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Virtual Organizations: An Overview

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Abstract

The need to remain competitive in the open market forces companies to concentrate on their core competencies while searching for alliances when additional skills or resources are needed to fulfill business opportunities. The changing business situation of companies and customer needs have motivated researchers to introduce Virtual Organization (VO) idea. A Virtual Organization is always a form of partnership and managing partners and handling partnerships are crucial. This paper presents base concepts of VO including VO management concepts, VO operational concepts, VO properties, and main issues in collaboration.

Keywords: Collaborative Networks, Virtual Organization, Virtual organization Breeding Environment (VBE), Virtual Enterprise (VE).

1. Introduction

Advances in Information and Communication Technology (ICT) and trends such as agility, globalization, and increasing demands for products and services with high productivity have motivated different organizations to cooperate and come together to explore business opportunities and fulfill customer tasks. In fact, evolution of the Internet and rapid changes in customer demands for extended services and products have motivated organizations toward a new cooperation schema including geographically and legally organizations that collaborate to achieve the goal. This cooperation is supported by computer networks. The changing business situation of companies and customer needs have motivated researchers to introduce Virtual Organization (VO) idea. Virtual teams, virtual workspaces, and virtual workers are defined in such extended enterprises. Network is the source of virtual organizations.

1.1 Importance of The Subject

The idea of VO/VE has not been invited by a single researcher, rather it is a concept that has matured through a long evolution process. The terms like virtual company, virtual enterprise, or virtual corporation have been introduced in the early 1990s, including the work of Jan Hopland, Nagel and Dove, and Malone and Davidow [1,2]. Then, a large body of literature has been produced mainly in two communities, the ICT, and the management. However, concepts and definitions of VO/VE paradigm are still evolving. During last 10-15 years, a large number of research projects have been run in Europe through the European commission funded programs, Japan, USA, Australia, and Mexico [3]. Therefore, research and discussion on virtual organization idea can improve distributed processing.

1.2 Structure of Paper

This paper is organized as follows. Section 2 presents an overview of virtual organizations including different virtual organization definitions and characteristics. Section 3 introduces Virtual Organization core concepts. VBE, VO lifecycle, and VO planning are main issues in this section. Section 4 discusses the most common issues in a collaborative work environment especially VO management. Finally, conclusions and further research are presented.

2. Virtual Organization: What and Why

This section presents different definitions and concepts related to VO. It is important to understand the reasons and motives for the building of a virtual organization.

2.1 Reasons for Virtual Organizations

Co-operation between organizations or enterprises is not a new phenomenon. For example, in some industrial fields, like construction, it has been typical

to subcontract also part of the tasks to external companies. This has happened far before the terms network and VO were launched. Networking can be seen as a proper way to build up co-operation with other organizations. Cost-effective, saving time, high quality, flexibility, agility, and management of risks are some benefits of using network as breeding environment for a VO.

2.2 Definitions of VE, VO, and VBE

In general, there are three concepts used in this context: Virtual Organization (VO), Virtual Enterprise (VE), and Virtual organization Breeding Environment (VBE).

[4] defines VE as a "customer solutions delivery system created by a temporary and reconfigurable ICT enabled aggregation of core competencies". L. M. Camarinha-Matos, H. Afsarmanesh, and M. Ollus [5] define VO as a "set of co-operating (legally) independent organizations, which to the outside world provide a set of services and act as if they were one organization. It is also reconfigurable. The co-operation is supported by computer networks". T. Dimitrakos et al [6] have also defined VO as a "temporary or permanent coalition of geographically dispersed individual, group, organizational units or entire organizations that pool resources, capabilities, and information to achieve common objectives.

A VO is always a form of partnership. Managing partners and handling partnerships are crucial. partners in a VO should collaborate in order to achieve business opportunities. Important attributes for good partnerships are basic principles of human interaction and business perspectives.

Basic principles of human interaction include:

- ✓ Fairness: Just to all parties, equitable.
- ✓ Trust: Reliance on the integrity.
- ✓ Integrity: Adherence to a strict moral or ethical code.
- ✓ Competency: Qualities of features that distinguish a person or group.
- ✓ Open communication: Exchanging data freely between two parties.

Business perspectives include:

- ✓ Balance of rewards versus risks or resources required.
- ✓ Self-interest of both partners.

Networks or breeding environments are an appropriate context for effective creation of dynamic VOs. [5] has called this context as VBE and defined it as "an

association of organizations and their related supporting institutes, 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". For each business opportunity found by one of the VBE members, acting as a broker, a subset of the VBE enterprises may be chosen to form a VO for that specific business opportunity. VBE also evaluates and coordinates created VO during its life cycle. Each VBE has a life cycle.

As a result, A VE is a subset of VO and VOs are initiated within the VBEs. On the other hand, VBEs are a context to select the best partners for creation new VO with high agility according to the business opportunity characteristics, competencies and capabilities of the partners. The aim of a VBE is to improve preparedness of the partners [5].

