

Informal Virtual Organizations: A Perfect Home for SUBJECTs as Building Blocks

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Abstract—The present era has witnessed a rapid technological advancement, which has shaped our social connection into a new dimension. Online social networks are gaining acceptance and popularity among masses. PCs and mobile devices are used to connect with each other. Availability of online social networks on remote devices, such as cell phones, has made it even more pervasively. A large population of internet users today is actively participating in online social networks (e.g., Facebook, Myspace, Twitter, Blogger). The percentage of members is growing higher each year. Online social networks are a specific type of Virtual Organizations, called informal VOs. This paper focuses on users and resources gathered and provided by online social networks. It presents online social networks as informal VOs and develops a generic pattern of user and its special type, which we call *SUBJECT*. It identifies the roles served by users as Subjects in online social networks and it reveals how users can be "consumed" as a resource in an informal VO.

Keywords-Social Networks; Virtual Organization; Subject; Logical Resources.

I. INTRODUCTION

A Virtual Organization (VO) is an orchestration of globally dispersed resources in a specific domain. VOs represent a combination of entities which are logically associated to achieve a goal. The building blocks of a VO are *Goal*, *User community*, *Tools* and *Resources*. These concepts are detailed in [1]. VOs provide resources which are utilized by users to solve their problems. In the early collaborations, these resources were restricted to storage, computational cycles, print facilities, high performance devices, parallel servers, simulation software, application programs and licensed software. The computing paradigm of Grid computing played an important role in providing such facilities, thereby, establishing a platform for VOs. Some examples of Grid based VOs are [2], [3].

VOs are of different types ranging from dynamic to fixed, temporary to long lived and formal to informal [3]. No matter what the type is, VOs offer resources to the users in the said domain to help them in problem solving activity. Specifically the Users in VOs play an important role. VOs creation, existence, evolution and deletion depends on user requirements. Users range from laymen to experts, beginners to professionals, learners to scholars from every field of life. Informal VOs are part of our lives in the form of social

networks (e.g., Facebook, Myspace, MyExperiment) [3]. These user driven networks are typical examples of informal VOs where every user has its own goal for consumption and contribution to the resources pool. Today, online social networks are becoming essential part of life of humans who have access to Internet. People find it easier to connect to each other using social networks. These social networks can be visualized as a collection of small scale informal virtual organizations. Each user is given the right to access a number of resources offered by an online social network by creating a profile. These platforms give a sense of authority to the members by allowing them to initiate different activities. On the other hand, members can participate in the activities initiated by other members. Online social networks are an interesting area to study roles played by members. This paper identifies the resources available in a virtual organization in general. It reveals the role of users as a resource in an online social network. In the context of this paper, online social networks are presented as a special case of VOs.

In all types of VOs, users are classified into following four categories: consumer, contributor, developer, and administrator. Resources offered by VOs are utilized by users in these four capacities. VOs offer globally distributed resources to its users. With the technological shift, resources offered by a VO are also changed. The relation between user and resource is partially overlapping. This situation motivated us to review the users roles and resources offered in a VO. Thus we introduced a new term for a special type of resource in VO in [1], [4], [5], which we called *Subject*.

VOs exist around us in many shapes, as first choice of research community for collaborative computing. Still, standard pattern/methods for building VOs are missing. This situation is the motivation of our research to design a Reference Architecture for VOs. We believe that this endeavor will not only help the research community to find a starting point for building a VO, but also will provide them with a blueprint to extend existing pilots towards a fully-fledged environment for their needs (i.e., identification of existing/missing components). In our vision users and resources are main building blocks of a VO. Therefore we introduce the newly defined notion of *Subject* as a generic building block of a VO, as our first step towards building a

Reference Architecture for Virtual Organization, which we call RAVO. A Reference Architecture for Virtual Organization can be defined as "an open source template that does not only depict the architectural patterns and terminology, but also defines the boundaries where heterogeneous resources from different domains merge collaboratively into a common framework".

A Subject is defined as a component of a VO, which can consume the resources, offered by a VO and also can act like a resource to be consumed in the VO environment. Therefore a Subject resembled the generic block of a VO, which results into a new definition for VOs. In the view of above discussion we propose a VO as *a set of cooperating building blocks, called Subjects*.

The rest of the paper is as follows: Section 2 defines the resource hierarchy in VOs. Section 3 explains the user acting as a resource and details a generalized pattern for users in VOs. Section 4 contains examples of users focusing their role as *Subject* in informal VOs. Section 4 concludes the paper with future aims.

