

Crossing Learning Boundaries

The Utility Related Virtual Organisation ISES

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Abstract

Due to changing circumstances, organisations start to co-operate with their competitors or with firms from other industries that can complement their range of products. This development of independent partners sharing, their resources and equipment with each other, can also be seen in the Swedish utility industry and will soon happen to other utility businesses after the deregulation of the European utility industry has become a fact. The co-operation can be seen as a virtual organisation and this research project investigates how virtual organisations operate and how partners establish and maintain such an organisation. For this reason the R&D virtual organisation ISES, formed by the utility related joint venture EnerSearch AB, is taken as a case study. When comparing a virtual organisation with traditional organisations, five boundaries are presented that can both create and inhibit learning and communication. Since learning can be viewed as a major objective of a virtual organisation, the five boundaries are discussed in more detail and are related to empirical results in the project ISES. These boundaries are time, space, diversity, structure and distribution and are characteristics of a virtual organisation. By observing this organisation, opportunities and obstacles of a virtual organisation are found that could help organisations who would like to establish a virtual

organisation. One example is the difference in decision styles or personality of the members of a virtual organisation, which influences information distribution, communication and co-operation.

Keywords: Virtual organisations, interorganisational learning, R&D, communication and information distribution, decision styles.

Deregulation opportunity

The utility industry within most European countries will be deregulated within a couple of years, or has been deregulated recently. In Sweden, the deregulation of the utility market has already started and competition increases between the utility providers. In Sweden, utility providers are buying competitors or are being bought and mergers take place, in order to create a better market position in the northern countries. However, not only take-overs are performed, also other organisation structures are tried out. Several utility providers now try to combine their resources with competitors and other lines of businesses in order to produce and offer a more complete product or service that fulfils the customer's wishes (e.g. a computer system steering the electricity use of one household). These co-operations can take place in several areas. In Sweden, Sydkraft AB (Utility Provider) and IBM Utility have formed a joint venture, EnerSearch AB. Not only Sydkraft is using this strategy to improve its market position, also other utility providers plan to co-operate with competitors and companies that could complement their range of products. When the European utility market is deregulating, industries and utility providers from several countries could benefit from a co-operation where research and development is combined and where partners can use each other's resources. The advantage with this kind of co-operation is that partners are still independent and only share resources to the point they agree. This co-operation can also be seen as a virtual organisation and has only recently been introduced in the European utility industry.

Empirical research

In this article results of an empirical investigation performed in the virtual organisation ISES (part of EnerSearch AB) in Sweden are presented. The research focuses on how the organisation operates and how it develops over time. Several important opportunities and difficulties arise in a virtual organisation that were not foreseen and that are hardly addressed in existing literature. The found results are presented in the article and could be of help to utility providers who consider to establish a virtual organisation or to those who already participate in a virtual organisation. However, in order to understand the investigated situation, the organisation EnerSearch is discussed in more detail.

The organisation EnerSearch AB, is a joint venture focusing on research and development. EnerSearch AB is owned by the utility provider, Sydkraft AB (50%) and the IT company, IBM Utility (50%). EnerSearch establishes several projects who are financed partly by her owners and by several sponsors. These sponsors are utility providers from Germany, France and Belgium and utility related companies like ABB Network Partners. EnerSearch AB started a large research project called ISES, *Information Society Energy System*, which does research and development on two-way communication on the electricity grid from the utility provider to the customers (customers can be private households, municipalities and companies). In order to reach this goal, nine subprojects are established, in which research is done how to deal with the technical applications (computer science), the customer side (interactive behaviour) and with the infrastructure (enabling technology) necessary to obtain a two-way communication means over the electricity network. The nine subprojects are the following. **Interactive Behaviour:** New Business Strategies (1, numbers correspond with figure 1), Virtual Organisations (4). **Computer Science:** Databases and Structured Documents (3), Distributed Load Control (8), Robust Distributed Decision Islands (9). **Enabling Technologies:** Global and Local Communication (7), Energy System Control Technology (6), Customer Interactive Interfaces (2), Energy Systems Cost Optimisation (5). All subprojects have a specific task, but together they have to

reach the aforementioned common goal. Therefore, the subprojects have to co-operate in order to reach the target within the stated time-limit. The participants of ISES are geographically dispersed. This distribution is not only within Sweden, but also concerns other countries, e.g. the Netherlands, France, Germany and USA. Furthermore, participants come from different disciplines (technical and organisational disciplines) and have this affects their way of working, e.g. different jargons. Most sponsors have a member working in one of the subprojects as a contact person between the researchers and the sponsor company. Besides these contact persons, most members are PhD students from different universities involved in the research (see figure 1).

