Towards the Sustainability of Virtual Organization Management

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Abstract
This paper focuses on the sustainable management of Virtual Organizations (VOs) within a collaborative network environment by means of searching and suggesting a VO coordinator. The proposed methodology is based on the fact that there is a growing up tendency of offering and hiring exclusive services addressing new opportunities to several organizations and persons collaborate – sometimes relying on different cultures, technology, management style, and so forth – in order to achieve common goals. In each single case much of the success of the VO depends on the way in which it is managed. For this reason it is becoming clearer that the role that the VO coordinator (also known as VO Manager) plays is not only important but also fundamental for adequately achievement of the objectives set during - mainly - the VO creation phase. In fact, the VO Coordinator is a key element during the whole VO life cycle. It is therefore mandatory to carefully consider his/her specific competences.

1 INTRODUCTION
The growing up tendency to offer and hire exclusive services, addressing new opportunities to several specializations is contributing to the appearance of the made-to-fit professional. This trend can be perceived in our daily life: nowadays you can easily find personal trainers, personal stylists, personal dancers among others. This is part of the customization concept of products and services and comprises the wish to find individual solutions which incorporates value [1]. Hence, professionals are being shaped and trying to develop skills as well as competencies to attend to specific needs.

In the Collaborative Network (CN) area each Virtual Organization (VO) is considered to be unique. A VO takes place in an environment where different organizations and persons collaborate – sometimes relying on different cultures, technology, management style, and so forth – in order to achieve common goals. In each single case much of the success of the VO depends on the way in which it is managed. For this reason it is becoming clearer that the role that the VO coordinator (also known as VO Manager) plays is not only important but also fundamental for adequately achievement of the objectives set during - mainly - the VO creation phase. In fact, the VO Coordinator is a key element during the whole VO life cycle. It is therefore mandatory to carefully consider his/her specific competences.

But how to choose an adequate coordinator for a given VO? Many aspects have to be taken into consideration: the characteristics of the VO – such as its topology and governance principles – as well as the required competences for each case, just to mention few. Furthermore the process of searching and suggesting a VO coordinator should be fast, simple and effective. Therefore the proposed alternative focus on making use of the human resources already available in the VO environment which on the one hand naturally concentrates several professionals with competencies in the CN area but on the other hand do not normally take advantage of these available human skills in order to select and/or indicate coordinators for VOs.

This work proposes a methodology for VO coordinator search and suggestion supported by a competence map. It is expected that this search and suggestion process, besides indicating the most adequate Coordinator for a given VO, also contributes to create new market opportunities by increasing interest of organizations and liberal professionals to offer this kind of specialized service: the made-to fit coordinator for VOs.

The paper is organized as follows: Chapter 2 introduces some basic concepts about the VO environment. Chapter 3 describes some essential competencies in the VO environment and how a Competence Map can be designed. Chapter 4 presents the methodology proposed to search and suggest a VO coordinator. Finally, chapter 5 presents some conclusions and the next steps foreseen for this on-going work.

2 VO ENVIRONMENT
2.1 Virtual Organization (VO)
Virtual Organizations are temporary alliances of organizations that come together to share skills or core competencies and resources in order to better respond to business opportunities and produce value-added services and products, and whose cooperation is supported by computer networks. The temporary nature of VOs, the needed inter-organizational processes, and the potentially diverging individual objectives of the partners, require a sustainable VO management. [2, 3, 14]

2.2 VO Life-Cycle
A well-accepted life cycle model for VOs includes four stages [4, 5, 6, 7]:
1. Creation. This is the initial phase when the VO is created/configured and for which some of the major required functionalities are: Partners search and suggestion, contract negotiation, definition of access rights and sharing level, join/leave procedures definition, configuration and so on.
2. Operation. This is the phase when the VO is performing its business process(es) in order to achieve its common goal(s), and which requires functionalities such as: Basic secure data exchange mechanisms, information sharing and visibility rights, orders management, incomplete orders processing, distributed and dynamic planning and scheduling, distributed task management and high levels of task coordination.
3. Evolution. Modifications might be necessary during the operation of a VO when there is the need to add and/or replace a partner. This might happen due to the occurrence of some unexpected event, such as (temporary) overloaded capacity of a partner, lack of...
adequate human resources, etc. Functionalities similar to the ones specified for the creation phase are also required here.

4. Dissolution. This is the last phase. There are two possibilities for dissolving a VO: a successful dissolution (when the VO finishes its business having achieved all its goals) or an unsuccessful dissolution (when some problem occurs during the operation phase which, for some reason, can not be solved). In the last case the common goal is not achieved and the partners decide not to go ahead with the collaboration.

Figure 1 shows the main VO phases as well as their relations to each other.