II. THE RESOURCE HIERARCHY

A virtual organization is a nonphysical communication model which aims to achieve a common goal. It consists typically of a heterogeneous collection of people and organizations with respect to geographical limits and nature. The existence of a VO is typically identifiable by many individuals, ad-hoc groups, research teams, and national and international organizations deploying a wide range of resources [5]. Initially, resources were meant to be hardware such as storage, high performance devices (measuring earth quake, weather forecast, printers, etc), and software (applications, utilities, simulation facilities) [3]. The extensive use of computer technology for problem solving changed the nature of resources [6]. Now resources are distributed as *logical* and *physical* resources. Defining a resource in a VO environment is dependent on the participating entities and domains in which the VO operates. A categorization of resources is presented in Figure 1.

In our research endeavor, a complex but interesting relationship was discovered between user roles and resources [1]. During resource consumption and contribution, at a certain point, user roles and resources are interchangeable. Some may find these concepts overlapping. Previously, resources are purely considered to be something, which is being consumed by the user, as shown in Equation 1.

$$USER \xleftarrow{Consumes} RESOURCE \quad (1)$$

However, resources are also contributed by users in a problem solving activity. This situation is defined by Equation 2.

$$USER \xrightarrow{Contributes} RESOURCE \quad (2)$$

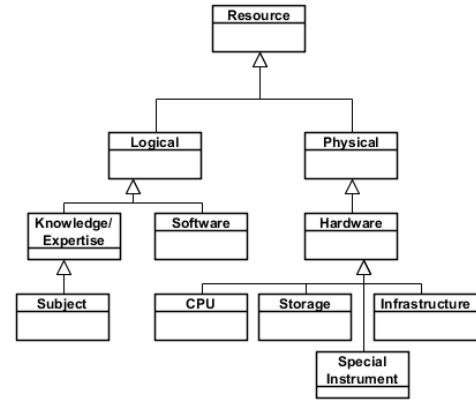


Figure 1. Resource Hierarchy in VO

The situation becomes even more complex, when a resource itself is a user. For example, in an exploration scenario, a meteorologist wants to know the reason that causes an unexpected storm. By chance she is the member of LEAD VO [7], [8]. So she searches for available data sources, and utilizes the tools offered by this VO for the analysis. In case of non-satisfactory results, she consults an expert for guidance and performs an analytical activity with changed data sets. In this scenario, the expert opinion is used as a resource, while experts also utilize VO resources for gaining knowledge [8]. In online social networks, the same situation can be easily identified in group discussions. A member asks a question and other members share their experiences, which can provide potential solutions to the problem, and vice versa. So the equation takes the shape as shown below

$$RESOURCE/USER \rightleftharpoons RESOURCE/USER \quad (3)$$

Even more according to our definition of Subject, the equations above can be generalized to Equation 4.

$$SUBJECT \iff SUBJECT \quad (4)$$

Here, the user is consuming the knowledge of an expert, who acts both as user and resource. Subject is the notion given to a user who itself can be used as resource. There are two reasons for choosing this term. First, a Subject (user) initiates an activity in the VO environment and secondly, a Subject (resource) is under consideration to be useful in a problem solving activity. Figure 2 shows the Subject, resource and user relationship in different types of VOs.

III. SUBJECT AS A RESOURCE

The previous section established the human expertise as a resource in a VO. Now we will present a template for a Subject class with its functions and relations to other user types in a VO. User types are a must for a system, because it helps

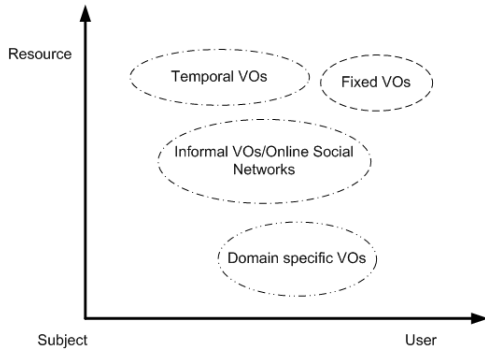


Figure 2. Subject, Resource and User in different VOs

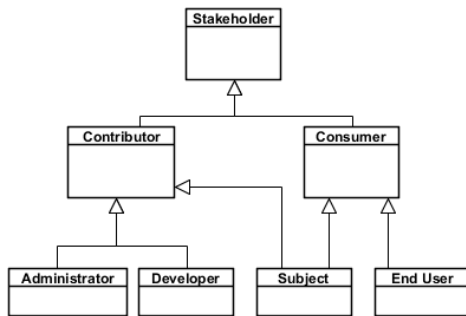


Figure 3. User Roles and their dependencies

in many ways, e.g., by defining trust, building a business model / negotiation model, setting security, authorization at different levels, managing the incoming and outgoing traffic (in dynamic environments), consumption and contribution of resources, and many more. In VOs a user is given a role according to a business model or negotiation pattern for collaboration. Roles may vary as the target domain changes. There are few characteristics and activities that can be generalized. Figure 3 presents the classification model of a user in a VO environment. This model covers both formal and informal types of VOs. A class diagram is created using UML 2.0 to present the pattern.

