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Virtual Organizations in Practice: A European Perspective

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ABSTRACT

The paper reports results from a European Union (EU) project dedicated to Virtual Organization (VO) research. It aims to consolidate VO reference models and related modeling methodologies based on experiences acquired in thirty relevant EU-funded research projects. The research reveals the complex reality of deployment and adoption of VO practices and identifies a number of organizational, legal, economic, socio-cultural, and technical challenges faced by VOs, presented in the form of open questions for the research community.

Keywords

Virtual Organizations, Virtual Teams, Culture, Legal Aspects, Economic Factors, Technology.

INTRODUCTION

Organizations are currently facing important and unprecedented challenges in an ever dynamic, constantly changing, and complex environment. Several factors, including the pace of technological innovation and the globalization of the economy, have forced business and industry to adapt to new challenges triggered by an ever sophisticated society characterized by an increasing demand for customized and high quality services and products in various segments of industry. Virtual organizations are believed to have high potential. Virtual business modes emerge as a result of a desire to improve market position, gain competitive advantage and of course, the will to create value. The uncertainties of the business are however growing and new game plans are being drawn every day by organizations concerned with their profitability. It is recognized that greater benefits can be achieved if reference models and good modeling practice are promoted. Thus During the last years numerous projects and studies have been carried out with the aim of establishing some technological foundations as well as operating practices for the support of virtual organizations. This effort is visible in Europe through funded programs supporting various projects in this area.

It is vital to note that when operating in global markets, the criteria for competitiveness change continuously in an increasingly competitive business environment. Sustainable competitive advantage is interwoven with innovation (Barrett and Sexton, 2006). In this context, value-added alliance formation can be seen as an innovation and is essential in the current dynamic business environment (Helling et al., 2005). While a number of requirements emerge to support the migration of traditional organizations to empowered alliances, a number of barriers hinder this migration. These include factors related to culture, organizational structure, decision making processes, perceptions in relation to change, shared responsibility management, liability, copyright and confidentiality issues, trust, employee-manager relationships, management strategies, and ICT maturity and capability (Rezgui 2007). Barrett and Sexton (2006) define the process of innovation as a cyclical process of diagnosing, action planning, taking action, evaluating and specifying learning. A value network or alliance cycle starts with sensing an opportunity or need to innovate in response to competitive conditions.

Organizations consider virtual business modes as (a) innovations with the potential to respond to complex business environments (Workman and Kahnweiler, 2001); (b) provide purported benefits (Rezgui and Wilson, 2005), and (c) create opportunities that are not found in traditional organisations (Barrett and Sexton, 2006).

The paper presents key results from the VOSTER project. It expresses a large number of complex issues that have been considered by virtual organizations researchers. It identifies a gap in formal theories, structure, modeling, and life cycle behavior of virtual organizations and alliances. Grounded in an extensive literature review of the existing research relevant to VOs, the paper identifies current barriers, limitations and insight for the deficient research in virtual organizations and expresses these in the form of open research questions. Moreover, virtual organization challenges are reviewed by integrating recent literature in response to the growing awareness of the need for formal business models for organizations. On the basis of this current literature review, a proposition for future direction is presented.

METHODOLOGICAL CONCEPTUAL FRAMEWORK

In an attempt to consolidate existing knowledge on virtual organizations, this paper aims to answer the following research question: What are the socio-technical issues that must be addressed for the effective implementation and operation of virtual organizations? The research has been carried out in the context of the EU funded VOSTER project. This involved the analysis of 23 EU research projects (illustrated in Table 1). Each project involves partner organizations from EU countries. These projects have all been carried out independently, although some partners were involved in more than one project, including the authors who were involved in OSMOS, eCOGNOS and ICCI. Each project had its own individual research agenda which had a strong technical (ICT) focus. At this juncture, the purpose of VOSTER is to analyze the individual results from each project so that to address its own research questions (including the one formulated above) according to a number of dimensions. The basic idea was, to capture the most relevant aspects of virtual organizations and to understand their underlying business and management set-up and principles. These dimensions are presented below:

Business rationale for the virtual organization: The reasons why virtual organization was chosen by the partners involved as opposed to other forms

Structure of the Virtual Organization

- **Operational VO Structure:** Topology used for operating the virtual organization
- **VO Governance Structure:** Topology used for governing (decision making, negotiating rules) the VO (if different from operational structure)
- **Source Network for the VOs:** Underlying organization for forming VOs assumed by the project; topology and boundary criteria of the structure?