![Figure 1 - VO life cycle][2, 6]

This work concentrates its focus in the Creation and the Evolution phases.

### 2.3 Virtual Breeding Environments (VBE)

VBE represents an association or pool of organizations and their related supporting institutions that have both the potential and the will to cooperate with each other through the establishment of a base long-term cooperation agreement. When a business opportunity is identified by one member (acting as a broker), a subset of these organizations can be selected and thus form a VO. A breeding environment, being a long-term networked structure, presents the adequate base environment for the establishment of cooperation agreements, common infrastructures, common ontologies, and mutual trust, which are the necessary facilitating elements when building a new VO. In other words, VBE represents a group of organizational entities that have developed preparedness for cooperation, in case a specific opportunity arises. [8]

### 2.4 Professional Virtual Community (PVC)

PVC is a term that represents the combination of concepts of virtual community and professional community. Virtual communities are defined as social systems of networks of individuals, who use computer technologies to mediate their relationships. Professional communities provide environments for professionals to share the body of knowledge of their professions such as similar working cultures, problem perceptions, problem-solving techniques, professional values, and behaviour. When professional communities adopt computer networks and most of the practices and tools of virtual communities, they become professional virtual communities [8].

**Virtual Team (VT)**

The concept of VT is analogous to the concept of Virtual Organisation (VO) in the sense that the VT is formed in response to concrete business opportunities. VT differs from VO in that they are made of individual professionals instead of Organisations. An individual can, at the same time, be part of a VT, a PVC and a VO. It is clear that, in case of an individual who is simultaneously employee of an Organisation and member of a PVC, once he/she joins a VT must respect the no-conflict of interest agreement with his/her own employer [9].

### 2.5 Roles

In the VO creation and operation phases, it is possible to identify several actors and their roles. The ones relevant for this work are the following:

- **VBE Members** – Basic role played by those organizations that are registered at the VBE and are ready to participate in the VBE activities [10]
- **VBE Administrator** – Performed by an organization or a person responsible for the: VBE operation and evolution; promotion of cooperation among the VBE members; filling the skill/competency gaps in the VBE by searching and recruiting/inviting new organizations into the VBE; daily management of the VBE general processes, e.g. assignment/reassignment of rights to different actors in the VBE based in their responsibilities; conflict resolution; preparation of a bag of VBE assets; and making common VBE policies, among others [10];
- **Broker** – It is a role played by an organization or a person (usually a VBE Member) that initiates/creates a VO through identification of business opportunities and search for partners [7];
- **VO Planner** – Performed by a VBE member that, in face of a new collaboration opportunity (designed by a Broker), identifies the necessary competencies and capacities, selects an appropriate set of partners, and structures the new VO. In many cases the roles of Broker and VO Planner are performed by the same actor [10].
- **The VO coordinator** – (S)He is the regulator component of the VO related activities [2]. The coordinator should be a person specialized in management with adequate competences for an appropriate VO coordination. The coordinator of a VO has the tough task of managing the information flow of the distributed business process (DBP) being carried out by the VO partners as well as the various relationships between business processes. [11].

Considering the relevant activities and responsibilities of this professional and with view to achieve a sustainable VO management, the choice of the VO Coordinator(s) is considered one of the most important actions inside the VO life cycle.

VBE/PVC members are natural and potential candidates to play the role of VO Coordinators as they are already aware about the paradigm behind the VOVs – a networked structure supported by computational infrastructure. This first rough analysis takes into consideration that it is essential to have a coordinator committed to the philosophy of collaborative networks in order to increase the chances to succeed in bringing about a sustainable VO management. The list of potential candidates can also be extended to the VBE/PVC outside world – provided they are accepted by the VBE Administrator to candidate to this job.

### 3 COMPETENCIES IN THE VO ENVIRONMENT

Many organizations use the concept of competence to both measure and improve employee development as well as during their recruitment process. The terminology of “competence” can be confusing because each organization normally has its own interpretation and understanding for the term. Along the time many researchers have been studying competence. One of the well-established definitions on
competence is provided by Durand [12] who states that competence is the ability to coordinate activities to the standards and rules required in the organization using an appropriate mix of knowledge, skill and attitude. According to him, these three dimensions must be present if someone wants to be effective in the coordination place. This understanding of competence is the one that will be used in this work.

As the VO coordinator has to deal with a distributed, dynamic and – sometimes - complex organizational environment one of his/her main attributes should be to adequately balance these dimensions of knowledge, skill and attitude in order to contribute to the achievement of the VO goals. As a direct consequence Individual Competences have a special attention in this work.

Based on Fleury & Fleury [13], in a wide vision addressed to the VO environment, it is possible to define some essentials competencies to the VO coordinator (Table 1).