Being part of one of the nine subprojects (project 4, virtual organisations) which deals with the interactive behaviour and organisational issues, my research is concerned with investigating the project ISES as a virtual organisation. Matters that are investigated within my project are e.g. how one can manage the virtual organisation where its members are geographically dispersed (HRM matters), how one can stimulate co-operation and communication between the members (or subprojects), how does one deal with distributing the results within the virtual organisation, to the mother companies (owners and sponsors) and to the clients of the mother companies. The research is a longitude research and started last year with the foundation of the organisation ISES and will last until the organisation diminishes (over 2 years). In the organisation, action research is performed, since I am part of the organisation as a member and co-ordinator. One could view my role within the project as observer, consultant and participant. In order to gain information from the organisation, interviews, questionnaires, team-building meetings and other informal meetings between the subprojects and the sponsors have been performed. Since the investigation only started last year, only limited results are available at the moment.

Figure 1: *Virtual organisation ISES (Information Society Energy System)*

The article is organised as follows. First the notion of virtual organisation and strategic alliance are discussed in more detail in order to understand the type of organisation we are dealing with. Several learning boundaries are described that occur in virtual organisations. These boundaries are related to the empirical findings of the virtual organisation ISES and both obstacles and opportunities are presented based on empirical material, logical deduction and literature.

Virtual organisation

When discussing the notion of virtual organisation, often strategic alliances are compared with this form. The strategic alliance can be viewed as the predecessor of a new term in organisational theory, the "virtual organisation". The virtual organisation is a co-operation between several independent partners (companies or individuals), who share their resources, skills and knowledge in order to produce a "best" customer solution [4]. The extensive use of information technology is one of the characteristics of the virtual organisation. With help of new developments in communication technology, e.g. e-mail, internet, www and video-links, partners from several countries or places can combine their strengths to produce a service or product. Furthermore, the virtual organisation is often characterised by the fact that its members are distributed geographically and communicate with each other via information technology. This aspect causes that members have less personal contact compared to a traditional organisation where members are situated on the same location. Depending on the tasks performed in the organisation and the members participating, the organisation form can be a short term project, but could also stretch over several years.

Learning across boundaries

A virtual organisation is a combination structure consisting of new and disbanded boundaries, co-operation and competition at the same time. Forming such an alliance can be viewed as a renewal process for the partners involved, where new rules are developed between the partners, in interaction with each other. This means that an involved organisation's stated boundaries and hierarchical structure between partners is no longer valid. Partners have to define new management philosophies, organisation structures and patterns of interaction and co-operation between the partners. An alliance may not only be a means for trading access to each other's skills (quasi-internalisation), but also a mechanism for actually acquiring a partner's skills (de facto internalisation) [7]. Here organisational learning plays an important role in internalising each others knowledge. Since, in a virtual organisation several partners can learn from each other in the organisation, the term interorganisational learning is used to describe learning which occurs within the virtual organisation and between the members participating. These participants could be the independent companies who finance the work, but could also be the members who perform the tasks within the organisation. Global competition highlights asymmetries in the skills endowments of organisations. However, collaboration might provide an opportunity for one partner to internalise the skills of the other, and thus improve its position on the market both within and without the alliance. Parkhe defines the strategic alliance as voluntary interfirm co-operative agreements, often characterised by inherent instability arising from uncertainty regarding a partner's future behaviour and the absence of a higher authority to ensure compliance. This self government complicates the aforementioned relationships, since mutual co-operation is not automatic [13].

Most co-operation is based on economical or social exchanges in order to increase each other's results. The relationship between partners continues as long as all partners can benefit from the co-operation [1,7,8]. Some of the structural changes in the co-operation are a radical decentralisation of tasks, power and responsibility. Especially, the employees gain more responsibility in order to make their own decisions and increased interdependency arises. To form a virtual organisation with other organisations and in order to co-operate, organisations have to cross boundaries. These boundaries are not only physical boundaries, but also personal, hierarchical, cultural and practical boundaries. In the co-operation, people with different backgrounds, cultures and nationality are combined and are supposed to work together. One could state that the aim of combining strengths and resources in a virtual organisation, is to learn from each other's knowledge and expertise. However, learning in a virtual organisation is complicated by the boundaries of space, diversity, time, structure and distribution. In order to co-operate and combine resources members have to learn across the boundaries within the virtual organisation. The five boundaries are derived from literature, logic and empirical research.