Business Processes

- **Processes for source network:** Models for processes (esp. management processes) for creating, developing and administering the underlying source network for VOs
- **VO Management Processes:** Models for management processes defined for creating, developing, controlling, and dissolving the VO
- **VO Operational Processes:** Models for the operational processes within the VO (e.g. product development, production planning and scheduling)
- **VO Support Processes:** Models for support processes within the VO (e.g. administration, finances, human resources). All process models should include the related information view and other views

Change in the VO and its source network

- **Change Patterns:** The typical forms of change for the VO and for the source network, such as lifecycle, evolution, design or negotiation
- **Preparedness for change:** The capabilities, investments and attitudes towards handling of change assumed for the source network, the VO and the individual company (relating to participating in VOs)?

Business Model

- **Risk and Reward Sharing:** Models for distributing risk and rewards within the VO and source network
- **Liability and Aftersales Responsibility (Guarantee):** Models for organising guarantee and aftersales for the VOs and source networks

Management Roles for the VO and source network: Roles consisting of a set of tasks, competencies, and power related to the creation, operation and survival/development of the VO and its source structure. The role can be taken by a single person or an organizational entity (partner, department, etc.) and be positioned at source structure, VO or individual enterprise level.

Project Acronym	Industry Application	Short Description
e-MMEDIATE	Fashion, Consumables, Automotive	The project redesigns existing business structures and procedures towards the shape of "smart organization".
PRODCHAIN	White Goods, Semiconductor	The project develops a decision support technique to analyse and improve the performance of globally acting production and logistics networks.
PRODNET II	Industrial Manufacturing	The project designs and develops an open platform and the adequate IT protocols and mechanisms to support Virtual Industrial Enterprises.
e-COGNOS	Architecture, Engineering	The project addresses electronic consistent knowledge management across projects and between enterprises in the construction domain.
ELEGAL	E-businesses	Defines a framework for legal conditions and contracts regarding the use of ICT.
GLOBEMEN	Manufacturing	The project defines the architecture for globally distributed product life cycle phases.
ICCI	Construction	Enhances the co-ordination of research and developments in Construction IT.
ICSS-BMBF	Construction	The aim of the Integrated Client Server System approach is the development of an integrated client-server system encompassing all team members in an entire building construction project.
ISTforCE	Construction Software developers	The approach provides a personalized human-centered environment, enhancing current, less flexible project-centered approaches.
OSMOS	Construction	The approach specifies a model-based environment where the release of, and access to, any shared information produced by actors participating in projects is secure, tracked, and managed transparently.
ProDAEC	Construction, Engineering, Software, Universities	The project sets up and sustains a Thematic Network for the European AEC sector that promotes the use and implementation of standards and best practices regarding product data exchange, e-work and e-business.
BAP	Project based businesses	The project facilitates the optimal design, efficient and effective operation and ultimate success of virtual enterprises.
BIDSAVER	Manufacturing	The project defines a framework for the constitution and operation of VOs.
E-COLLEG	Engineering	The project defines transparent infrastructure that will enable distributed engineering teams to collaborate during the design of complex heterogeneous systems.
EXTERNAL	Software providers and network	The project provides solutions that make forming an extended enterprise (EE), characterised by a dynamic and time-limited collaboration between business partners effective and repeatable.
FETISH-ETF	Tourism	The project explores methodologies to allow tourism organizations and enterprises to register their services in federations of services under a VE perspective.
GENESIS	High-technology	The project involves the adaptation and fine-tuning of the already available methods of the Value System Designer, towards the new class of users' needs.
GNOSIS	Manufacturing	The objectives are about the development of the Virtual Factory Platform.
MASSIVE	Moulds industry	The project develops an advanced layer on top of agile scheduling system prototype, previously developed, extending the system towards a virtual enterprise.
SYMPHONY	High-technology or service oriented	The project explores dynamic management methodology with modular and integrated methods and tools to support major management concerns.
UEML	Project based businesses	The project facilitates interoperability in the frame of on-going standardisation; define a core set of modelling constructs; demonstrate the concepts; prepare a

Project Acronym	Industry Application	Short Description
		project to define, implement, extend, the complete UEML.
VDA	Tourism	The project provides an extensive range of services and a dissemination platform in order to establish a one- stop- shop for the tourist customer.
VL	Experimental sciences Systems engineering.	The project explores necessary technical and scientific computing framework to fulfil requirements of several scientific and engineering application domains.