2.3 Benefits of Virtual Organizations

Some benefits of VOs include in the following:

- ✓ Save time, such as time to market and Reducing development process.
- ✓ Spreading costs and risks with partners.
- ✓ Improving quality factors such as performance and flexibility, exchange and share knowledge, and marketing in high scale (global networks).
- ✓ Matching VOs with dynamic changes in marketing.
- ✓ Access to new technology and new customers.
- ✓ Access to new markets through partnership.
- ✓ Improving access to financial resources.

In most cases a mixture of these will be the driver for operating and doing business in networks.

2.4 Virtual Organization Properties

According to definitions of VOs, some basic characteristics of the virtual organization are often referred to [3] and described in the following:

1. **Delocalization:** Delocalization is one of the most important developments in the globalization process. It is potentially space dependence. Therefore, enterprises become independent off space and capacity. It eliminates the need for a particular space.

2. **Temporalization:** This property refers to the inter-organizational relations and to the internal process organization, in the sense of the modular and fractal organization. The interdependence is described in the life cycle stages of an VO as a circular process of creation, operation, evaluation, and dissolution.

3. **Dematerialization:** Dematerialization has the virtual forms in products, communities, services, and so on along the development of the virtualization. With increasing virtualization products become *potential immaterial*. It means that all object areas are immaterial. Existing mutual confidence for members, absence of physical attributes and administrator can affect system performance and flexibility.

4. **Individualization:** The main reason for this property is increasing consumer demands. One of ways for capturing market is to attend to mass production along with personal needs. Mass customization is one approach for manufacturers to fulfill customer demands and capture new markets.

5. **Non-Institutionalization:** Because operations are performed in a virtual environment without physical attributes, institutionalization of inter-organizational relationships in such environments can be waived.

6. **Asynchronization:** This attribute causes members to asynchronously communicate and interact with each other via the ICT in the context of innovations with the release of time. Some companies globally schedule their works in three shifts between dispersed locations.

7. **Integrative Atomization:** This property refers to integrate all atomized core competencies of the participants for satisfying customer.

These properties can be categorized in three groups: product and service (, VO conditions and environment, and effective VO operation characteristics. It is outlined in table 1.

Many researchers have presented definitions about VOs. Our aim of this survey is to identify all possible definitions and properties of virtual organizations.

Camarinha-Matos [3] introduces all characteristics described in above for a VO. Dimitrakis [6] selects temporary, permanent, delocalization, individualization, and dematerialization as main properties of a VO while Fang [7] deletes individualization and permanent and Graser [8] serves dynamism property instead of permanent and non-institutionalization instead of individualization. Guidi-Polanco [9] uses *agent integration* as one of main properties of an VO. Haller [10] only considers temporary, delocalization, non-institutionalization, dematerialization as property for a virtual organization. As mentioned, researchers focus on temporary,

delocalization, and dematerialization as shared properties in definition of virtual organizations.

3. Virtual Organization core concepts

The main purpose of surveyed VO concept is to understand the basic elements in the co-operation between enterprises. The preparedness, VBE, VO planning, and VO lifecycle are main issues in this context.

3.1 Virtual organization Breeding

Properties/Type	Product/Service	Environment	Operational
Temporalization		*	
Dematerialization	*		
Delocalization		*	
Individualization	*		
Non-Institutionalization			*
Integrative			
Atomization			*
Asynchronization		*	

Table 1. A Form of VO Properties

Environment (VBE) and Preparedness

Efficient creation of dynamic VOs requires a proper environment that the members of new VOs are selected in it according to their capabilities and trust among them. The main goal of VBE is to improve the preparedness of its member organizations for efficiently creating VOs. The preparedness includes defining core competences, harmonizing procedures and interfaces, creating and sharing common knowledge, etc. A VO is setup quickly by the preparedness. Some benefits of the VBE include:

1. Agility in dynamic VO creation.
2. Facilitating VO reconfiguration.
3. Providing a bag of assets, resources, tools, policies, and knowledge for better collaborating among members. It also holds the past performance measurements of members for selecting in new VOs.

4. Managing competencies and reduction of risk in selecting members (in creating a VO).

5. Defining criteria for evaluation of members trust with recording their performance history and introducing methods for building trust among the members.

Each VBE serves a specific domain and attempts to select the best members to achieve its specific aims in the domain.

3.1.1 VBE Members [3]

VBE Members can be different organizations such as business entities, ministries, legal service providers, and environmental organizations. These organizations should be registered at the VBE, accept the general VBE rules and policies, and have access to common information and tools for operation in a VO.

A VBE member can have different *roles* in different VOs established. The different member roles are listed in the following:

- **VBE Member:** The basic role for organizations that are registered in VBE for participation.
- **VBE Administrator:** Responsible for providing better cooperation among VBE and VBE management. It can find some organizations with high competencies from outside the VBE as a member.
- **VBE Broker:** Responsible for identifying and obtaining new business opportunities.
- **VO Planner:** Identifying, evaluating, and selecting the best partners for creating a new VO in terms of the competencies and capabilities are performed by VO planner. In some cases, the roles of broker and planner are performed by the same actor.
- **VO Coordinator:** Responsible for coordinating a new VO during its life cycle.

Of course, some researchers believe that another roles can be defined in a VBE with considering needs. VBE advisor and VBE service provider are some examples in this context.