A possible future scenario for economies consists of co-operations with autonomous partners and competitors, where partners hire expertise in order to fulfil their stated desires. This means that more and more virtual organisations will arise. This increase in virtual organisations will also be seen in the utility industry, especially when competition strengthens because of the utility deregulation in Europe. Therefore, it might be interesting for companies to know if a virtual organisation will increase their market position and if partners gain a synergistic effect of the co-operation. Furthermore, it could be interesting to know how one should deal with such a partnership and how one can manage it. In order to state if a virtual organisation is successful, obstacles and opportunities of a virtual organisation should be taken into account. With help of these matters, organisations can understand what kind of aspects could be important guidelines in order to establish their own virtual organisation. The opportunities and obstacles mentioned below are based on the empirical work within ISES and consider the five boundaries of time, space, diversity, structure and distribution. These boundaries can inhibit personal communication and interorganisational learning, but within ISES one tries to counter effect these boundaries with team building meetings, empowerment of the participants, an internal information system and a guiding or supporting management style. These aspects are discussed in

more detail below, where not only the opportunities of the virtual organisation are presented, but also obstacles that are found during the development process. Although most of the results are based on the case study ISES, the aspects found are also applicable to other virtual organisations.

1. Boundary of space

Participants working within a virtual organisation, often work geographically distributed. People from different locations are combined in one organisation and try to co-operate. This co-operation is often performed via information technology, since participants can also work on different times. In order to perform research within a project so that a final product can be made, people have to communicate. This communication is decreased because of the geographical distribution in space and this can have consequences for the learning abilities within a virtual organisation.

The boundary of space in a virtual organisation is an important aspect, especially when participants are dependent on the expertise of others. For this reason it might be more suitable that participants are located in the same place, but due to circumstances (e.g. to long distance, other responsibilities, short term project) members prefer to communicate via IT over a distance. Within ISES, some information technology tools are tested in order to decrease the learning boundary of space between the participants, e.g. a brainstorming tool and a file sharing tool. Important is that members are motivated to work with these tools in order to increase communication and information distribution. One subproject in ISES is working on the problem of how to store and retrieve all information within the virtual organisation. This group is working on an active information system where the information is steered actively by agent technology. Unfortunately, this has not reached the development phase yet and members still communicate mostly via e-mail, phone and face-to-face. From a questionnaire performed within the ISES organisation, it appeared that members do not feel that these tools are sufficient, although they spend too much time on them. Although the information richness theory which will be discussed below, states that complex matters, e.g. research, should have maximum sensory richness like in face-to-face meetings, the ISES members prefer to use both a rich and a less rich mode for their communication, see table 1 [5].

	Preferred	Used	Received	Want
Face-to-face	5.7	4.8	5.3	4.9 - more
Phone	5.0	5.2	5.4	4.4 - more
E-mail	6.3	6.4	5.7	4.4 - more
Fax	3.8	4.6	3.0	3.5 - less

Table 1: *General Ratings of communication modes by ISES members*. Scale used is from 1-7, where 1 is the lowest and 7 the highest score [5].

Within the virtual organisation, communication often exclusively occurs via information technology and this is often not sufficient for a close co-operation and synergistic effect of combining several strengths together. Intense communication between people is important in order to reach the stated common goals or strategy. For this communication, direct relationships and information sharing between individuals, irrespective of their role, status, level, function, culture or location should be achieved.