A User is the superclass with attributes defined in the context such as

- Id: string (any combination used for authentication)
- Role: string (assigned role in the said VO)
- Status: string (active, passive)

A User class is further specialized into two broad categories of **Contributor** and **Consumer**.

- The **Contributor** class presents the instances of a user, who contributes to the VO. The main method is **contribute()**. This class is further divided into **Developer** and **Administrator**, performing pure contribution and no utilization. Here, the **Subject** is also a subclass of **Contributor**. It realizes the role of a contributor while it can also act as a consumer in a VO environment.

It inherits the attributes of the main **User** class and provides contributing methods (functions). The type of contribution can be added according to the role of the user and the domain in which it is active.

- **Administrator:** Another potential subclass is Administrator, who monitors the VO platform for smooth use and in case detects and manages hardware and/or software crashes. Again the Administrator class can be represented by a group of paid experts, who are specialized in their respective jobs assigned. Participating organizations can hire such professionals to monitor the services they are offering to the VO.
- The **Developer** class includes the professionals and application developers from participating organizations. There can be professionals who contribute open source software to the improvement of IT support in specific domains. However, any person can contribute knowledge in form of applications in a specific domain, even if they are not member of a participant organization.
- The **Consumer** class represents the class of users, who just utilize the resources by performing pure consumption only. This class has two subclasses called **End User** and **Subject**. It contains a method **consume()**, which shows that an instance of this class will be able to consume the resources offered by the VO.
 - The **End User** class represents a set of users who only consume the resources provided by the VO.
 - The **Subject** class represents the category of users who utilize the resources and also contribute to the VO environment. Currently two generalized methods are associated with the Subject class namely, **contribute()** and **consume()**. An instance of the Subject class is capable both to utilize the resources of the VO and to contribute to the VO at the same time. Instances of the Subject class can act as a Consumer or Contributor (as a resource), who share partial characteristics of their superclass.

A business model can also be developed on the basis of this categorization. Users belonging to the **Subject** class, can be given a high priority. This priority can entitle them to benefits such as money, free memberships to different participating organizations, utilizations of resources (test beds access, and access to reference material, etc).

The Contributors can have the 2nd highest priority, because they are the paid members of the VO. They develop tools for the maintenance of VO and monitor it. Such users are employed by the system. A possible subcategory could be developers contributing open source applications for the improvement of IT environment. They can be given priorities according to their contribution to the system, e.g., free resource consumption.

IV. INFORMAL VO AND SUBJECT

The above described user classification can be observed in different domains. We presented the elaborated roles in VOs for E-learning [4] and Computational Intelligence (CI) [5]. Both are examples of formal virtual organization. *Ambient intelligence* is taking social networking to a new level of awareness [9]. This awareness is propagated from relatively constant contact with one's friends and colleagues via social networking platforms on the Internet. Informal VOs realize the concept of ambient awareness. Social network fall in the category of informal Virtual Organization. Informal VO are characterized by absence of a specific goal, rather they are user driven [3].

Online social networks are user driven, with no specific goals. However, they can be joined to meet several goals (e.g., making friends, playing games, joining research, religious, social, health, sports groups, to communicate with distant relatives or friends, promote different causes, advertise, participate in discussion forums etc). Goals can be anything supported by the platform. Here, it can be clearly observed that every user is a resource of this informal virtual organization. It exists only due to the relationship between the users and improves with the feedback they provide. Popular social networking websites are Facebook [10], Myspace [11], Twitter [12], and Blogger [13], etc.

To justify the patterns developed in the previous section, we choose Facebook as an example of an informal VO. Facebook [10] is a popular online social network launched in February 2004. It is selected as an example to identify the roles and resource dependencies in informal VOs. The activities performed by Users are

- Create a profile, update and set privacy settings, delete and add applications
- Add people as friends (send, reject and accept requests)
- Send and receive private and public message
- Notify of updating to friends
- Define status settings
- Chat with online friends
- Make lists depending upon privacy settings
- Add photos
- Add videos
- Create notes
- Join networks organized by workplace, school, or college
- Like fan pages
- Join and start groups, networks
- Send a virtual "poke" to each other (a notification in turn tells a user that they have been poked)
- Send gifts
- Visit marketplace
- Play games

In social networks every need or goal is dependent on another user. If a user wants friends, so this user is looking

for a resource (friend). She plays games, which are provided by other users (in most cases). She joins a cause, which is initiated by another user. In any of the above listed actions a user needs other users and their expertise or shared information to fulfill her needs.

On the other hand, information, expertise, material, pictures, videos provided by her can act as a resource for other users. She can initiate fan clubs, discussion groups and any cause, to invite people and grow her community. A use case was developed to understand the activities performed in this informal VO, shown in Figure 4. The user roles and their interaction with existing resources is detailed below.