Table 1. VOSTER projects

The analysis of the above projects has been complemented by a comprehensive literature review targeting virtual organization research. The aim of this work is not to show the different regional approaches towards VOs, but to report about the findings of one of the European commission funded programs dedicated to VOs. The European perspective of the paper relates to the fact that the research has taken place in Europe as opposed to denoting a different conceptual or methodological approach. The conceptual framework underpinning the review is illustrated in Figure 1. The dimensions have been identified from both the literature review work and initial results from the VOSTER project. These dimensions have then been discussed and agreed in several research meetings.

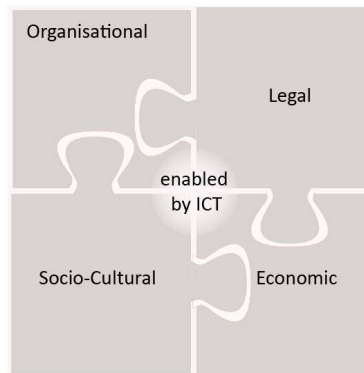


Figure 1. Research Conceptual Framework.

VIRTUAL ORGANIZATIONS TOPOLOGY

A major distinction between different virtual organizations is their underlying organizational topology, i.e. the structure of links between the different entities. According to Kürümlüoğlu et al. (2005), the structure of VO have been viewed using three different types of topologies:

- Supply-chain topology: VO in supply chain networks, which is characterized by hierarchical process models and can be described by widely accepted SCOR model.
- Star/consortia topology: Main contractor-driven project consortia: hub-and-spoke topology of a network. Contractual issues play an important role. This type of VO is characterized by more stable project teams, which are coordinated by one project leader (main contractor), who has administrative and financial power.
- Peer-to-peer topology: Project-based networks. These types of VOs are quickly re-assembled project organizations, which have a peer-to-peer topology of the network.

To support the analysis, the selected projects are distributed according to their topology and illustrated in Table 2.

<i>Supply-Chain Topology</i>	<i>Peer-to-peer Topology</i>	<i>Others</i>
e-MMEDIATE	BAP	ALIVE
PRODCHAIN	BIDSAVER	CE-NET II COVE
PRODNET II	E-COLLEGE	KM Forum
	EXTERNAL	NIMCube NGMS
		THINKcreative

<i>Star/Consortia</i>	FETISH-ETF
<i>Topology</i>	GENESIS
e-COGNOS	GNOSIS
ELEGAL	MASSYVE
GLOBEMEN	SYMPHONY
ICCI	UEML
ICSS-BMBF	VDA
ISTforCE	VL
OSMOS	
ProDAEC	

Table 2. VOSTER projects by Topology

ORGANIZATIONAL DIMENSION OF VIRTUAL ORGANIZATIONS

Virtual organizations rely on the wide use of ICT, nevertheless handling the barriers and limitations of organizational structure, decision making, and perception in relation to change are fateful. This section addresses apiece respectively.

Structure

Collaboration gives rise to the fundamental requirements of labour division into tasks and the coordination of these tasks. The structure of an enterprise is reflected in the ways in which it divides its labour into distinct tasks and then achieves coordination among them. Virtual organizations literature to date (Kürümlüoğlu et al., 2005; Rezgui and Wilson, 2005; Zigurs, 2003) and research carried out within the context of e-MMEDIATE, eCOGNOS, GOBEMEN, OSMOS projects, has focused on the necessity of restructuring traditional organizational structures to exploit the fast development of ICTs. In review of the substantial research on team structure in the traditional environment, coordination difficulties facing virtual teams have been found uncounted for. The related work to the structure of virtual working has put forward some suggestions attempting to achieve high team performance (Kaiser et al., 2000; Kaywoth and Leidner, 2000; McDonough et al., 2000; Workman, 2001). Yet, as managerial structures are associated with poor virtual SME alliance performance (Rezgui, 2007; Vakola and Wilson, 2004; Zigurs, 2003), the lack of structures handling virtual team working came under light. As such, the nature of the virtual organization alliance requires fresher approaches, thus providing fertile grounds for future research.