Within the project ISES, people do research on unexplored fields and have to communicate in order to reach the stated common goal. Most subprojects are dependent on the results of the other subprojects and therefore it is important that during the whole development process, participants

communicate about the choices they make and the results they find. One can state that the product of ISES is research and that it is non-routine, non-standardised, personal and often very complex for outsiders. According to the information richness theory of Daft & Lengel [3], research should be communicated personally. Complex and personal communication is best received via a rich medium, this means that face-to-face communication and the telephone are appropriate means for this. However, since participants are distributed geographically and do not meet regularly, it is difficult to make use of rich media in order to communicate. For routine communication like reports, a less rich medium is required, like e-mail or fax. Within today's business, e-mail is used more often and people have to learn to deal with the different way of communicating with each other. Some people have more difficulty than others to change their behaviour and therefore it is important that within the virtual organisation participants make clear how they want to communicate with each other. It is recommendable that people meet regularly in order to learn to get to know each other, to discuss the common goal and the way how to get there, to start co-operation and learn from each other's expertise. For participants who have problems in meeting in person regularly, because of the geographical distance, video conferencing could be a solution. Emphasis should be put on the fact that if people want to co-operate and work on complex and new matters, close co-operation between members with different expertise is important in order to gain the stated goals. Within ISES team-building meetings are held in order to get to know the members. However, members are fluctuating, depending on the time they finish their tasks or contracts. For this reason it is difficult to keep up with the changes and members have to be presented to each other regularly.

2. Boundary of diversity

Often participants in a virtual organisation come from different disciplines (within the ISES case the disciplines are within: computer science, human work science, organisational science and marketing), since together they can perform and learn from each other's experiences. Within EnerSearch the participants working in the ISES project come from different disciplines (technical and organisational science), different countries (thus different language and culture) and different companies. A difference in discipline can make it difficult for people to co-operate, since members have another way of thinking about a certain problem and define it in another way (jargon). Furthermore in ISES, organisational science members had difficulty in understanding the way of thinking and argumentation used by technical people and the other way around. On the other hand the difference in discipline and culture can also work positive, since people get a different insight in problems and aspects, due to different backgrounds. Within the ISES project, the differences in discipline, culture and nation are decreased through team-building meetings and informal meetings between several members. Participants who are in need of expertise and/or results of other members, arrange informal meetings (where one gets together on a single location) where they discuss the development process of their research. In these meetings one has the possibility to explain in more detail the results, jargon, and other differences that could influence interorganisational learning and co-operation. Unfortunately not all diversity problems are solved by introducing these meetings. From the questionnaire it was found that group interaction was below the median rating of 4 (on a scale of 1-7, where 1 is the lowest and 7 the highest), ISES as a whole was rated at 2.7, and the subprojects' interaction was 3.7. The desired level, however, was rated much higher, 5.4 for ISES and 5.3 for the subprojects [5].

Another aspect that should be taken into account when discussing diversity is the fact that people have different personalities. Every person has a unique combination of nation, skills, education and culture and this influences one's decisions and way to work. Not being part of the same organisation means that the participants have not been recruited on the same way as in traditional organisations. In traditional organisations one recruits people in order to fit the company's social life, culture and often nation. However, in a virtual organisation this is not the case, since people are chosen on their expertise and are located at different places in different countries.

The diversity in personality of the members can be both an obstacle and a positive factor for a virtual organisation. However, in the ISES project the diversity in personality is seen as very positive, since members can add different qualities to the organisation. Since the members and their skills are one of the most important assets of a virtual organisation, it might be good to understand and know how these members prefer to communicate, make decisions and what kind of information they need for making decision. For this reason the ISES project makes use of the Dynamic Decision Style of Driver, Brouseau and Hunsaker [5]. This theory states that every person has its own cognitive style to make decisions, and these styles affect one's way to deal with information, people, systems and data. The authors have defined five decision styles that describe people's behaviour in certain situations, depending on the load of work and amount of information needed to make decisions (see figure 2). This can be used to increase the team spirit and can help co-operation. Due to differences in personality or decision style, people also view the organisation and their research tasks in another way. This means that some members would like to have a rather specified job description where rules and routines are defined clearly and where the responsibility of management and the members is clear. However, on the other hand there are members who rather work individually and who feel empowered to make their own decisions and they define their own way of working. It is not very easy for management to address all of these different requirements and therefore a middle way has to be found. On the one hand members should be empowered to make a large amount of the decisions concerning their own task, on the other hand, certain rules and annual reports might be necessary for management in order to justify financial aids in the project.

