CONTRACT NEGOTIATION WIZARD FOR VO CREATION

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The establishment of collaboration commitments, represented by contracts or agreements, is a crucial step in a virtual organization (VO) creation process. The contract negotiation shall proceed in parallel with the other phases of the VO creation process, namely preparatory planning, consortia formation, and VO launching. In each step specific elements for the contract / agreement are collected as a result of a focused negotiation processes. The specifications for a contract negotiation wizard in this context are proposed.

1. INTRODUCTION

VO creation context. The possibility of rapidly forming a virtual organization (VO), triggered by a business opportunity and specially tailored to the requirements of that opportunity, gives enterprises an expression of agility and survival mechanism in face of market turbulence.

However, finding the right partners and establishing necessary conditions for starting the collaboration process has proved to be costly in terms of time and effort, and therefore an inhibitor of the aimed agility. Among others, obstacles include lack of information (e.g. non-availability of catalogs with normalized and updated profiles of organizations, non-availability of past performance in collaborative processes), lack of common collaboration infrastructure, and above all lack of preparedness of organizations to join the collaborative process. Overcoming mismatches resulted from heterogeneity of potential partners (e.g. in ICT infrastructures, corporate culture, methods of work, and business practices) requires considerable investment; furthermore, building trust, that is a pre-requisite for any effective collaboration, is not straight forward and requires time.

It is also important to note that partners' selection is not simply an "optimization" problem. In addition to a matching process based on potential and abilities (e.g. competencies and capacities), many other factors, some of them of subjective nature (e.g. personal preferences and established trust based on previous experience) suggest that fully automated processes are not at all a realistic approach for VO creation. It is rather preferable to conceive a computer-assisted framework to help the human planner in making decisions.

An approach to overcome the mentioned difficulties is to consider the VO creation process to happen in the context of a VO Breeding Environment (VBE) (Camarinha-Matos & Afsarmanesh, 2003; Camarinha-Matos, Afsarmanesh et al., 2005b; Rabelo et al., 2000). A VBE can be defined (Afsarmanesh & Camarinha-Matos, 2005; Camarinha-Matos, Afsarmanesh et al., 2005a) as: an association of organizations and their related supporting institutions, adhering to a base long term cooperation agreement, and adoption of common operating principles and infrastructures, with the main goal of increasing both their chances and their preparedness towards collaboration in potential VOs. This long term collaborative association is composed of organizations that are prepared to collaborate and thus rapidly respond to a collaboration opportunity.

A VBE is created as a long term “controlled border” association and its members are recruited from the “open universe” of organizations according to the criteria defined by the VBE creators or administrators. A VO is a temporary organization triggered by a specific business/collaboration opportunity. Its partners are primarily selected from the VBE members. In case there is a lack of skills or capacity inside the VBE, organizations can be recruited from outside. For difficulties of preparedness, trust, etc, this last category will, of course, be the last resort.

In this context and in order to better identify the necessary support functionality, a number of steps (Figure 1) have been suggested for the VO creation process (Camarinha-Matos, Silveri et al., 2005).

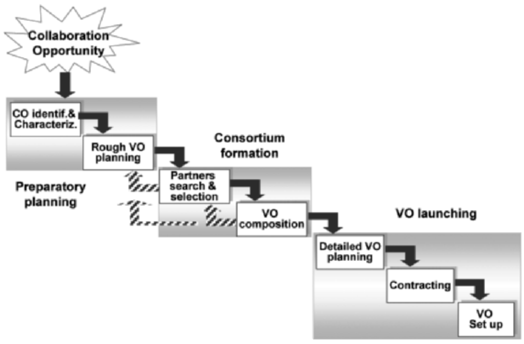

Figure 1 – VO creation process.

The role of contracts and negotiation. An important process that runs across and embedded in the steps shown in Figure 1 is the negotiation and contract establishment. Similarly to the traditional business relationships, the virtual organization also relies on the notion of contract and collaboration agreement among its members. Standard paper contracting is often slow and requires involvement of human actors in all contracting phases. In order to enable a fast contracting process an electronic representation of contracts is required (Grefen & Angelov, 2002). To (Rocha et al., 2004) an electronic contract describes the rights and duties of all virtual organization partners, as well as penalties to apply to those that do not satisfy the agreement. Computer assisted negotiation and e-contracting is expected to provide a faster and cheaper solution than standard contracting.

In this paper a contribution to the characterization of the negotiation and contracting processes in the context of VO creation is presented and the functionalities for a contract negotiation wizard being developed in the ECOLEAD project are outlined.

