activities and scheduling;
- Information exchange agreement: i.e. how should information be exchanged among partners, and also which kind of information should be exchanged. These agreements have also a close relationship with the detailed scheduling of activities; detailed costs agreement, i.e. discuss and agree with each partner the value of the part that it will produce or the service it will perform;
- Support for privacy of proposals, where only the involved partners have access to the information being negotiated; and
- Provide a mechanism for tracing the history of the negotiation.



**Fig. 1.** Basic architecture of the negotiation environment.

Having into account this list, it is evident that these types of agreements require fundamentally decision making by human actors rather than fully-automated decision-making. Therefore, in this case, what is addressed is not a complex e-contracting process where the system is capable of automatically generate, interpret, execute, and

manage a contract or agreement, but to a certain extent, a system that is capable of storing and receiving inputs into an electronic source for later interpretation and user guidance through the process.

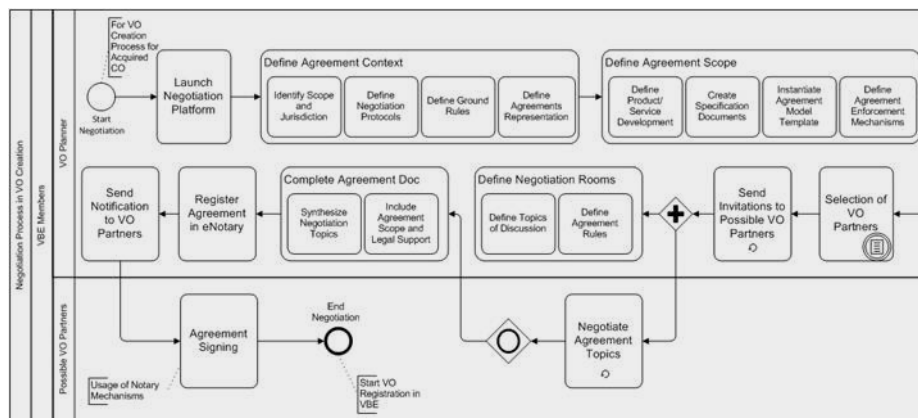
Therefore, at a macroscopic level three important stages of the negotiation steps lead to different negotiation “focus”:

- The negotiation with the potential customer;
- The negotiation towards the selection of partners to compose the VO; and
- The negotiation to reach agreements on the details of the VO (negotiation topics) among the selected partners once the consortium is defined.

Nevertheless it is expected that at an abstract level the negotiation support mechanisms will be basically the same. Therefore, **Fig. 1** illustrates the central actors and basic support modules that a negotiation environment should then have and in Table 4 it is described some of these modules.

**Table 4.** Actors and basic interactions of the negotiation support environment.

<i>Actors interaction</i>	<i>Description</i>
Interaction with other systems	A robust negotiation process will have to directly interact with the VBE information management system to have access mainly to the VBE members profile and competencies as well as access to collaboration history.
Negotiation support modules	the ones identified (so far, more will appear during the accomplishment of this research work) are the following: <ul style="list-style-type: none"> <li>- Editor that will enable: agreement templates generation; agreements templates instantiation; agreement configuration to current situation/context;</li> <li>- Negotiation rooms that are (online) virtual spaces where each participant will be able to negotiate and/or discuss certain clauses of the agreement; and</li> <li>- Notary support services to guarantee on one hand the authenticity and validity of the agreements, and on the other hand to provide a safe deposit for documentation.</li> </ul>



**Fig. 2.** Simplified negotiation process in VO creation.

Moreover, depending on the different contexts and on the BO/CO, the proper mechanisms for negotiation must be instantiated. Examples of such mechanisms are for instance [24]: Identifying network members whose agreement is necessary; Identifying the scope and (legal) jurisdiction of the network; Negotiating the ground rules; Discussing administration and allocation of responsibilities; Negotiating the decision rules for closure of an issue; Identifying a system for resolving impasses; and Identifying a decision process for ending the network.

Having into consideration the main requirements of the negotiation environment as well as the identified mechanisms, the simplified negotiation process in VO creation (for an acquired collaboration opportunity) can be represented as illustrated in **Fig. 2**.

**Negotiation wizard prototype.** To support some of the previous concepts, an Agreement Negotiation Wizard (WizAN) was developed [25]. This prototype was designed with the aim to assist the human users in their decision making process, of consortia creation, structuring the negotiation process and making it traceable [24].

**Discussion of Results.** The developed prototype that supported some of the basic requirements and concepts, was positively validated in a real scenario with a Swiss and a Chinese VBE supporting negotiations between partners from the two geographical areas [2]. Some basic functionalities that were validated were: synchronism, negotiation editor, CSCW functionalities, privacy, etc. As a result, it is possible to draw some positive conclusions, namely in terms of preventing misunderstandings due to focused negotiation and the possibility to attach (electronic) documents. Moreover, a degree of *authenticity* is also guaranteed due to the existence of an *eNotary* service. Also, the system ensures the privacy of the information exchanged during negotiations, guaranteeing that partners have access only to authorized information. Finally, by using such system, it is possible to reduce the negotiation time of the VO creation process, which increases the indicator of *agility*.

Moreover, considering the previous results, other important mechanisms and characteristics of the hypothesis of the current research work are:

- Traceability of the negotiation process;
- Management of participants' expectations regarding the collaboration; and
- Management of the different levels of participation in collaboration, either in terms of participants' commitments or in terms of collaboration duration.

For these specific mechanisms and characteristics, one topic that has considerable importance and can influence the negotiation process is the related associated risks and their prediction. For that, the current work also relies on the characterization of risks and failures in collaboration, so that the negotiation model can also support risk analysis of potential risk of members behavior during VO operation. Fundamentally it is important to consider the sources and drivers of such risks [26]. Elementary questions arise such as: what can happen and what can be the case?; how likely is it that it will happen?; and if it does happen, what are the consequences? In all cases, to avoid the risks it is imperative to consider externally-driven or environmental risks; internally-driven or process risks; and decision-driven or information risks.

## 5 Conclusions and Further Work

A robust electronic negotiation support environment is essential to increase the agility in the creation process of successful dynamic virtual organization. Nevertheless, despite several works have already addressed some of these items, further research is mandatory in particular regarding agreements and/or contracts establishment, because of the new requirements that are constantly challenging the current processes, specially due to the constant market evolution and technology advancement. Some of these challenges are related to communication channels, use of artificial intelligence methods, intellectual property rights, electronic institutions, etc. More specifically, if the main aim is to explore how an electronic negotiation support environment can increase the agility in the creation process of successful dynamic VOs, a complete collaborative background, where automation is not the focus and information for the agreement establishment is sometimes not clear, has to be considered. As some of the concepts and preliminary developments have already been positively validated, it is now foreseen to achieve an environment that comprehends most of the described areas with the needed adaptations to support the aimed negotiation support of dynamic VOs with "smart" characteristics, such as: collaboration risks reduction, management of participants' expectations, traceability, etc. At a later stage, a first validation of such multifaceted environment is expected according to a set of indicators such as: negotiation process fully understood by involved actors; significant time reduction of the process; stakeholders opinion, etc. The validation process is then intended to consist in peer validation and supported by EU projects.

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