Hardly any person has just one decision style, but often several styles are seen, depending on three aspects: a) the amount of work/time one has. With little time, people tend to make decisions based on little information. b) people have two behavioural patterns, in one pattern they behave according to the formal and informal rules of society (how one is supposed to act), this is called the role style and c) the second style is when people behave as if they were all by themselves and do not have to think about rules how to behave, this is called the operative style and is mostly seen when people are alone or with good friends. By understanding the decision styles of the members it is easier to deal with them and send information tailor made to that person. Furthermore, management could benefit from knowing and understanding the decision styles of its members in selection and matching of different styles of members who can work together [5]. From the questionnaire held in ISES it became clear that people with a similar style could co-operate better. Reciprocal relationships in a unit relate to having high information use people in pair. While non-reciprocal relationships within a unit are related to pairs with one high and one low information use style [5]. Within ISES the decision style of every member has been analysed and is discussed on the team-building meetings. On these meetings the different styles are presented and also ways how to deal with these styles is performed.

Information Use			
	Satisficer	Maximizer	
Tough Controls Environment Persistent Uni focus Focus	Decisive Candid Loyal Tense Efficient Bottom-line	Hierarchic Serious Methodical Solid values Quality Oriented Logical Visionary	Systemic Serious Contemplative Complex Global Thinker Strategic, Over-arching goals
Multi focus Open Adapts to Environment	Flexible Adaptable Intuitive Sociable Agreeable Varied Changeable	Integrative Team Oriented Creative Exploratory Tolerant Diverse Interests	Process & Methods Multiple, prioritized solutions aimed at "Big Picture"
	Action oriented, fast	Thinking oriented, Analytical	

Figure 2: *The Dynamic Decision Style Model*, by Decision Dynamics Corporation 1992 [6]

3. Boundary of time

The opportunity of working with IT is that members of the virtual organisation can work whenever they want to and where ever they want to, irrespective of different time zones (e.g. members of ISES are working both in the USA and Sweden). This means that members can work irrespective of time and space, and this could complicate personal contact and communication in the organisation and could decrease interorganisational learning.

4. Boundary of structure

Participants in virtual organisations often come from different organisation structures. For some members conflicts can arise due to working in an organisation structure not familiar to the member. Within the flexible and dynamic research project ISES, some members come from bureaucratic

organisation structures that can give differences in perception, rules and definition of the work procedures. When one combines members from different organisations, one also combines different perspectives of how an organisation should perform. Some might see the organisation as bureaucratic with rules, forms and routines, while others view the virtual organisation as flexible and where members have a lot of empowerment. This difference could influence interorganisational learning.

Management

Another aspect important to mention under the boundary of structure is the style of management that is performed within a virtual organisation. Management should be able to combine the differences in diversity and organisation structure, in order to make the virtual organisation reach its target. The members in a virtual organisation are often distributed geographically and perform their work individually, but their work is combined with the work of other participants so that the stated goal can be reached. For combining the research results, methods and ideas of the members of a virtual organisation, management is important. Within ISES, management has developed towards a supporting role, where the CEO stands for stimulating participants and their work inside and outside the organisation and where co-ordinators are appointed out of the members. The CEO has the overall responsibility of arranging finances, final reports and discussions with the board of directors (board of directors consists of sponsors of ISES). The co-ordinators have a more personal contact towards the research participants in order to solve practical problems and increase team spirit. In general one could state that management's role is to stimulate the co-operation between the participants, so that the final product is reached. Furthermore, management has to make sure that participants work towards a similar organisational goal. Besides this stimulating role, it is important that someone deals with the general communication towards participants, this means communication about routines, rules, final reports, new members and about finances. Also in a virtual organisation, certain routines and rules are necessary in order to have some clarity for the members.

Management does not only have an internal role, but management is also the messenger towards the mother companies or the sponsors of the project and in this sense the manager becomes more a controller in the traditional way. The management has to see to it that the participants in the virtual organisation live up to their expectations. Participants in the organisation are often chosen because of their expertise and if they do not fulfil the task stated for them, the organisation suffers from this. Within the virtual organisation ISES there is a strict time-limit and this should not be delayed by bad management or delay from participants, therefore it is important that management performs a controlling function. Management should have a clear role in focusing on the assignment and the target that should be reached. Participants in the subprojects have annual sponsor meetings where the results of the research are presented and discussed with the sponsors. Furthermore, the sponsors also obtain all publications written and book personal meetings with the member that can help them within their organisation or the other way around. The members of ISES are dependent on the skills, resources and finances of the sponsors and therefore close contact with them is important.