2. RELATED WORK

Contracts and the way they are established are being challenged by new technology, such as: communication channels, artificial intelligence, intellectual property rights, electronic legal entities, etc. The negotiation process can follow various paradigms: auctions, game theory, intelligent agent mechanisms, etc (Rocha & Oliveira, 1999). Nevertheless, and according to (Angelov & Grefen, 2002), the efforts in this direction did not yet produce any context-independent solution.

Although much work is still necessary in this area, several approaches and initiatives are being carried out in order to solve (or at least reduce) the difficulties faced in the contracting process by enterprises that want to work together. Some of these concepts and techniques will be described bellow and the most relevant milestones related to e-contracting research are summarized in the time line of the Figure 2.

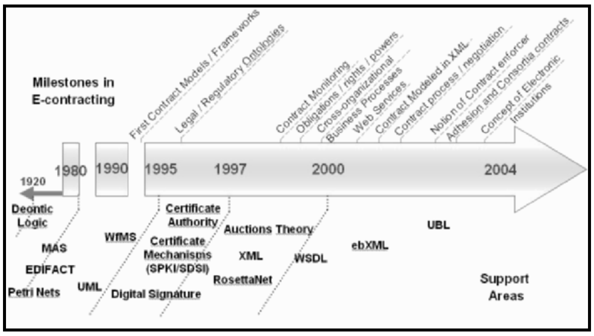

Figure 2 – e-Contracting development through time.

Some related and relevant current research topics are listed below.

Contract representation. Deontic Logic is being tried to describe contract models specifying obligations, permissions, and forbiddances for a specified business process which works in an extremely ideal process. Some works in this area can be found in (Quirchmayr et al., 2002), as well as (Xu, 2004) that make use of deontic logic for the representation of the contract clauses.

Trust. (Dimitrakos et al., 2004) through the TrusCom European Project, among other objectives, tried to focus on the provision of trust services to support the management of electronic contracts, the incorporation of guarantees to facilitate trustworthy collaboration, and performance assessment at the enactment of electronic contracts.

Legal Issues. Legal issues, especially about VO legal personality and contract with third part (B2C e-contract), have been studied mainly in the **ALIVE** project.

According to (Shelbourn et al., 2002), a VO needs a legal personality that will allow it to be seen as a legally independent entity in the country in which the contract has been incorporated. This requirement is however a subject of controversy as many definitions of VO claim that it does not have a legal entity. In the eLegal European Project (Carter et al., 2001) the main goal was to develop solutions to legal issues related to VEs in the area of construction. These solutions would result in a framework for specifying legal conditions and contracts to enable admissible use of ICT in project business. Nevertheless, this framework would be prepared specifically for each project. Furthermore, (Shelbourn et al., 2005), describe the legal and contractual issues associated with each of these contracts/ agreements, concentrating on the ICT perspective.

Electronic Signatures. Electronic signatures are methods to authenticate digital information using cryptography techniques. The directive 1999/93/EC of the European Parliament and of the Council on a Community framework for Electronic signatures provides clarification regarding its use.

Electronic institutions. An electronic Institution is a framework that enables through a communication network, automatic transactions between parties, according to sets of explicit institutional norms and rules. Thereby, the Electronic Institution ensures the trust and confidence needed in any electronic transaction (Rocha et al., 2004). In (Rocha & Oliveira, 1999) this area is combined with a multi-criteria negotiation protocol based on a multi-agent system. It consists on the traditional architecture representing enterprises by agents and introducing into the community a market agent that plays the role of coordinator in the electronic market and its main goal is the virtual enterprise formation when a consumer's needs are identified. The negotiation protocol is through the MAS paradigm. Also on this topic (Cardoso & Oliveira, 2004) have been working on the validation of contracts according to normative framework and their monitoring and enforcement. Further developments in various projects try to establish the notion of e-notary.

Contract Clauses. Clauses defined in an ICT contract often overlaps with those of the business contract (Shelbourn et al., 2002; Shelbourn et al., 2005). More specific clauses on electronic data exchanged, the use of objects; ownership of electronic data/information; and the use of software agents, is included in the ICT contract. The ownership of electronic data/information is an important issue that needs to be addressed in the ICT contract. Clauses should state who owns the information, which has access rights to the data/information to read, write, or delete data and information. In the work of (Xu, 2004) it is pointed out that a Business Contract Architecture should have: Contract repository; Notary; Legal rules repository; Contract validator; Contract negotiator; Contract arbitrator; Contract monitor; and Contract enforcer.