<table>
<thead>
<tr>
<th>COMPETENCIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>KNOWLEDGE (WHAT)</td>
</tr>
<tr>
<td>KNOWLEDGE (WHERE)</td>
</tr>
<tr>
<td>ACT</td>
</tr>
<tr>
<td>MOBILIZE</td>
</tr>
<tr>
<td>COMMUNICATE</td>
</tr>
<tr>
<td>LEARN</td>
</tr>
<tr>
<td>COMPROMISE</td>
</tr>
<tr>
<td>TAKE RESPONSABILITIES</td>
</tr>
<tr>
<td>HAVE STRATEGIC VISION</td>
</tr>
</tbody>
</table>

Table 1 – Some Essential Competencies of a VO Coordinator (adapted from [13]).

These competences can be extended and detailed according to the interest of the VO Planner and the VBE Administrator. These competencies data can be gathered in a Competence Map where the data can be classified in the three dimensions (Knowledge, Skill and Attitude) aiming to facilitate the recognition of an adequate candidate in the search and suggestion process. A very crucial issue for the elaboration of the Competence Map is the use of an adequate Competence Common Ontology as well as the proposition of mechanisms necessary for using and evolving this ontology during the VBE/VO management. It is not the scope of this work to go deeper on this subject. However, given its relevance for the accuracy of this work, its importance is acknowledged but the scenario is considered deterministic i.e. it is assumed that an ontology exits and is in use.

An example of the Competence Map is presented below (Table 2):

<table>
<thead>
<tr>
<th>Name (Who)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area ▼</td>
</tr>
<tr>
<td>Competence ▼</td>
</tr>
<tr>
<td>KNOWLEDGE (What)</td>
</tr>
<tr>
<td>KNOWLEDGE (Where)</td>
</tr>
</tbody>
</table>

Table 2 – An example of a Competence Map

This Competence Map integrates three complementary competencies types: Individual Competences (the ones related to each individual person), Functional Competences (the ones required by the role to be performed – in this case the VO coordinator) and Organizational Competences (the ones necessary to achieve the objectives of the VO). The synergy among these competences potentializes the latent capacity of the individuals and contribute to leverage the results that can be achieved for the identified needs. The competences serve to attend the needs; and the needs serve to instigate competences. (Figure 2)

![Figure 2 – Integrated complementary competencies](image)

4 LOOKING FOR A VO COORDINATOR

The coordinator(s) search and suggestion is a very important step in the VO life cycle, occurring normally in the Creation phase and – sometimes – in the Evolution phase. This step can be taken making use of the human resources available in the VO environment. The VBE can be an inexhaustible source for this kind of resources. Its members are organizations that have the knowledge of how to work in a Collaborative Network and, in some cases, already have persons with the required competences to manage a VO. Besides tangible goods or the traditional support services offered in the VBE, it is also possible to find this specific service for VO coordination. In some cases organizations may be elected/selected to act in a business “just” as VO coordinator. Furthermore the trust environment in force in the VBE cares for the quality and the accuracy of the information provided by the VO candidates.

This new “role” of VO Coordinator will most probably require in the near future specific training and educational programmes focusing on the VO management requirements. This will enlarge the universe of choices
and will certainly contribute to a more sustainable VO management. It is expected that all efforts being undertaken by the research and academic world in order to establish a stronger theoretical foundation for the new discipline of Collaborative Network [14] also result in new courses being offered for both in-campus and off-campus professionals.

The methodology developed in this work for searching and suggesting a VO Coordinator is a 3-move process. Figure 3 summarizes this process which will be detailed in the following:

Figure 3 shows some VO coordinator candidates (inside the dotted circles) and a 3-move process of the suggested methodology which is further detailed in the following:

**Move 1: Register of VO Coordinator candidates**

The big circle on the right-side of the figure represents manifestations of the CN world where a VBE and a PVC are already established. Potential VO Coordinators are highlighted inside the small dotted circles. These potential candidates may belong to the inside or the outside VBE/PVC world. Organizations belonging to a VBE may be represented by more than one candidate. In this case the candidates must respect the non-conflict of interest agreement with its own employer.

The candidates should firstly contact the VBE Administrator to ask for identification and password. After that each candidate should fill in his/her own Competence Map. The candidates should introduce their individual data based on their individual competences (Knowledge, Skill and Attitude) and – whenever possible – relate them to some functional competencies, distributed in a 5W1H form (who, what, what, when, why and how) based on the Standard Operation Procedure (SOP) as suggested in the Table 2. The name of the candidate is introduced in the field “Name”. In the case of a candidate belonging to an organization which is member of the VBE, this field also provides information about the mentioned organization. The field “Area” will present some alternatives pre-defined by the VBE Administrator (other alternatives can also optionally be included). Examples of some competence areas include: technology, administration, motivational, interpersonal, decisional, and environmental [15]. Each individual competence should be linked to one of these areas so that a filter can be applied whenever necessary.