Furthermore, management should build trust in the company and stimulate co-operation in the project. Trust is an important aspect in a virtual organisation, where members hardly meet in person and are geographically distributed. Members have to share valid information and expertise together and therefore members have to be able to trust each other on using the obtained information in a proper way. In order to make a virtual organisation successful, members should be willing to share their knowledge and skills with others in order to learn from each other's experience. This could be a problem when companies co-operate with their competitors, since they might be afraid of disclosing important material that could be used against them and that could decrease their market position. Furthermore, in order to build trust, people have to learn to get to know each other, not only formally but also socially. This means that people have to meet each other regularly in person so that social and informal contact can arise. Within the project ISES, the participants who are chosen to work in the

virtual organisation are often chosen out of a personal network of the member companies or out of the network of the management of ISES. This is done, because in a virtual organisation, one has to be able to rely on each other for doing the work one is supposed to do. Therefore, participants whose work is known to the organisation are chosen, so that one has a certain guarantee that these participants perform according to their reputation. Furthermore, management within the project ISES has arranged for team-building meetings where, with help of Prof. M. Driver, the decision styles of the participants is analysed. With help of this analysis members learn when and how to address the other members in the project [5].

Benefits

Since most participants have to divide their time between the virtual organisation and other commitments (within ISES, most members have another position elsewhere), the virtual organisation has to offer certain benefits to the participants so that they are still prioritising their work in the virtual organisation. The benefits for participants could be various, ranging from money to social status. It is important that management discusses what kind of benefits could be suitable for the participants. It will be difficult to state a general beneficial for all participants, since participants bring in different kinds of expertise and work different periods of time in the organisation. For the participants it is also important to gain some sort of advantage from the organisation or management. Most participants work geographically distributed and hardly meet management in person. Since it is difficult to get feedback on one's work, it is important that members get some kind of appreciation for their work. This appreciation can be from a compliment to financial benefits. Important is that participants know in what way their work is validated. Within ISES, the benefit for most members is financial support for their PhD studies.

5. Boundary of distribution of information

The fact that participants of a virtual organisation often are geographically distributed, does not only complicate personal contact and communication, but also affects the distribution of information. A lot of literature is written about information distribution, but unexplored is how units possess information and units that need this information can find each other quickly and with a high likelihood [10]. Within a virtual organisation, all information should be available, e.g. stored within a database, to all members participating. However, unclear is how the distribution of information should take place in order to increase knowledge with the members of a virtual organisation. This aspect can also be derived from literature [12], which states that knowledge is created by individuals through a continuous dialogue between tacit and explicit knowledge. The tacit knowledge consists partly of technical elements that contain know-how, skills and crafts applied to specific contexts. However, this tacit knowledge is often unconscious and deeply rooted in a person, it contains a person's image of the world. Therefore it is very difficult to transfer this tacit knowledge, so that more persons can learn from the knowledge of an individual. Nonaka [12] claims that in order to obtain the tacit and explicit knowledge, an informal community of social interaction is important. This means that close communication and personal contact are important to transfer knowledge in a virtual organisation.

Within the virtual organisation ISES it is important that all information concerning the research is available for the participants, so that they together can work towards a common denominator. For this reason not only the hard information (e.g. reports, notes) is important, but also the soft data, e.g. knowledge and expertise, should be stored somewhere. Organisations often have rather weak systems in order to find where a certain item of information is known to the organisation. Hard information is often stored quite well, while soft data is difficult to collect and store. What will happen with the expertise available in the organisation, when the project is finished, will all expertise be gone and so the new learned research results? Especially in a world where more and more short term projects arise, consisting of co-operations of several partners, it is important that the learned aspects, the

expertise, is maintained so that the partners involved can make use of it afterwards. Recently some new ideas arise on how knowledge can be stored. However, it can only be stored partly and is a passive entity which should be maintained continuously.