Supportive Frameworks. For the support of those contracts and negotiation some tools have been suggested such as "Contract wizards" that contains a clause library, contract editor and Virtual Negotiation Room. A Clause Library is the knowledge base of the Wizard (Shelbourn et al., 2002), the contract editor uses this knowledge base to electronically produce contracts and the Virtual Negotiation Room (VNR) that could be used by the different parties to collaborate, choose the different terms of the contracts and download the last version of the contract. However, in terms of implementation such concepts are at a very primitive stage.

(Andreoli & Castellani, 2001), have developed a framework based on multi-agent systems to permit partners to engage into flexible negotiation. The negotiation mechanisms is an extension to the Contract Net protocol and it exploits the coordination mechanisms provided by CLF/Mekano, that consists in a middleware platform designed to integrate negotiation and transaction aspects in distributed systems. The framework is based on unidirectional "announce/collect/decide" paradigm, but intends to go towards a multi-directional "announce/refine/decide" paradigm allowing flexible refinement of the negotiation terms.

3. CONTRACT MODELING

The purpose of establishing contracts in this context is to regulate the internal behaviour of the VO to be created in a VBE environment. It shall be noted that in a VBE context, all possible (or most) partners for the VO are members of the VBE and take advantage of all the infrastructures provided.

Classes of Contracts. The major classes of contracts that can be related to VOs are: The ones associated to the number of parties involved, such as Bilateral contract that is an agreement in which both parties to the contract makes a promise or promises to the each other; or Multi-party or multi-lateral contract that is an agreement in which it is required information from all participating sides. On the other hand, contracts can also be classified by the promises implicated, where an Adhesion contract is a standardized contract form that in general is offered to consumers of goods and services without affording them a realistic opportunity to bargain and under such conditions that they cannot obtain the desired product or service except by accepting all the contract terms; an Internal contract does not include supply to third parties (although the members goal's might include it); and an External contract represents the "joint" activity to third parties.

In the considered context, where the VOs are created in the VBE environment, the most suitable application for these types of contracts would be: the adhesion contract for the members to enroll the VBE; the internal contract as the agreements that will regulate the internal behaviour of the consortium; and the external contract to represent the commitment of the VO to the client.

Structure of Contracts. When dealing specifically with VOs, there are two different types of contracts that should be considered: the consortium internal contract/agreement and the contract established with the client. The first one regulates the behaviour of the VO typically through a multi-party contract; whereas the second establishes the actual contract with the client.

For instance, in the case of the explicit consortium (Figure 3), the collaboration is regulated by a joint contract with the customer and a consortium agreement; in this case, the client has all the information about who is part of the consortium. In the internal consortium structure (Figure 4) there is a contract between one representative of the consortium and the client. Here, the client does not necessarily know about the way the consortium is organized. Only the representative of the consortium holds the contract with the client, whereas the other partners are committed to the one that signs the contract.

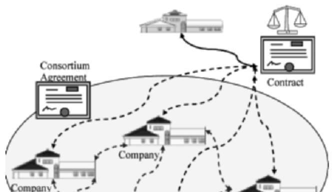

Figure 3 – Explicit Consortium structure.

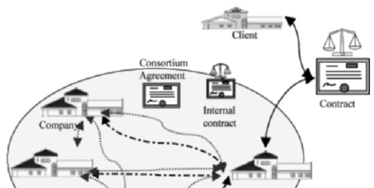

Figure 4 – Internal Consortium structure.

Life-cycle of Contracts. The contract life-cycle includes several phases between the intention of establishing a contract and its actual enactment. The contract establishment process is the process of finding suitable contracting parties and negotiating a contract with them. Contract enactment is the fulfilment of the promised obligations of the parties involved and the correspondent benefits. The contract management process starts before the contract establishment process, runs in parallel with contract establishment and enactment and ends after the completion of the contract enactment process.

In this work, the focus of the addressed research is the contract establishment, whereas the contract enactment is out of the scope of this paper.

4. CONTRACT ESTABLISHMENT

At the current stage the focus of the negotiation wizard being developed in the ECOLEAD project is put on the negotiation of the internal consortium contract/ agreement, rather than on the contract with the client. Therefore, the use of the term "contract" or "agreement" (here used indistinctly) shall be understood as the result or synthesis of all agreements established among the participants of the VO being created and that will regulate their collaboration.