It emerges from the analysis of findings from the VOSTER projects that further research should address: what structural work arrangements are best suited to the work that must transcend geographical boundaries and time? How organizations effectively enforce these structures? What are the necessary abilities of the manager to facilitate communication among team members to create clear structures and foster role clarity to improve collaboration? Are there other strategies that organizations can implement to improve virtual team working performance?

Decision making and perception in relation to change

Organizations find themselves in an almost constant state of change as they strive to respond to the pressure of the increasingly globalised and competitive environment. Thus, quick decision-making and innovation activity in response to rapidly changing conditions and demands is necessary (Barrett and Sexton, 2006; Pawar and Sharifi, 2000). The creation and operation of the organization alliance is regarded as a change initiative within the participating organizations. Its members are likely to experience lifecycle problems— set up, operation, and winding down, where each of these different phases is likely to involve change in staffing, tasks, objectives and resources (Rezgui and Wilson, 2005). While most research (Barrett and Sexton, 2006; Pawar and Sharifi, 2000) and proposed approaches PRODCHAIN, e-COGNOS, ProDAEC in this area has been unable to break away from the traditional models. Rezgui and Wilson (2005) thoroughly reviewed existing barriers and argued for new approaches.

Future research in this area poses the questions of: what tasks enable perception, awareness, and preparedness to change? Do traditional managerial change mechanisms remain applicable in the virtual organization alliance environment? Either wise, what are the most appropriate change mechanisms? What business and organizational methods offer innovative and sustainable services along the collaboration? What formulas, depending on the nature and scale of the organization changes, are effective for decision-making? What is the necessary vision and systemic thinking required to manage the change lifecycle?

LEGAL DIMENSION OF VIRTUAL ORGANIZATIONS

A typical process in the virtual organisation is the removal or inclusion of participants. Virtual organisations involve cooperation between legally independent organizations. The fact that a virtual organization has a legal identity does not mean that claims cannot be addressed directly towards the members. However, claimants will probably suffer some difficulties in determining the exact identity of the different members because of the appearance of the virtual organization as one enterprise (Shelbourn et al., 2005). A group of researchers in the eLEGAL project implemented legal support tools and promoted an enhanced business practice in which the use of ICT in inter-enterprise information exchange is contractually stipulated. eLEGAL develops software tools for contract editing and configuration together with a virtual negotiation room. To this end, attention should be paid to liability sharing and distribution.

Organizations use of virtual business modes arises unanswered legal questions. The legal status still has to find a coherent framework and has not yet been adequately discussed. To ensure that organizations are efficiently supported along their virtual collaboration path to delivering innovative solutions requires addressing the following issues: How to manage intellectual property rights and cope with copyright and confidentiality issues? How to manage responsibility? How to share and distribute liability? How to monitor these throughout collaboration? How shared responsibility by means of rights and ownership of outcomes is identified? How these foundations can be blended together to generate the basic building block to deliver sound legal entity?

ECONOMIC DIMENSION OF VIRTUAL ORGANIZATIONS

The rapid pace of ICT has transformed the traditional economy into a smart new economy (Arnison and Miller, 2002; Walker, 2000). Pressures are forcing organizations to become more adaptive and agile in their tasks and adopt innovative approaches. As a result, virtual organisations have the potential to improve quality and performance and leverage capabilities (Lipnack and Stamps, 2000). Economic activity in this context means the cooperation of production ingredients to achieve competitiveness and maintain good cooperation between members of the organization alliance (Alsakini et al., 2007; Coulson and Kantamneni, 2006; Franke, 2001).