From the ISES case, it became clear that when participants are geographically distributed and have large decision making power over their own tasks, the participants should also be able to gain all the information necessary for their work. This means in ISES, (detailed) information from the other subprojects about e.g. ideas, research results and methods. The information that is stored should be available for every participant at any time and place, it should be flexible and updated regularly. Furthermore, participants should be able to find the information, this means that a search system and structure have to be defined suitable for the organisation. Since participants in a virtual organisation are very dependent on the information system for communication and information distribution, it is important that the organisation pays attention to the aforementioned aspects, e.g. updates, flexibility, adaptability. Unfortunately, there are not many information systems that fulfil the requirements a virtual organisation has on an information system. The current information systems are often not flexible enough to be updated within a short period of time. Furthermore, most systems do not fulfil the availability and adaptability requirements that are so important in a virtual organisation. Also the soft data, e.g. expertise and knowledge, can hardly be stored in an information system. The virtual organisation is changing constantly, not only its structure, but also its members are fluctuating. For this reason it is important that the participants working in the organisation have access over all the changes occurring in the organisation, so that they still feel part of organisation and are able to create a team feeling and co-operate and the expertise that comes and goes with participants should maintain in the organisation. An internal network (intranet) for a virtual organisation is a popular solution. Although the intranet can help sharing information and support communication over distance, still tacit aspects are difficult to store.

A possible solution to this problem of updates and storing part of the soft data could be an idea described by Bosch-Sijtsema & Bosch [2], where an information system is described that functions as a mirror of the organisation. Nowadays the information system is often an enabling system, that enables certain tasks in the organisation. However, the information system mentioned by the authors is a complete reflection of the organisation, this means that when the organisation changes also the information system has to change. Furthermore, all entities available in the organisation are also available in the information system. In figure 3 one can see three different organisation forms: traditional or hierarchical form (a), the BPR or process form (b) and the virtual organisation (c). Within the figure the relationship with the organisation and its information system is changing from some separate functions towards a copy of the organisation form. Within the third picture the physical organisation or physical layer is almost structureless. However, the structure of the organisation can be found within the information system which is a copy of the organisation. The information system described above is based on object orientated principles, but could well be performed through agent technology. The information in the IS does not lay passively waiting for someone to obtain it, but is seen as an active entity, which can come to the members.

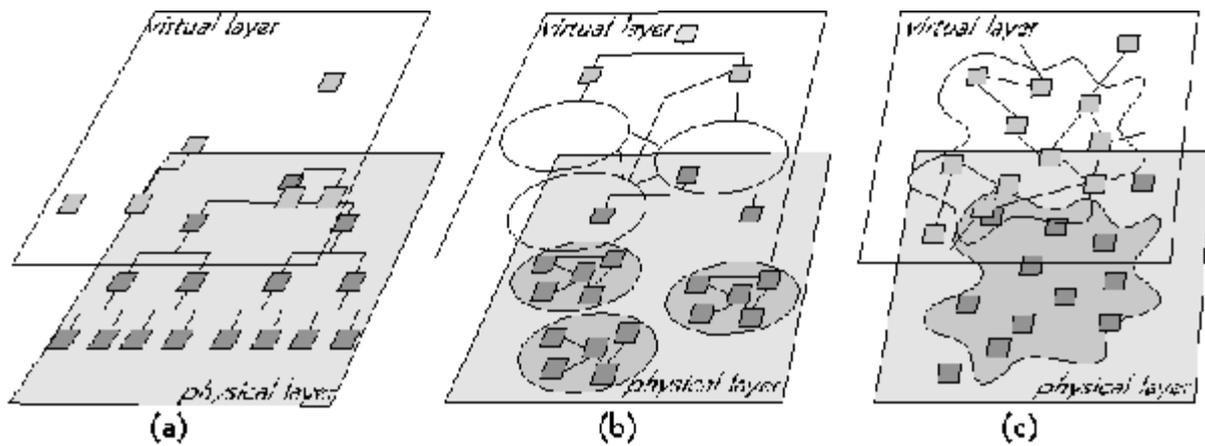


Figure 3: *Virtual and Physical organisational layers* [2].

Conclusion

Concluding one can state that there is much research left on the subject of the virtual organisation. Especially the distribution of information and the communication within a virtual organisation is important to investigate further, since the virtual organisation is almost completely dependent on the distribution of information and communication in order to function. Also storing knowledge and expertise are important matters.

Another future research track is investigating the human resource management matters, e.g. management, recruitment, selection of members, training of members and cognitive styles of participants and their affect on a virtual organisation. The members of the virtual organisation all have their unique personality and this should be taken into account when forming a virtual organisation. When considering these matters, several questions are interesting for future research:

- How to deal with the personal heterogeneity within the virtual organisation, so that close co-operation and team work can be increased.
- How do people perceive, organise and manage a virtual organisation. Some members would like to see an organised organisation with rules and routines clearly defined, while others do not need these definitions and rather work in a flexible and dynamic surrounding.

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