The field “competence” is to be fulfilled according to each candidate own profile and should follow a Competence Common Ontology. The other fields (Skill, Knowledge and Attitude) are dependent of a self-interpretation of the candidates. In the field “Skill” the candidate should rank his/her ability according to a 1(minimum) - 10 (maximum) scale. Candidates are the ones responsible for updating their own competence maps.

The competence maps formalize the information about the profiles of possible VO coordinators and help to overcome habitual obstacles in the CN world such as the lack of information.

**Move 2: Information Management**

The VO candidates’ Competence Maps are stored in a Data Base for future use by the VBE Administrator and/or the VO Planner. If necessary – and depending on the agreement of the VBE Administrator - the VO candidates information can also be put available to other interested persons (the Broker for instance).

In this stage a validation of the self evaluation (field “Skill”) executed in Move 1 can be applied. External evaluators can analyse the skill rate given by each candidate to each one of their competences. In the sequence they give their impressions to the VBE Administrator who will take this analysis into consideration in order to have a wider view about each candidate.

Information privacy policies are applied according to the VBE rules.

**Move 3: VO Coordinator search and suggestion**

The VO Coordinator search and suggestion process normally takes place during the Creation (or Evolution) phase. For each business opportunity a different VO is created. Consequently each VO has its own specific needs and requirements which are identified and analysed by the VBE Administrator and the VO Planner. Based on the VO needs some organizational competences are mapped. These ones constitute the basis for the VBE Administrator/VO Planner to search for specific VO Coordinator competences. In this methodology this step is a human-based one but it can also be performed in an automatic or semi-automatic way provided some intelligence technique is applied. Additionally the VBE Administrator/VO Planner can also set some preferences and/or constrains (e.g. they can apply filters and look for candidates from just a given organization).

The Move 3 can be executed according to the following alternatives: (Figura 4):

1 – **Direct search**: Based on the VO coordination needs it is possible to make a search for a VO coordinator directly on the Competence Map DB. This search is performed based on the data provided by the candidates (and eventually post-analysed by an external evaluator) and applying some criteria or filters (specific competencies, area, skill level and so forth). The resulting list of potential candidates is stored. Each time a different criteria or filter is applied, a different list is generated. Multiple searches can be performed which implies in several lists. These stored lists can be accessed at any time. The same candidates may appear in several lists. These lists will be cross-checked and a final list will be provided. The final decision is taken by the VBE Administrator/VO Planner, based on the final list.

2 – **Direct search and “call”**: If the final list does not include any candidate considered adequate to play the role of VO Coordinator for a given VO, the VBE Administrator may launch a call. This call will focus on the required individual competences (making use of the Competence Map standard) and will be addressed to the outside VBE/PVC world.
Figure 3 – The 3-move process for VO coordinator search and suggestion

Figure 4 – Alternatives to the Move 3
If even so no adequate candidate appears the VBE Administrator should decide for the one who is best recommendable for the role to be performed. Training activities should then be provided in order to guarantee that the required competence will be achieved.

It is important to stress that there are some auxiliary steps that can be taken in order to improve the process of searching and suggesting a VO Coordinator. This includes:

- Dissemination of the "job" opportunity;
- Provision of facilities and motivation to the candidates to register;
- Recommendation of competence improvement for selected (and also for pre-selected) candidate(s);

5 CONCLUSIONS AND NEXT STEPS

The work presented is this paper is a study that is currently under development. The basic idea is to contribute to the Collaborative Network discipline, more specifically to the VO area, with emphasis in the search and suggestion of an adequate VO coordinator.

This search and suggestion process is based on a 3-move methodology which can lead to the development of supporting tools (a specific functionality) in order to attend to the needs of the VBE Administrator and of the VO Planner. The first version of a web-based software prototype with the mentioned characteristics was developed by the GSigma group [16] using the Ruby on Rails version 1.1 framework [17].

The presented methodology aims to establish a formal – but at the same time simple, fast and effective – procedure to the search and suggestion of the VO coordinator based on the human resources already available in the VO environment. The methodology is supported by a competence map which is the basis for cross-checking the available and the VO required competencies based on knowledge, skills and attitude.

As next step the authors intend to implement this VO coordinator search & suggestion functionality in a VBE management system. Another interesting possibility is to test the integration of this functionality with other ones such as the Profiling and Competency Management System for VBEs [18] and the e-Cat (electronic Catalogue for VBE) [19] developed in the Ecolead project [20].

6 ACKNOWLEDGMENTS

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7 REFERENCES