While a number of studies (Alsakini et al., 2007; Arnison and Miller, 2002; Coulson and Kantamneni, 2006; Franke, 2001; Helling et al., 2005; Lipnack and Stamps, 2000; Walker, 2000) and research carried out within the context of the ICCI, ISTforCE, BAP, BIDAVER, E-COLLEGE, EXTERNAL projects discussed the collaborative networks' economic dimension to enable organizations to realize the value of business innovation, the complex business environment poses persistent problems to organizations. From the economic standpoint, achieving competitiveness and maintaining good cooperation cannot depend solely on mutual faith. Research is needed to devise how to share profits and losses in the context of an organization alliance? How to ensure that the collective financial gain of the organization alliance outweighs the individual profits of associated member organizations? How organizations evaluate and determine the right economic costing in a consistent manner across the network?

SOCIO-CULTURAL DIMENSION OF VIRTUAL ORGANISATIONS

Socio-cultural barriers and limitations of maintaining virtual working teams are highlighted by integrating present literature and results from the field work that identifies the important socio-cultural challenges inherent to the virtual business mode including issues related to trust, social cohesion, team member structure – user / manager relationships, influences on the management and strategies.

The core of research arguments on trust centers on a belief that only trust can prevent the geographical boundaries and time zones of virtual team members from becoming psychological distances (Zigurs, 2003). Several suggestions to manipulate trust are present within related work from the literature (Arnison and Miller, 2002; Kayworth and Leidner, 2000; Kürümlüoğlu et al., 2005; McDonough et al., 2000; Rezgui, 2007; Rezgui and Wilson, 2005; Workman et al., 2003) and results from the projects (OSMOS, SYMPHONY). Yet, such trust albeit swift is known to be fragile (Hoefling, 2001; Mezgar, 2006; Wiesenfeld et al., 2000; Zigurs, 2003).

It emerges from the VOSTER project findings that face-to-face interaction has a direct impact on organisation performance through building team trust and enabling team members to exchange valuable socio-cultural information. Research stresses the need for initial face-to-face meeting to provide the grounds for a worthwhile ICT collaboration (Arnison and Miller, 2002; Kürümlüoğlu et al., 2005; Rezgui, 2007). Extending this idea even further, research suggests that virtual team members conduct periodic face-to-face meetings (Kürümlüoğlu et al., 2005; Rezgui, 2007).

It is essential that team managers play a pivotal role in favour of relationships (Arnison and Miller, 2002; Kayworth and Leidner, 2000; Kürümlüoğlu et al., 2005; McDonough et al., 2000; Pawar and Sharifi, 2000; Rezgui and Wilson, 2005; Yukl,

2002). Relationship management ought to influence a strategy that identifies and maintains relationships which in turn ensures that objectives meet expectations (Walters, 2000). The SYMPHONY project aimed to equip organizations with a dynamic management methodology to support major management concerns. Rezgui (2007) accentuated this issue calling for a certain shift in the leadership approach identifying the need for essential attributes.

Seeing the decades of traditional team working, the legitimate question posing itself here is whether virtual teams can function effectively in the absence of frequent face-to-face communication? Further research should address what facts pave the way to foster swift trust? How is trust maintained? What working infrastructures utilized by teams attempt to foster trust? Which, if any, team training accustoms expert team members in their fields to the particular requirements of virtual working? What can relationship management do to foster teams of mixed experiences? How would members relate and identify themselves to their manager in a virtual context? What are the qualities that a virtual team manager ought to have to cope with the complexity resulting from non-collocation and virtual collaboration including trust, lack of cohesion and resolving issues? In the worst case scenario, what requirements the team needs to benefit from the diversity and dispersion regardless of trust?

It is established from the analysis of findings from the VOSTER projects that organizational culture is a critical factor to hold virtual organisations. What remains unclear are how team members in a virtual context build, sustain and strengthen culture in the absence of frequent face-to-face interaction? How often should the team members communicate to remain glued? How to foster a culture of extensive collaboration? What behaviors inhibit a team's ability to develop a shared culture? What behaviors raise a team's ability to develop a shared culture? What current organizational culture circumstances hinder team effectiveness in the virtual environment? Can a set of cultural attributes that promote effectiveness of teams be identified? How can these attributes be effectively enforced in virtual organisations to ensure that members remain glued?

TECHNOLOGICAL DIMENSION OF VIRTUAL ORGANIZATIONS

As established in several VOSTER projects, including eCognos, Globeman, Prodchain, ISTforCE, a technological solution in the context of virtual organizations has to support the central business processes; allow integration of systems and interoperability between disparate applications; and the management of interactions between individuals and teams (Rezgui, 2007). A number of researchers have proposed to adopt approaches that federate services from various non-located organizations and software houses and making the applications they offer available via ubiquitous web browsers. This is commonly known as service composition.