Taking into account the phases of the VO creation shown in Figure 1 (Camarinha-Matos & Oliveira, 2005), a suitable approach would be to have a contract negotiation wizard that would be capable of helping the right users to construct the VO contract in each phase of the VO creation, resulting in a multi-step iterative process. The elements for the contract are incrementally collected along the various steps of the VO creation process.

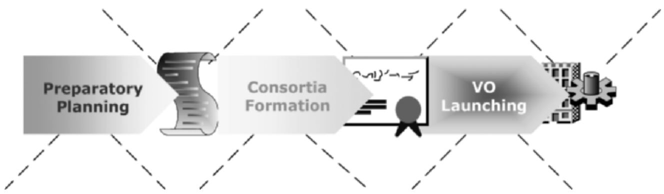

Figure 5 – Steps for VO internal Contract establishment.

There are other works that try to accomplish results for establishing contracts, namely in the area of the multi-agent systems (especially when dealing with e-commerce). Such approaches try to reach a solution that is as fully-automated as possible, while in the present work, the goal is not to have a fully-automated, but a semi-automated process to help in human decision making. For instance, taking the simplified view of Figure 5 at a certain stage, the results from the preparatory planning phase can lead to the selection of a contract template that is appropriate for the collaboration opportunity (CO) (depending on the specifications of the requirements identified in the preparatory planning that includes the CO identification and characterization and subsequent draft of the VO plan) and some fields of this template can be filled in with the results of this initial planning. More intensive negotiation steps will then take place during the consortium formation (selection of partners) and detailed VO planning. The results of all partial agreements will then be integrated into a single document, the "contract", or the VO internal agreement.

Table 1 illustrates the VO creation phases and the activities towards a contract negotiation wizard, as well as the actors involved and the situation of the contract in each phase.

Negotiation "focus". At a macroscopic level two important stages of the negotiation steps lead to different negotiation "focus":

- The negotiation towards the selection of partners to compose the VO;
- The negotiation of the details of the VO (negotiation objects) 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.

Table 1 – Approach to contract negotiation wizard.

VO Creation Phases	Sub-phases	Description	Actors Involved	Contract situation
Preparatory planning	*CO identification & characterization*	From a repository/library of contract templates, a part of the contract could be filled, namely the one related to type of CO and consequently the needed VO requirements, like: structure, topology, etc.	Opportunity Broker Client	**➨ Contract type specification and general definitions**
	Rough VO planning		Opportunity Broker VO Planner	
Consortia Formation	*Partners search and suggestion*	After the suggestion of potential partners, a negotiation round takes place in order to obtain the most suitable combination of partners and agreements among them. This stage will lead to the VO Composition.	VO Planner VBE Member	**➨ Contract under negotiation** **➨Agreed and in progress negotiation objects**
	VO Composition			
VO Finalization	*Detailed VO planning*	In this phase, the VO constitution is nearly finalized so, after having a refinement of the VO plan, it is possible to further fill the VO contract in terms of its members, obligations, sanctions, etc.	VO Planner VBE Member	**➨ Signed agreements / assembled contract**
	Contracting		VO Planner VBE Member VO Coordinator	
	VO Launching		VO Coordinator VBE Member VBE Administrator	

A Scenario. Considering the characteristics of the needed human interaction, a support environment offering typical functionalities of a CSCW system can be foreseen. The full negotiation process involves a number of elementary negotiations, i.e. reaching agreements on a number of "negotiation objects". A "negotiation object" (e.g. definition of the schedule and location for delivery of a prototype), once agreed by all involved parties, will become part of the global contract.

The initiator of the negotiation process (VO planner) shall have mechanisms to create new negotiation objects and "open" a kind of "virtual negotiation room" or "negotiation channel" for each negotiation object. One (in a bilateral negotiation) or more (in a multi-party negotiation) participants will then be invited to join the "room". Using standard collaboration tools (e.g. chat, forum, notification, file sharing) the discussion over the "negotiation object" will proceed, driven by the human negotiators, until the process ends. Possible outcomes include:

- *Agreement reached* – in which case the "negotiation object" can be stored in a dedicated "agreed negotiation objects" folder for later integration in the contract.

- *Negotiation failed* – in which case the “negotiation object” is discarded.
- *Re-negotiation needed* – in which case a new “negotiation object” might be created, although some data from the previous one might be re-used.

The full negotiation process may be guided by a “contract template” composed of a number of sections. When a “negotiation object” is created it is associated to a specific section of the contract where a link to the object can be kept (Figure 6). After all negotiation objects are agreed, the final contract is built by a kind of “compilation” or integration of these objects.