3.2 VO Life cycle

As mentioned, a VO framework is created for responding to a business opportunity and terminated after completion.

The VO life cycle is similar to VBE life cycle. It is formed from three stages: creation, operation along with evolution, and termination. These stages are discussed in the following:

1. VO Creation: Identifying business opportunities, examining the partner competencies, selecting partners

from within or outside the VBE (network), forming the best partnership in terms of the competencies, creating the necessary databases, registering new members, and setting up the VO are the key tasks in the VO creation.

2. VO Operation and evolution: At this stage, the activities of the partners are integrated, competencies and common knowledge are managed, co-operations are organized, and collaboration is improved in order to the best respond to the business opportunities. Performance measurement and evolution play key roles at this stage.

3. VO Dissolution: Each VO has a limited lifetime. Therefore, when a VO fulfill the business opportunity, It is dissolved. Of course, the partner competencies and relationships between the partners are kept in the network (VBE) knowledge. The collected knowledge can be used in creating another VO in the VBE.

3.3 VO Planning

VO planning activities include receiving and analyzing business opportunities, selecting proper partners, determining high level Work Breakdown Structure (WBS), and setting up VO. R. Camacho et al [11] present a reference model for VO planning and launching. This model integrates the elements involved in VO creation in VO creation, modeling, and knowledge management dimensions. After VO planning activities mentioned in above, VO modeling is created in four views: Resource, organization, functional, and Knowledge. Resource view represents all resources used in the VO operation. Organization view represents responsibilities and authorities of the elements involved in the VO. Functional view represents the behavior of the elements involved in VO life cycle. Knowledge view represents the structure of knowledge among the elements involved in the VO and relationships between these elements (VO partners). Knowledge sharing and using among the VO partners needs to efficient management. This knowledge includes VO structure, VO members profiles, procedures of VO member responsibilities, and reports developed into VO life cycle.

4. Virtual Organization Management

As a VO is composed of different members located at dispersed sites, different issues can affect the VO. Therefore, the VO management must be examined in different aspects. They can be categorized in human issues and technical issues. For example, different

experiences and cultures play the key role in collaboration. Beside, communication between the partners, trust among them, VO planning, and security are important challenges from technical point of view. Some of them are briefly explained As follows.

4.1 Trust Management

Trust among VO members (partners) is one of important issues in collaboration and VO creation, and affects the result of VO operations. It means that one organization as a VO member expects to other behave reliably in performing their tasks for achieving desirable goal of the VO.

VO modeling is based on Trust. Modeling is an appropriate tools to enhance planning and implementation. The basis of trust management are Trust Parameters (TPs) such as customer response time as an operational TP and damages by natural disasters as a Economic TP. Jochen Haller [10] has defined trust, reputation, and recommendation, as master concepts in creating a successful VO whose partners trust to each other to perform their roles and actions. He has categorized TPs in operational TP, economic TP, organizational TP, and legal TP. He also presents some trust requirements such as identifying and selecting TPs, aggregating them, considering trust values for reputation, and managing trust in collaboration. Finally an architecture for reputation system has been proposed. In a VBE, trust can be built according to result of examining the history of past performance information recorded in the VBE. Trust accelerates collaboration among VBE members, enhances information sharing and knowledge creation, and reduces the management cost and transaction costs between the members.

4.2 Competency Management

Competencies are a set of capabilities and skills that play the key role in partner selection for creating a new VO. If the partners with high level competencies are selected, new VO will be able to achieve its goal efficiently. The important issues associated to competencies include applying robustness in competency management, introducing approaches for dynamically competencies collection and updating, and Designing an autonomic approach for collecting and upgrading competencies can be introduced as a challenge in this context.

4.3 Security Management

Security of a system indicates that the system is protected against damage, threat, and risk. Identifying threats and preparing security technologies are important issues in information systems and VO. Threats can alter the state of the system such as illegally use of resources and data loss. They may obtain secret information without altering the state of the system or cause malfunction of the system [13].

Each VO member is responsible for its own security and the common resources security. Trust among VO members can nearly affect security. Security management should guarantee security in three aspects: legal, organizational, and technical. It is possible that legal operation is violated or new threats alter the organizational structure of VO. Technical errors can also change configuration. In this case, the VO system should have a reconfigure plan for reorganization. Security manager should continuously monitor the VO members operation and authorization, detect violation of rules and threats, then generate proper alarms for eliminating it.

The important issues in security management of VOs including members at dispersed locations are member authorization to control access to resources, security in communication between members, and data integrity.

5 Conclusion and Future Workent

Virtual organization is becoming a strategic characteristic applicable to any organization without physical, geographical, or structural constraints. Network is the source of VOs. Breeding environments are used for a long-term supporting network in order to enable efficient collaboration in VOs and handle VO activities. In this paper, basic concepts of virtual organizations were presented. VO core concepts including management, operational, lifecycle, and planning were discussed. As future research, the following topics can be proposed in the following:

- ✓ Domain engineering of creating and managing virtual organizations.
- ✓ Investigating main criteria in improvement of VO management.
- ✓ Designing a new architecture for honorary members in a collaborative environment.

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