- **Subject** : The role of a user as a resource is more profound in an informal VO than in formal ones. This is illustrated clearly in our current example of Facebook. A user creates an id and is given right to perform several activities, as listed above. Here the user is a contributor and a consumer herself. For example, a member uploads a video or photo or creates a note, which is being watched by other users and vice versa. Sending and receiving friend requests, messages (open and private), initiating groups, causes and campaigns, joining groups, reading and writing notes, sending and receiving gifts, communicating with friends through wall, and chat and status updates are the activities performed as Subject.

A Subject also gains information from news feeds. An interesting facet are business promotions, which play the role of End user. Many products are introduced to E-communities using social networks by their manufacturers. Facebook is also used by different manufacturers to reach their customers. News channels, media, health, education, research communities, etc., all use social networks according to their requirements and goals.

- **Developer** : Members also play games, utilize applications developed and contributed by developers to the platform.
- **Administrator** : Group of specialized person(s) maintains the platform for performance, backup and routine maintenance.

V. CONCLUSION

This paper presented the concept of resources and users in both formal VOs and informal VOs. A resource hierarchy is defined and the role of a user as a resource was observed and discussed in different environments. The understanding of user roles is necessary for building a trust model for VOs. This approach was extended by a generic pattern for users in VOs and was justified using online social networks (e.g., Facebook). The concepts are elaborated with examples to understand when a user changes her role from a consumer to a resource and starts contributing to the environment. Hence the term *Subject* was justified.

Online social networks provide resources to its members. Every member contributes to the community silently. The impression of a member as a consumer is fading by growing needs of "give and take" collaborations. This new concept of *Subject* fits well into the nature of online social communities. It will help in the future research on VOs to understand the concept of a Subject as a fixpoint where users and resources become the same. It will also set the bases of user roles in designing a Reference Architecture for VO (RAVO) as our future direction.

REFERENCES

- [1] W. Khalil and E. Schikuta, "Towards a virtual organisation for computational intelligence," in *Proceedings of the 2010 Fourth International Conference on Digital Society*, ser. ICDS '10. Washington, DC, USA: IEEE Computer Society, 2010, pp. 144–149.
- [2] L. Hluchy, O. Habala, V. Tran, B. Simo, J. Astalos, and M. Dobrucky, "Infrastructure for grid-based virtual organizations," in *Computational Science - ICCS 2004*, ser. Lecture Notes in Computer Science, M. Bubak, G. D. v. Albada, P. M. A. Sloot, and J. J. Dongarra, Eds. Springer Berlin / Heidelberg, 2004, vol. 3036, pp. 124–131.
- [3] C. Kesselman, I. Foster, J. Cummings, K. A. Lawrence, and T. Finholt, "Beyond being there: A blueprint for advancing the design, development, and evaluation of virtual organizations," NSF Workshop, Tech. Rep., May 2008.
- [4] K. Wajeeha, M. Juergen, and S. Erich, "Veloci: A virtual e-learning organization for computational intelligence," in *World Conference on Educational Multimedia, Hypermedia; Telecommunications ED-MEDIA 2010*, Toronto, Canada, 6 2010.
- [5] K. Wajeeha, , juergen Mangler, and S. Erich, "Virtual organization for computational intelligence (voci):architecture and realization," in *International Joint Conference on Neural Networks 2010 (WCCI2010)*, Barcelona, Spain, 2 2010.
- [6] U. Farooq and W. Khalil, "Grid as human's assistant: A logical solution provider for physical problems," in *CTS '06: Proceedings of the International Symposium on Collaborative Technologies and Systems*. Washington, DC, USA: IEEE Computer Society, 2006, pp. 312–317.
- [7] [Retrieved: December 6, 2010]. [Online]. Available: <http://portal.leadproject.org/gridsphere/gridsphere>
- [8] D. Gannon. (2008, January) Building virtual organizations around super computing grids and clouds. Indiana University and Tera Grid Infrastructure Group.
- [9] E. Aarts and R. Wichert, "Ambient intelligence," in *Technology Guide*, H.-J. Bullinger, Ed. Springer Berlin Heidelberg, 2009, pp. 244–249. [Online]. Available: http://dx.doi.org/10.1007/978-3-540-88546-7_47
- [10] [Retrieved: December 6, 2010]. [Online]. Available: www.facebook.com
- [11] [Retrieved: December 6, 2010]. [Online]. Available: <http://www.myspace.com/>
- [12] [Retrieved: December 6, 2010]. [Online]. Available: www.twitter.com
- [13] [Retrieved: December 6, 2010]. [Online]. Available: <https://www.blogger.com/start>



Figure 4. Facebook: User Roles