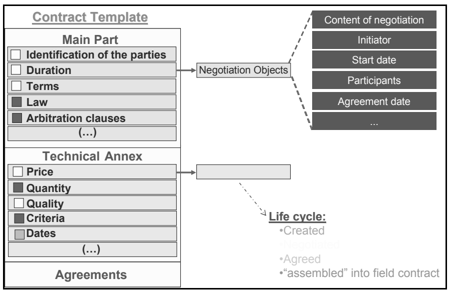

Figure 6 – Negotiation objects.

The processes described in this scenario are quite hard to structure in terms of well defined workflows/protocols as several flows depend of the decisions made by the human negotiators and also their individual timing (mostly asynchronous regarding each other).

However some “organizational/operational support” can be envisaged, namely in terms of:

- Specialized CSCW-like environment: document management and sharing, versions management, access rights definition and control, interaction mechanisms (chat, forum, notification, invitation, etc.).
- Specialized data structures and ontology’s, and some minimal data-driven flow control (keeping track of the negotiation status, reached agreements, etc.).

From this simplified scenario it can also be inferred that there is a need for a close interaction between the Negotiation Wizard and other tools supporting the VO creation framework as they provide the main inputs of the wizard. On the other hand, the results of the negotiation steps influence or even determine the actual selection of partners for the VO being built. Therefore, it is not enough to design a loosely coupled architecture but rather it is necessary to invest more on the understanding of the inner interactions of the various sub-processes illustrated on Figure 1.

Functional Specifications. As previously mentioned, the focus of this wizard is not intended to reach a fully-automated tool for the contract establishment, but a semi-automatic tool to enable and facilitate human-based negotiation and decision-making. The reason for this is that the contract establishment involves a large complexity as well as huge risks; consequently the wizard will play the role of an auxiliary system in human decision making.

The planned negotiation wizard is designed to have two main layers. The first layer of the architecture consists of an extension/adaptation of the functionalities already provided by CSCW tools, such as:

– Logging including functionalities for identifying users and their properties;
– Administration with qualifications for calendar administration, generation of Gantt diagrams etc;
– Communication with possible usability of chats, forums, email, etc;
– Projects where commitments can be specified and where events for partners can be generated, as well as the inclusion of to-dos. There is also the possibility for file storage with versioning; and
– Export Objects, namely files in several formats, like pdf, xml, xls, doc, html, etc.

The second layer of the architecture is designed to facilitate and regulate the negotiation of the VO internal agreement/contract. Main components to include in this layer are:

– Contract templates repository (CTR), is a collection of contract templates and negotiation objects templates to support the contract creation,
– Contract editor, uses the repository to produce contracts,
– Virtual negotiation room (VNR) supporting the human interactions in a negotiation process, and
– Facilities for contract signing, notifications and notary.

From the wizard point of view, the other tools being developed for the VO creation framework can be considered as a third layer of the architecture, as they will all interact with the contract negotiation wizard tool.

The following table summarizes the functionality and outputs of the contract negotiation wizard:

Table 2 – Functionalities of contract negotiation wizard.

Functionality	**Description**	**Outputs**	**Actors**
Contract Templates repository (CTR)	Collection of contract and negotiation objects templates to support the contract creation	"skeleton" of contracts	VO Planner
Contract Editor (CE)	uses the CTR and agreed negotiation objects to add new clauses to contracts	contracts	VO Planner
Virtual negotiation room (VNR)	Virtual "place" where the negotiation participants can access the various negotiation objects and can "discuss" in order to reach agreements	Agreed negotiation objects	VO Planner and all possible partners
Support for agreement establishment (SAE)	With facilities for contract signing and notification to relevant parties, and repository/archive for its storage	"notary" with signed contracts	VO Planner and all partners involved

5. CONCLUSIONS

It is unrealistic to assume that the complexity of generic contract and contracting process can be fully automated. But what makes e-contracting so appealing is that it provides a way to decrease costs and time to reasonable values. Also the idea of having a virtual space that allows negotiation for all parties involved seems very promising. What should not be ignored is that there are a large number of organizations and SMEs that will still have to catch up with the ICT e-contracting requirements.

Some open issues that still have to be considered are: the legal implications of data exchange, both for the provider of the information and for the recipient; relation of past collaboration between organizations with "levels" of success; how should metrics and weights be assigned for the products parts and then for the partners; etc.

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