Management and organizational topics in virtual enterprises – business drivers, characteristics and issues in collaborative environments

MEHMET KÜRÜMLÜOĞLU
Fraunhofer Institute Industrial Engineering
Nobelstr. 12c – 70569 Stuttgart
GERMANY

RITA NØSTDAL
Fraunhofer Institute Industrial Engineering
Nobelstr. 12c – 70569 Stuttgart
GERMANY

Abstract: - A large number of research initiatives and industry cases focusing on virtual enterprises (VE) or enterprise networks have been developed world-wide during the last years. This paper presents a synopsis of results from various research projects. Although the use of appropriate information and communication technology (ICT) is a prerequisite for and a critical element in efficient collaborations, human factors, organizational and management issues are still under development and further research on business drivers and success factors of virtual enterprises is required.

Key-Words: - Virtual enterprise, source networks, management concepts, collaborative business.

1 Introduction
Co-operation between enterprises or organizations is not a new phenomenon. For example manufacturing companies have been purchasing raw material, equipment and components from other companies. In some industrial fields, like construction, it has been typical to subcontract also part of the work / tasks to external companies, even within the same job site. This has happened far before the terms network and virtual enterprise (VE) or virtual organization were launched.

In the past years a large amount of new virtual enterprise concepts and approaches have been developed. The motive is based on the changing business situation of companies and customer needs. Main drivers for the rise of organization networks are mass-customization, extension of products, globalization, and agility [1]. There are basically two different types of concepts for the inter-enterprise organization. Different terms have been used for both of them:
- Network / source network / support network / breeding environment is a more stable, though not static, group of organizational entities which have developed a preparedness to co-operate in case of a specific task / customer demand.
- Virtual organization / virtual enterprise is a temporary consortium of partners from different organizations established to fulfill a value adding task, for example a product or service to a customer. The lifetime of a VE is typically restricted: it is created from the network for a definite task and dissolved after the task has been completed.

Both of these concepts thus presume the participation of different organizations, for example different enterprises. The main features distinguishing them are the temporal nature and the operational mode of the organization. A network operates developing, maintaining and managing the preparedness for value creation and setting up a VE for a customer delivery. The timeframe of the VE is restricted by its task it has been set up for, but may extend from a few hours to some years. As the base concepts have been developed simultaneously with the development of information technology, the utilization of modern ICT is often seen as an enabler for the VE. Figure 1 presents a description of the basic concepts and their relations.

![Fig.1. Basic concepts of virtual enterprises.](image-url)
2 Expectations and potentials in virtual enterprises
Collaborating in networks can be seen as a more systematic way to build up co-operation with other organizations. In companies it has been seen as an answer to tightening requirements of competitiveness relative to cost-effectiveness, time and quality. In addition it is expected that networking contributes to flexibility, agility, customer orientation and management of risks.

For complete comprehension of collaboration in the virtual enterprise, it is essential to understand the reasons and motives for the decisions to form co-operation or the building of a VE. Approaching business problems or seeing business opportunities – both can lead the way to the establishment of networks. The motives can come from within the company or from outside, for example internal cost problems versus new market developments. Reasons for collaborating in a VE may include [2], [3], [4], [5], [6]:
- Tie down resources which are hard to get on the market
- Save time, for example reducing development process, time to market
- Spreading costs and risks with partners
- Improving access to financial resources
- Benefits of economies of scale and advantage of size
- Access to new technology and new customers
- Access to new markets through partnership
- Access to innovative managerial practices
- Diversification, approaching new product or market segments with the help of partners
- Improve capacity utilization
- Know-how exchange and sharing of information
- Creation and exploitation of synergies
- Ease political tension (overcome trade barriers)
- Gain access to global networks

In most cases a mixture of these will be the driver for operating and doing business in networks. But the partners’ reasons do not need to be the same. This leads to different expectations on all sides of the partnerships. Therefore the definition of the goal of the alliances is essential to the success and the satisfaction of the enterprises involved. There are competitive goals like cost saving, outrival competitors, influencing structural evolution of the industry or the creation of stronger competitive units. Strategic goals can be the creation of synergies, the transfer of technology or diversification.

Potentials of networks are not self-fulfilling; they must be developed and fostered. Thriving on the virtual enterprises necessitates an efficient management of collaborative tasks and business and a basic, common foundation of the virtual organization.