As largely reported in the literature, web service composition is a very complex and challenging task. A number of key issues emerge from the literature as essential to support effectively service composition in favour of virtual team working, including: Coordination (to manage interaction between services and coordination of sequences of operations, to ensure correctness and consistency); Transaction (to manage short-duration / atomic and long running business activities); Context (to adjust execution and output to provide the client with a customised and personalised behaviour: may contain information such as a consumer's name, address, and current location, the type of client device, including hard- and software that the consumer is using, or all kinds of preferences regarding the communication); Conversation modelling (to facilitate service discovery and dynamic binding, service composition model validation, service composition skeleton generation, analysis of compositions and conversations and conversation model generation); Execution monitoring (involves either centralised or distributed execution of composite web services). On the other hand, existing web service engines are ill-suited to support the dynamic and changing nature of service environments. The paper argues that a number of key limitations emerge, which hinder full exploitation of web services as a promising middleware technology to support virtual team working, including:

- Existing service description and Web Service flow languages are ill suited when addressing the dynamics and non-functional characteristics of distributed business processes. The current Business Process Execution Language (BPEL) version does not support run-time alterations to address unforeseen problems, such as the replacement or addition of a new Web Service. In order to manage this uncertainty, BPEL processes need to have the ability to be extended to meet unforeseen post-deployment requirements and user needs.
- Web service flow engines, such as the ones implemented to support BPEL, lack execution monitoring functionality to manage the running process. These can help debug processes during development stage, with monitoring, and even be driven by agents at production stage. It is possible, for example, to embed, without modifying the engine implementation, a planner on the top of the latter. From events triggered by a monitor, this planner can take actions to avoid any disruption and to adjust the process. Such a tool can be useful particularly for long running processes.
- Web service composition methodologies have a focus on syntactic integration and therefore do not support automatic composition of web services. Semantic integration is crucial for web services as it allows them to (a) represent and reason about the task that a web service performs, (b) explicitly express and reason about business

relations and rules, (c) understand the meaning of exchanged messages, (d) represent and reason about preconditions that are required to use the service and the effects of having invoked the service, and (e) allow intelligent composition of web services to achieve a more complex service.

Also, long running virtual team processes are subject to evolutions and change of different nature: process model evolution due to change in the environment (change in the law, change in the methodology), process instance evolution (or ad-hoc evolution) due to specific events occurring during a given process execution (delay, new available or lack of resources) or partnership evolution at execution time having an impact on part of the process. These shortcomings require essential advances and improvements.

Also, VOSTER results suggest that new forms of software licensing are needed to provide a better software service that includes configuration, maintenance, training and access to a help-desk to ensure that SMEs are efficiently supported along their path to engage effectively in virtual teams.

CONCLUSION

This paper presented an overview of the key issues that must be addressed for the effective implementation of virtual organizations. Original motivation of the analysis in this paper was to review present virtual organization research. However, the lack of present research made additional research questions equal focus of the paper. The characteristics of virtual business modes suggest that the value-added alliance equation consists of a combination of technology, organizational, and ultimately legal and economic considerations. Thus, in researching, developing, and evaluating potential virtual organization solutions, these issues must be blended successfully toward the shared virtual organization purpose.

Given current limitations of virtual organisations research, the paper contributes to existing knowledge by raising a number of research questions related to (a) clarifying and defining the nature of virtual business modes that takes place amongst organizations, (b) specifying the technological, regulatory and socio-organizational environment to support virtual organizations effectively; and (c) researching into factors that facilitate virtual business modes adoption and use across organizations. Also, while existing research has provided little formalization of working procedures and managerial structures of virtual organizations, the paper calls for further research in (a) technology maturity and software provision models, (b) organizational and process settings, and (c) social, including socio-emotional considerations, adapted to the needs of organizations. Finally, the authors argue the case for the need to develop a business oriented social and organizational roadmap, aimed not only at senior management but all categories of staff of an organization. It is hoped that the paper will trigger further research that will contribute to develop a holistic understanding of the complex theme of Virtual Organizations.

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