3 VE basic concepts
Within the VOSTER project [7] more than 60 national, European, and global research projects (incl. IMS), as well as US research and road-mapping activities (IMTI and FIATECH) with focus on state of the art approaches and concepts of virtual organizations/virtual enterprises have been analyzed and consolidated. The main purpose of surveyed VE concepts is to understand the basic elements in the co-operation between enterprises.

The level of preparedness of a network and the tightness of the linkages between the organizations may vary, ranging from an almost open market setting with just some knowledge about the entities between them to entities within a large company or other organization. The preparedness includes defining core competences, harmonizing procedures and interfaces, creating and sharing common knowledge etc. The preparedness makes it possible to set up a VE quickly and operate efficiently over organizational borders. To achieve the preparedness an investment to the network development is needed. In case of different companies the co-operating network can be called an “enterprise network”. Other terms sometimes used are enterprise constellations and enterprise associations.

The practical purpose of concepts has in many projects been the business process redesign in the inter-organizational environment. Different projects have addressed different product life cycle phases, different environments and different issues (organizational, human, business, legal, ICT).

Many surveyed research projects present the expected benefits of operating in VEs compared to more traditional forms. It is not analyzed if there are differences between the divergent (outsourcing) and convergent (coming closer) creation of VEs. The implementations do not go far enough to get empirical data of the benefits. As the objectives of the projects have mainly been in developing the tools, processes and methods, there is no sufficient analysis of the prerequisites, realization or dependencies of the success factors in the projects. Thus it is not possible to make a synthesis of them based on the cluster projects. A critical study of the success factors and business drivers of VEs can be seen as a requirement for further VE research.

3.1 Management concepts for source networks
The main process considered at the source network level is the inclusion of a new partner to the network
(rules, policies, tools). Typically in the industrial cases researched in the VOSTER project the source network has already existed at some level of cooperation and thus there has not been a need to create the network from the beginning. Another process is the development of the network preparation: procedures, tools and services for the existing network. Product development within the source network is also mentioned.

Nearly all the surveyed projects address the development of information sharing and ICT infrastructures at the source network level. Typically web-based tools and services like organizational models, cost and performance monitoring, have been created for sharing different kinds of information: documentation, product information within the total life cycle. In addition the support for teamwork, design, partner management and tools have been developed.

The main modifications for the implementation of VE management concepts for source network of the VE were the redesign of business processes, organizations and roles, human resource development and dissemination of quality standards. It has been clearly understood, that it is not enough to develop the IT tools, to make them beneficial also process improvements and redesign are needed.

3.2 Management concepts for virtual enterprises
At the VE level the processes considered are set up and configuration of a specific VE and operation and management of VEs (including project management). At this level information sharing is developed for a specific task and VE; supporting also the coordination, people and relationship management. The modifications needed are similar to the source network level: socio-organizational, process and technological redesign. Evaluation and dissolution of VEs were only minor issues.

3.3 Organizational concepts in virtual enterprises
Concerning the VE operation there is an overlapping with the VE management. This relates to VE phases, the modifications required and ICT infrastructures. The operational processes considered cover the total product life cycle from sales and marketing, product development, engineering, manufacturing (including scheduling and order management) to product operation, service and renewal.

A special question analyzed within VE operation was how individualization correlates with VE operational processes. The main forms of individualization are the mass customization and one-of-kind products, in which not the same resources and capabilities are needed in each project. Thus the VE must be configured separately for each case. In addition individual considerations are needed in different market areas and regionally and culturally distributed environments. The analysis does not clearly explain how these one-to-one features are handled in the surveyed concepts, but probably they must be taken into account in the configuration phase of the VE.

4 Common issues in virtual enterprises
One of the most debated questions about virtual enterprise is “What replaces hierarchy”. As far as the analyzed partnership is a co-operative organization of parity, the linking type is contractual and every hierarchy is banned. The agreeing on the same policy mostly consists of mutual support and advantage, therefore the alignment of actions and stated values requires a common agreement, even if not always completely explicit.

Hierarchies should not exist among the collaborating partners because [8]:
- Hierarchies tend to build barriers between functional areas, so that a cross functional communication raised in one branch, is channelled into the bottleneck of the high level hierarchical branch and only then can flow down the other branch.
- Hierarchies tend to filter and distort information as it is passed upward
- Hierarchies tend to create rules and controls that increase complexity. Often the hierarchies multiply themselves creating obsolete heavy mechanisms that are against the peculiar agility of the VE
- Teams close to the customer know what actions to take to delight the customer; higher management does not. Teams doing work know better than anyone else how to improve the work process.

Due to the special multi-site configuration of the VE, some additional issues in the collaboration can occur. As found in literature and in previous researches [9] associated to a distributed collaboration (geographic and cultural distances) there are some typical situations that can be avoided with simple advices. A preliminary categorization of the issues are people, technology, process and context. The first ones are the issues due to Human Factors: maturity, experience, culture. The issues related to the behaviour of mangers, employees, and people in general and are the most difficult to solve. Only a slow, evolving process can change habitudes and let working cultures grow together.
The issues due to technology often relate to the tools utilized by the collaborators. The development and utilization of ICT is a critical element in the current networking. It can be seen as an enabler for distributed co-operation - even if its potential is currently still underused. Incompatibility of data formats, non-availability of network links, different platforms, can not only slow down the processes – the bottle neck is in the data exchange, so in communication – but also can lead to errors – like approximations and losing of information.

The issues related with processes are often found in particularly complex collaborative processes. The main issue in this case is the co-ordination. Bad timings, not clear operations, incompatibility and low interoperability always lead to delays and additional costs. Often a common planning is missing, so the need of a common project management and project strategy, becomes vital.

Adding to these problems there are all the issues due to the context, less controllable but often foreseeable. It is about the market stability, the demand fluctuations, but often the problems are still into the companies, like structural problems and lack of resources. The context in this case is no more external but internal and maybe within the VE.

The most common issues in collaborative work are discussed below [9]:

**People issues:**
- Unaccustomed to teamwork: Team members may be experts in their own technical fields but unaccustomed to the particular requirements of collaborative work. Building teams of mixed experiences, special team-trainings and support from team externals in early phases are adequate countermeasures.
- Different management styles: If management styles don’t fit, dysfunctionalities must be expected. Identifying and understanding of differences in management style is the basis for evolvement of common culture and decision making. Oral or written agreements widely communicated supports the acceptance of a joint decision culture.
- Team building: The difficulty of tracing the boundaries of a team and its tasks can lead to various problems. Teams and tasks are often not defined well enough. A successful team needs a set of common goals and values, shared responsibility, relationship and trust. Ensuring a shared vision, providing an adequate infrastructure and an accurate selection and assessment of the team increase team.
- Cultural and language barriers: A feeling of discomfort and distance increased by language barriers. Different professional cultures, different corporate cultures, nationality barriers are often a problem. Promoting team awareness and support of adequate communication media should help to establish a “team climate”. Shared values of each of the cultures; finding a new team-based culture, use of agreed codes, protocols, and cross-cultural training are further means to overcome cultural barriers.
- Team trust: One of the most difficult issues to be obtained within collaborating people. A lack of team trust can lead to information hiding and stop in communication. Trusts tends to be built over team performance. Face to face meetings can consolidate the team trust at the beginning of the project, when significant personnel changes, or for critical decisions.

**Technology issues:**
- Data compatibility: Distributed information can often not be used because of format incompatibility. Many costless software can transform the data produced into files of a standard format (pdf, html, java). A minimum hardware support is needed. As migration to new standard may be costing, format translators can be found in commerce.
- Availability of appropriate communication networks: Slow and inappropriate networks are one of the greatest lack in collaborating companies. The problem issue becomes a problem of cost and planning of a reasonable commercial solution, in order to ensure the respect of all the requirements. The solution covers both the infrastructure and the work structure planning.

**Process issues:**
- Project complexity: The project articulation can leave out some responsibilities and the horizon of the task can be too wide. Often the project status and the progress are not clear. Communication lacks are very sensible. A good communication structure can support difficulties in complex projects. The use of a forum with a dedicated “war room” can be set up. In this forum the status, the progress and all the changes are regularly updated.

**Context issues:**
- Different Working practices: Some of the behaviour found in distributed teams arising from local conditions require management strategies. A lack of a strategy to handle working practices may lead to emphasize the national and cultural barriers. The strategies should be documented and available to all the team members. Study the probable workflow and optimize the working practices.
- Resources: The availability of skilled workers, adequate time to undertake tasks and an appropriate communication infrastructure are the most important resource issues. In the planning phase it is essential to consult people experienced in multi site-operations, so that they can provide realistic estimates of the resources that will be needed.
- Industry stability: Turbulence and transition in the industry can seriously hamper multi-site operations, especially with international collaborating groups. It is important to maintain trust within the team during periods of instability. Good communications should be ensured and a equitable distribution of power.

- Insufficient corporate structures: The maturity level and the structure of the companies affect the good project behaviour. The use of project oriented teams, but above all project management solutions in order to establish an order in the organizational structure.

5 Management areas in virtual enterprises

A recent case study research [10] shows typical management topics in collaborative environments and allows deduction of the relevant management areas. Topics covered in the case study include the strategic backbone of the collaborations, overall collaborative business processes, collaboration mechanisms, structures and procedures for knowledge transfer as well as problems encountered during the collaboration. The analysis of the interviewed networks highlighted typical problems for the management and operation of critical issues in different thematic areas [10], [11]:

- Integration strategy: The main finding is an overall lack of a common strategic approach and of a formal agreement that establishes the sharing of benefits and risks between partners.

- Collaboration: Language and cultural issues play a fundamental role: different languages and working cultures can hinder the daily activities. Difficulties in establishing a community spirit and in changing from a competitive attitude to a collaborative one. For VEs as well as for global organizations there is an increasing need to get groups of people sometimes from different nationalities to work together effectively either as enduring management teams or to resource specific projects addressing key business objectives. The cultural management in VEs has the tasks of building awareness of the cultural differences, developing knowledge about the impact on the business of those differences and - most important - building skills to over-come cultural caused problems and to benefit from the cultural diversity.

- Knowledge sharing: No knowledge management strategy is currently performed in any of the analyzed case studies; this implies a dispersion of distinctive know-how and competences and difficulties in the exchange of information (the excess of paper based information flow). An effective knowledge/information transfer can only be achieved by different coherent means: the fostering of relationship and trust building, the activation of formal communication channels in parallel with informal ones and the overcoming of rigid hierarchical communication procedures. VOs still experience the lack of adequate tools for knowledge/document base management and an excess of paper based information flow. One of the possible reasons to collaborate is to gain knowledge the partners already have, so to complement each other by collaborating. The knowledge transfer is therefore especially in technology intensive industries of essential importance. The learning capacity of organizations becomes a sustainable competitive advantage.

- Technology and Information Technology: In this area the necessity of bridging the gap in technical expertise, technological infrastructure and IT tools (software integration and compatibility) is the first need of each virtual organization. The partners need the same or similar technology levels for all relevant interaction areas. This covers collaboration/communication tools, project management tools as well as logistic-supporting ICT-systems. Best and up-to date communication, knowledge exchange and development tools available, accessible and exchangeable for every team member. Highly educated employees at all partners are essential for successful collaboration.

- Organization: Different standards for production and product development technology within VEs are a frequent source of inefficient processes and redundant work. Need for common working procedures and wide cross-organizational labour mobility aiming at assimilating common practices. Legal and organizational structure should be clear and should not give cause for misunderstandings. This includes the legal structure of the VO and the operational management of the day-to-day tasks. Organization includes the implementation of coherent and common management procedures strategic aspects and operational management and collaboration.

- Logistics: Lack in common planning and warehouses managing, difficulties in coordinating and tracking deliveries.

- Project Management: A strong necessity of improving co-operation and project management processes has emerged, due to insufficient visibility on partner’s activities and lack of inter-functional coordination.

6 Conclusion

In the context of inter-enterprise co-operations, there exist two basic types of concepts ‘network/source
network/support network/breeding environment’ and ‘virtual organization/virtual enterprise’. Most of the analyzed research projects/initiatives/etc. has focused on the development of methods, tools and infrastructures for specific business processes, starting from an existing network and focusing on the creation and operation of the virtual enterprise. VE concepts and approaches for the evaluation phase and dissolution phase of virtual enterprises was not main focus of research. There is not sufficient analysis of prerequisites, realization, or dependencies of the VE success factors. A critical study of the success factors and business drivers of virtual organizations can be seen as a requirement for further VE research. As a final conclusion, there are still many open questions and research needs in the field of virtual enterprises.

References: