

Knowledge Management in virtual organisations: Interorganisational and interproject knowledge transfer

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Abstract

Due to developments in technology and in the environment of organisations, organisations can become more virtual. This virtual aspect can be found in geographical dispersed workforces and intensive use of information and communication technology (ICT) for communication and co-ordination. An extreme form is the virtual organisation (VO) which is discussed rather often in current literature. However, the body of literature is ambiguous, normative and often conceptual. Therefore the focus of the research is on investigating co-operative organisation structures that have a degree of virtualness (implying a certain amount of dispersion of the workforce and use of ICT for communication and co-ordination). The research discusses that a high degree of virtualness has impact on knowledge transfer. From learning and knowledge literature, it becomes clear that transferring knowledge requires personal interaction, especially for transferring tacit knowledge. However, within organisations with a high degree of virtualness, there is little personal interaction, and most interaction is through ICT. In VO literature, several problems are stated due to geographical dispersion and intensive use of ICT. From this one might assume that organisations with a high degree of virtualness have much difficulty in transferring and memorising knowledge organisationally. However, from empirical studies on three case studies, it was found that knowledge was transferred within these organisations. The focus of knowledge transfer in organisations with a virtual setting is more on interorganisational, interpartner and interproject knowledge transfer, than on organisational transfer of knowledge. The contribution of the paper is in discussing concepts on how knowledge could be transferred in co-operative (virtual) organisation structures. Furthermore, making these concepts on transfer of knowledge more explicit for the involving parties in the virtual setting can create win-win situations for all involved parties, so that they can receive the knowledge they prefer.

Key words: virtual organisations, knowledge transfer, interorganisational, interpartner and interproject knowledge transfer.

1 Introduction

Globalisation of the market of organisations has placed its environment in a different perspective and the role of the customer changed (Goldman et al. 1995). The changes in organisational environment have caused a change in organisational perspective. The organisation is more viewed as a flexible and organic system rather than a hierarchical or mechanical system. Besides changes in the environment of organisations, new technological developments influence organisations. With developments in tele- and data-communication new possibilities are created for storing, distributing and retrieving information and communication independent on time and space. Due to changes in the organisational environment and developments in ICT (information and communication technology), organisations started to benefit more from co-operations independent on space and time. Several co-operative organisation structures had been around for several years, i.e., strategic alliance, joint venture and networking organisations. However due the possibilities created by ICT, organisation structures arose that could work on several locations with different partners from a number of different countries, although they still had the possibility to communicate and distribute the same information together. Organisations can become more virtual¹. More and more organisations work with a certain degree of virtualness, where virtualness is defined as the degree of geographical distribution of the workforce and the use of ICT for communication and co-ordination. Organisations with a high degree of virtualness are often discussed in literature and are called the virtual organisation (VO). In this organisation type, there is a high dependency on ICT in order to do business with dispersed participants.

¹ Virtual: something that seemingly exists despite the lack of some distinguishing attributes. For the observer the reality product is existing in the mind, especially as a product of imagination (Zimmerman 1996).

The virtual organisation

The VO is defined in many different ways, from a team within a single organisation, to a web company where different organisational partners combine resources and work mainly with ICT (cf. Lipnack & Stamps 1998). However, several aspects are put forward in most literature: (a) an organisation with no physical location; (b) an organisation with a high fluctuation of the workforce; (c) an organisation that combines competencies from several organisations and (d) an extensive use of ICT in order to communicate and co-operate between the geographically dispersed members. Especially the use of ICT is discussed in a large amount of literature to extend possibilities for the way in which activities are organised over time, geographical space and organisational boundaries (Gristock 1997). According to Goldman *et al.* (1995) a virtual organisation is valuable because it reduces time, costs and risks and increases product service capabilities and relationships. The VO is defined as a co-operation of independent partners who combine their knowledge and skills in order to fulfil a certain goal, in the form of research or a product (Davidow & Malone 1991, Goldman *et al.* 1995). There is still no consensus in literature about a single definition of a virtual organisation (Ahuja & Carley 1999). The VO is viewed as rather effective and flexible, however, on the other hand virtuality implies several negative aspects like work overload, social loafing, and a low commitment (Jarvenpaa & Shaw 1998).

Literature about VOs is very broad, is rather normative and is written from several different perspectives. Furthermore, there is little empirical research performed in the field and there is no acknowledged definition. Although, most literature on VOs describes the organisation as a new organisation structure, where a different way of co-ordination is needed in order to fulfil the final goal, others (e.g., organisational scientists) are more sceptic towards this (cf. Hedberg *et al.* 1994). Goldman *et al.* (1995: 208) states that the concept of VO and the mechanisms used to form VOs are not in themselves new. Nor is the idea of co-operation new; but the degree of use and intensity of co-operation are new.

Virtualness

However, the main discussion is about what makes a virtual organisation virtual? From literature, it does not become clear where the boundaries are between virtual and other organisational structures. In VO literature several different organisational structures that are viewed as virtual, but could just as well be called otherwise. From these discussions, some authors have tried to define a typology of virtual organisations partially based on empirical studies (Bultje & van Wijk 1998, Palmer & Speier 1997, Lipnack & Stamps 1997). Others state that the differences in definition are based upon four different perspectives of the concept "virtual" (Bultje & van Wijk 1998, Ulrich 2001). Due to the ambiguity about VOs and the different perspectives used, it becomes difficult to investigate the VO as such. Therefore, the research focuses more on degrees of virtualness within organisations. These degrees of virtualness have impact on several aspects in an organisation, e.g., participants, co-ordination, structure of the organisation and on knowledge. In this research the main interest is to look upon the relationship between virtualness and knowledge transfer.

Virtualness is an emerging concept that has conceptually been discussed in literature (Kraut *et al.* 1999, Burn *et al.* 1999, Tetteh 1999, Speier and Palmer 1998, Venkatraman & Henderson 1998). However, the theories on a degree of virtualness apply different dimensions for defining the degree. Most authors agree that two dimensions are of importance for defining the degree of virtualness, geographical location in combination with the use of ICT for communication and co-ordination. However, the models are mainly conceptual and little empirical evidence is presented. Furthermore, a large amount of literature focuses upon popular scientific fields and models are often descriptive (Burn *et al.* 1999).

Focus of the research

There is a large amount of literature on knowledge and learning available. However, there is limited literature on knowledge transfer in geographically distributed organisations, project organisations and collaborative organisation structures. Some work is performed in interorganisational (interfirm) learning where mainly partner selection and strategic fit between alliance partners are discussed (Hamel 1991, Larsson *et al.* 1998, 1999). However, also in learning literature a lack is viewed in empirical studies (Henriksson 1999, Huber 1996) and the operationalisation of the theories in practice (cf. Schein 1996). Furthermore, Simonin (1999) mentions that much research is based on static theories of the firm and investigations of structural questions, very little research has delved into the process of knowledge transfer and the barriers to successful intra-organisational learning.

For these reasons, the research focuses on investigating how knowledge is transferred in co-operative organisation structures that are virtual (geographically dispersed) to a certain extent. The research focuses on collaboration projects between independent organisations and of which the co-operative organisation is (partially) geographically dispersed and uses ICT for communication. Not only the micro level of the internal organisation (the core where the work is performed) is taken into account, but also the level of the mother organisations (the alliance partners) participating in the co-operation is perceived. The co-operative projects investigated in this research, are temporary structures (comparable to virtual project structures) that disband once the market opportunity for their existence has ended. Furthermore, the geographical dispersion makes the transfer of

knowledge rather important in order to fulfil the goal in the stated time span. From literature, it is unclear what happens with the knowledge that was developed and collected within the organisation, once the organisation disbands. There is hardly any literature available on knowledge transfer within the VOs and to partners of the VO. Furthermore, in project literature the concept of knowledge is not often discussed. Turner and Keegan (1998) state that since projects are transient, they can not be used as repositories for knowledge. Kotnour (1999) focuses on the fact that project organisations must continuously build on knowledge from experience. Kotnour (1999) and Turner and Keegan (1998) base their work on project organisations, but do not mention the fact that members can be geographically spread. Therefore, this paper tries to contribute to this field, by focusing on knowledge transfer in co-operative and virtual organisation structures. In this respect several levels have been found empirically. These levels have been found empirically with help of three case studies. The aim of the paper is to develop new concepts for knowledge transfer within VOs, based on empirical studies within geographically dispersed organisations who are project based (temporary structure), where several partners co-operate (multi-disciplinary character) and who use ICT for communication and co-ordination. This research focuses on three organisations that have a different degree of virtualness. The degree of virtualness is defined as the geographical location and the use of ICT by the organisation. In the research the main question is to investigate the relationship between virtualness and knowledge transfer. How is knowledge transfer affected by a degree of virtualness and to which persons or parties is knowledge transferred when there is a high degree of virtualness available.

The structure of the paper is as follows. As discussed in section one, the focus of the article is on a degree of virtualness within organisations, rather than on a VO. This is mainly due to the fact that literature about VOs is very broad and ambiguous. In section two, knowledge transfer literature is discussed briefly and is related to virtualness. After the theoretical part, the methodology of the research and the case studies are presented in order to gain understanding about the development processes of the research. In section five the empirical findings from the three case studies are described and related to literature and the last section presents a discussion and future research possibilities.

2 Knowledge transfer

In co-operative organisation structures, the main goal is to create a synergetic effect by co-operating on several aspects. This co-operation implies knowledge transfer and learning from a partner's procedures, skills, way to work and routines can be relevant for a successful co-operation. According to Davenport and Prusak (1995) a difference is viewed between data, information and knowledge. Data is defined as objective facts, information is data that means a difference, a message that is meant to change the way the receiver perceives something, in order to have an impact on his judgement and behaviour. Knowledge is derived from the minds.

“Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms” (Davenport & Prusak 1995: 5).

An organisation with a high degree of virtualness is characterised by geographical dispersion (implying less personal contact) and ICT-dependence (a high degree of ICT applied for co-ordination and communication). These characteristics make it harder for members of the organisation to communicate informally, face-to-face and frequently as compared to members of an organisation with a single location. When discussing knowledge transfer, Davenport and Prusak (1995) mention that most knowledge is transferred in the coffee room or at the water coolers in the informal sphere. Virtual offices threaten transferring knowledge by conversations; this lowers the frequency of informal knowledge transfer. In literature (e.g., Nonaka 1994) a difference is made between explicit (which can be expressed into signs, text, words) and tacit knowledge (sensory, feelings, things that cannot be expressed). Explicit knowledge is transferable in reports, discussions and signs, however tacit knowledge is more difficult to transfer, since it is often deeply rooted and difficult to articulate (Nonaka 1994). Tacit knowledge transfer needs extensive personal contact, and according to Davenport and Prusak (1995), some kind of working relationship is essential. Knowledge transfer is the combination of transmission (sending or presenting knowledge to a potential recipient) and the absorption by that person or group. Knowledge that is not absorbed has not really been transferred (cf. Davenport & Prusak 1995). Through knowledge transfer and absorption, members of the organisation learn (Spender 1994). Shenkar *et al.* (1999) mentions that knowledge transfer is an inseparable combination of both the tangible embodiments of a technology and its associated tacit and embedded managerial know-how. Several authors state that tacit knowledge has to be experienced, this is viewed as learning by doing (Polanyi 1958, Cohen & Levinthal 1990).

Siminon (1999) states that knowledge faces barriers and is relatively immobile, knowledge is not as mobile as it has often been assumed. Kogut and Zander (1992) mention the inertness of knowledge. They state that knowledge transfer depends on how easily that knowledge can be transported, interpreted and absorbed (Hamel

et al. 1989). Others mention the internal stickiness concept, i.e., the difficulty of transferring knowledge within the organisation, where sticky information is hard to understand and interpret away from a specific applied context in which it arose (also viewed as difficult to imitate, inert, or sticky information) (Heath & Staudenmayer 2000).

“The more codifiable and teachable a capability is, the higher the “risk” of rapid transfer” (Zander and Kogut 1995: 85).

Knowledge transfer related to virtualness

In knowledge and (organisational) learning literature, virtualness is hardly mentioned as an empirical example. Most learning theories discuss traditional organisations, where members are located on a single place. Furthermore, organisational learning often discusses learning within the organisation, instead of taking into account the independent partners involved in a co-operating organisation structure.

When discussing the transfer of knowledge related to virtualness, not only explicit knowledge but also tacit knowledge should be taken into account. Within an organisation with a high degree of virtualness, members are geographically dispersed, and co-operate mainly via ICT. Explicit knowledge can be distributed and communicated with help of ICT (e.g., via mail, fax and document transfer), and via more personal communication means. However, transferring tacit knowledge with help of ICT is more difficult. Tacit knowledge is often deeply rooted and people have difficulty in describing this knowledge. Nonaka (1994) states that in order to transform and legitimise knowledge (especially tacit knowledge) that is created by individuals, an informal community of social interaction is important to provide an immediate forum of knowledge at each level and for developing new ideas. Firms are social communities that use their relational structures and shared coding schemes to enhance the transfer and communication of new skills and capabilities. To replicate new knowledge in the absence of a social community is difficult (Zander & Kogut 1995). Other authors also mention the importance of physical proximity and a social culture (Nonaka 1991, Galegher et al. 1990) in order to develop knowledge and to learn in an organisation.

When there is an intensive use of ICT for communication, non-verbal and informal contact due to differences in space and time decreases. Non-verbal contact could be helpful in order to understand each other and to share knowledge. Often a lot of non-verbal aspects are lost when communicating via ICT, e.g., facial expressions, tone of voice, and it is difficult to interrupt or interact the messages (Hinds & Kiesler 1995). For this reason the use of media to distribute information becomes an important matter, since media can affect the way the message is obtained and if there is a chance for interaction (cf. Daft & Lengel 1990). Within organisational learning theory the lack of informal and non-verbal contact, as occurring within an organisation with a high degree of virtualness, is not often taken into account, since organisational learning is mostly based on organisations whose participants are situated on the same location. In order to transfer knowledge to another person a certain amount of trust and acquaintanceship is important. People have to be able to trust upon the fact that the knowledge that is transferred is used in a proper way and for the purpose for which it was transferred. Kraut *et al.* (1999) state that prior personal acquaintanceship and trust among parties that will be sharing data is required for introduction and effective use of electronic networks for electronic integration. They found empirically that, in contrast to other literature, the personal relationship and use of electronic network are used as complementary instead of substitutable co-ordination mechanisms.

Researchers have argued that storing new knowledge and using stored knowledge are key components of organisational learning (Duncan & Weiss 1979, Huber 1996, Levitt & March 1996). Providing access to dispersed experiential knowledge can reduce the organisational costs of repeatedly developing solutions to common problems (Olivera 2000). When discussing a co-operative organisation structure, organisational memory should be taken into account. In literature VOs are characterised as having a high fluctuation in the workforce and a short existence period (Davidow & Malone 1992). When discussing the degree of virtualness, these aspects might play a role, but not necessarily. Building up an organisational memory is rather important for the partners involved in the co-operation. On the one hand they deliver their own expertise and combine it with knowledge and skills of other partners in order to create a synergetic effect or to learn from each other's way of working. The knowledge that is developed together should be transferred to the autonomous partners involved in the co-operative structure, and it should be stored within the co-operation. From literature it becomes clear that routines can be viewed as a kind of organisational memory (Nonaka 1994). Although most information can be stored with help of ICT and manually, there is still no satisfying way how to store tacit knowledge in such a memory (cf. Huber 1996).

3 Methodology

Within the investigation an open systems perspective is applied and the study is performed in an explorative manner. In this research an interpretive perspective is applied (hermeneutic systems thinking). The aim of the research was to follow the knowledge transfer process in organisations with a degree of virtualness. Since there is little empirical research on virtualness related to knowledge, the research was mainly based on qualitative data collections and case studies were selected. The research question deals with how knowledge is transferred in an organisation with a degree of virtualness and to whom this knowledge is transferred. For this reason, three

organisations with different degrees of virtualness were investigated, where a difference in structure and final goal can be perceived. The research focuses on the differences and similarities between several organisation structures in the field of knowledge transfer, in order to modify and partially contribute to theory about knowledge related to virtualness. The three case studies are presented below in more detail and table 1 denotes the differences between them. The first two case studies (A and B) were longitudinal cases, where the cases were followed respectively three to one years (with help of questionnaires, observations and interviews). The third case study was a point study, where only qualitative research was performed with help of interviews (and partly observations). From the case studies the empirical data was coded and several aspects were found of interest. The coding of the raw data was partially structured by the theoretical reference frame developed parallel with collecting the empirical data. From the coded data several fields of interest for virtualness, contextual aspects that influence knowledge transfer (like co-ordination, participants, communication and information distribution) and the relationship between virtualness and knowledge transfer were found. This article presents a comparison of the three case studies in the topic of knowledge transfer.

3.1 Case studies

Project A

The case study examined is a project initiated by a research company called EnerSearch AB. EnerSearch can be viewed as a joint venture where different (alliance) partners combine resources in order to produce research results in the domain of energy and electricity. Project A was a research project and the goal was to publish articles and PhD dissertations in the energy line of business. The members of case A were geographically dispersed over Sweden, the Netherlands, Germany, France and the USA. The project consisted of several sub-projects that all performed a part of research (technical, organisational or enabling studies were performed). The sub-projects together resulted in the defined target of two-way communication via the electricity network with the customer. There was an internal core of experts who performed the research, and there were linkages to the alliance partners (mother companies) who financed the research (they also brought in equipment and sometimes expertise).

Project B

The second case is a project of the IT in Energy research academy², the DESS body (Delegation för energiförsörjning i Södra Sverige) and SITI-Syd (The Swedish IT institute). It was initiated by EnerSearch AB, who could be viewed as the initiating organisation of case study A and B. This project had a different scope and strategy than project A. Project B was an application project, making use of part of the results of project A, and re-using them within a municipality in Southern Sweden. The project was one year, it started in November 1998 and it finished in October 1999 (the project was followed from the start till the end). Participants of the project were geographically dispersed. The internal core consisted of experts (researchers and consultants) who worked mainly individual. A steering committee was available for guidance and discussion of the process of the work. Furthermore, alliance partners (mother organisations) sponsored the project financially and were interested in the final result.

Case C

Case study C produces a railway track between Rotterdam (NL) and the German border for the transportation of goods. The railroad is 160 km long and the project lasts 10 years. Besides the actual construction part of the project, a large project organisation was developed over the years where co-ordination, administration, quality control, planning and risk management is situated. The project organisation was developed in order to make sure that the railroad is developed in time, with a good quality and within the planned budget. The project organisation C is a co-operation of a public (governmental body) and a private organisation (the mother companies). The project organisation (the internal core) is located at different sites. There is a head office and two regional offices. The regional offices monitor the work of the building contractors on the scene with help of partially dispersed teams.

For the research, only the project organisation was taken into account. Further demarcations were performed in only investigating the aspects of control and planning. It was difficult to investigate the whole project C, due to its size. Control and planning are integrated in the whole project organisation from top-management to the building contractor who performs the actual work of building a railroad.

² EnerSearch AB sponsors the IT in Energy research academy financially.

<i>Aspects/cases</i>	<i>Case A</i>	<i>Case B</i>	<i>Case C</i>
<i>Primary process</i>	Research. Resulted in dissertations and publications	Application methods based on research. Resulted in publications and demonstrations	Product based organisation. Results in a railroad.
<i>Space</i>	Completely geographical dispersion	Completely geographical dispersion	Partially geographical dispersion. Several locations, some members located at construction site.
<i>ICT use</i>	File-sharing system, e-mail, ICQ, internet (moderate use for communication of core group)	e-mail (very little to no use for communication)	Intranet, Internet, e-mail (much use as database, less use for communication)
<i>Virtualness</i>	High dispersion, moderate ICT = Rather high virtualness	High dispersion, low ICT = moderate virtualness	Moderate dispersion, moderate ICT = moderate virtualness
<i>Domain</i>	Energy industry (public-private partnership)	Energy industry (public-private partnership)	Infrastructure project. (public-private partnership)
<i>Size</i>	20-30 members (core group)	12 members (core group)	+/- 150 members project control organisation (core)
<i>Members</i>	Members hired from universities, consultant firms and companies.	Members hired from universities, consultant firms and companies.	All members seconded from other organisations.
<i>Task</i>	Research, non-routine task. Some interdependency (individual research based upon other research).	Applying research results to a new situation. No interdependency between the tasks. Project leader integrated the work personally.	Applying experience and theory to a new situation. Development of a new control system. Rather much interdependency between tasks and members.
<i>Project Duration</i>	3 years	1 year	10 years
<i>Structure</i>	Loose and flexible project structure. Hierarchy arises over time.	Loose and flexible project structure. Project leader in charge.	Project organisation. Structure changes per project phase. Formal hierarchy
<i>Research time</i>	1996-1998	1998-1999	2001

Table 1: Key characteristics of all three case studies

4 Empirical results

The three case studies had a different structure and their tasks and final goals were rather different. However, several similarities could be viewed when comparing the case studies. All case studies were based on (a) geographical dispersion of their participants. (b) All participants were hired in order to fulfil a certain task and once the task was finished they left the organisation. Participants were seconded from other organisations, and had to divide their time and loyalty in between the different projects or tasks they performed. (c) For case A and C there was a high fluctuation within the workforce. (d) Participants acknowledged the fact that knowledge should be transferred, but hardly anything was performed to accomplish the internal knowledge transfer between the fluctuating workforce. In all cases it was stated that participants learned rather much from their individual work in the project, they learned more about their own field (especially in the research case studies A and B), they learned to work in such an organisation structure and they learned project management (in case C). However, when discussing knowledge transfer within the whole organisation, many participants mentioned that not much organisational knowledge was transferred. With organisational knowledge culture, language, jargon, procedure and norms are meant.

The initiating organisation behind case study A and B, mentioned in interviews that they had learned rather much from following the virtual projects and that they re-used this knowledge when they started up new geographical dispersed projects. Furthermore, case C, also implied that other similar projects could learn from the knowledge developed within their project organisation and they started on implementing a knowledge transfer between project C and another rather similar project organisation. These examples are only some of the aspects found within the case studies. From the empirical studies, it became clear that organisational learning in the form of routines, common language and culture were not developed in short term projects (like case A and B). However, other forms of knowledge transfer were found, that are not often discussed in learning literature about classical organisation structures. These types of knowledge transfer are mentioned below and in table 2 the knowledge field that was transferred is stated (not the content of the knowledge that was transferred). Five different levels of

knowledge transfer were empirically found within the three case studies, (a) individual learning; (b) organisational knowledge transfer; (c) interorganisational knowledge transfer; (d) interpartner knowledge transfer and (e) interproject knowledge transfer. These five levels are discussed below. Table 3 presents the different media used in order to transfer knowledge to five different groups.

1. Individual learning

In all three cases, experts were hired in order to fulfil a certain task. These experts worked rather individual, however, they did have to co-operate (to a certain extent) with other experts in the organisation in order to fulfil the final goal. From all three case studies it became clear that individual members learned rather much. All case studies hired experts to either perform research within their field (case A) or to apply their expertise within a new situation (case B and C).

“You pass through a whole process. We started with the realisation phase, so you learn different ups and downs and problem fields. Before I came here, I had seen construction specifications; however, I did not know on what aspects I had to pay attention. When I read the specifications now, then I know exactly what is important for my expertise; planning, control but also quality” (case C: PM27).

In case A, members deepened their knowledge in their own field, while in case B and C, experience for applying knowledge in new situations was build up. Besides learning within their own expertise field, members also learned about working in an organisation structure with a degree of virtualness and its environment (industry or political environment). Furthermore, social networks of people participating in the projects were built up. In case A and B, members had little interdependency within their tasks and they could work rather individually. In case C the interdependency of the tasks was higher and members from the higher management levels of the control organisation were dependent on the work performed in the lower levels. The work in case A was innovative, new ideas had to be developed. Case B and C were less innovative; they applied experience and existing theory to new situations. For example in project C, members had to develop new models and methods that fitted the situation of their project. This development process was performed partially individual and partially with the whole control group. However the development of new methods mainly took place in the start-up phase of the project. Later on the work became more routine.

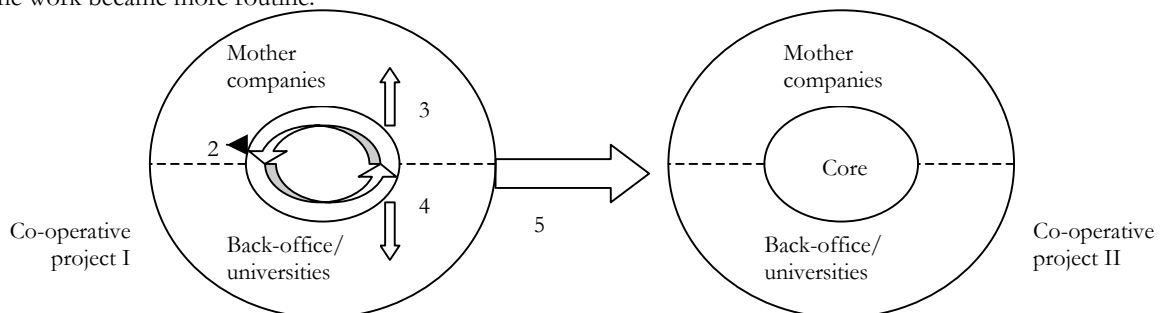


Figure 1: Knowledge transfer levels in co-operative project structures, where a high degree of virtualness is available. 2 = organisational knowledge transfer; 3 = interorganisational transfer; 4 = interpartner transfer and 5 = interproject knowledge transfer (1 = individual learning, this is not viewed in figure 1).

2. Organisational knowledge transfer

Organisational knowledge transfer deals with knowledge that has been transferred or learned throughout the whole organisation or within a certain part of the project (for example the project control organisation). Examples of organisational knowledge transfer within the case studies, are the development of a common jargon (partially in case A) and the development of a quality system (in case C) that was accepted and used throughout the whole project organisation. In case A, it was denoted that members had little communication besides the meetings (once a year) and there were language differences between participants from different countries and within several disciplines. In order to overcome these communication problems, team-building sessions were held in which concepts for communication and information-processing styles of members were presented and applied. These concepts (a communication jargon) helped to communicate between members with different backgrounds and over geographical space. These concepts were accepted throughout the internal project. The concepts were used in meetings, social events and even in e-mail and chat communication for explaining situations and for adding humour to the project. In case C, the organisation developed an internal quality system that was applied and accepted by all members of the organisation. All members independent of where they were located knew in this respect their task and role within the project organisation. Furthermore, the quality system tried to guarantee a decision-making process accepted by all parties. In project C, procedures for information distribution, meetings and routines were developed that were learned to all new members joining the organisation. Case B did not develop any routines, procedures or common jargon. The project only lasted one year, and there was too little time to learn organisationally.

Other aspects that were viewed with at least two case studies were the gaps between academic and industry and the gap between public and private companies.

- “There was a gap between industry and academia. We had two different languages, different interests, needs and expectations. A different game and a different reality” (case A, B: PL8);
- “The culture was one of a private company, however, the company (bureaucracy) was more public than I expected” (case C, PL17).

3. Interorganisational knowledge transfer

Interorganisational knowledge transfer implies the transfer of knowledge towards the private and public partners; the mother companies who financed and/ or initiated (or managed) the project organisations. Within case A, it was rather dependent on the mother companies what kind of knowledge they could receive. It was expected by the internal project participants, that the partners would have an active role in collecting knowledge. By the end of the projects A and B, all final results were collected and published in a book that was presented to the mother companies. In project A, the mother companies had regular contact through the CEO and within annual meetings, but no clear results were demanded from the mother companies. In project C, the mother companies produced a list of reports they want to receive once the project is to be delivered. Furthermore, they receive quarterly reports from the project organisation.

”One of the mother companies, made a product (a router) with help of the research material of one of the participants” (case A: PM10).

Another aspect is that some mother companies have seconded expertise in the form of contact persons or experts to the internal collaborative project (this was in case A and C). These contact or expert persons brought a certain amount of knowledge from the mother organisation to the internal project and vice versa.

<i>Levels / Case study</i>	<i>Case A</i>	<i>Case B</i>	<i>Case C</i>
<i>Individual learning</i>	<ul style="list-style-type: none"> • Content • Working in a VO • Social network 	<ul style="list-style-type: none"> • Content • Working in a VO 	<ul style="list-style-type: none"> • Content • Experience in project organisation • Political situation
<i>Organisational knowledge transfer</i>	<ul style="list-style-type: none"> • Language (common) • Expectations • Academic-industry gap 	<ul style="list-style-type: none"> • - 	<ul style="list-style-type: none"> • Routines/ quality procedures • Standards • Public-private gap
<i>Interorganisational knowledge transfer</i>	<ul style="list-style-type: none"> • Future ideas • Book with results • Knowledge of own employees who worked within the project 	<ul style="list-style-type: none"> • Book with results • Ideas • Confirmation of target 	<ul style="list-style-type: none"> • Reports • Knowledge about the overall project development • Knowledge of own employees who worked within the project
<i>Interpartner knowledge transfer</i>	<ul style="list-style-type: none"> • Content • Social network • Knowledge of professionals 	<ul style="list-style-type: none"> • Content • Ideas • Application • Knowledge of professionals 	<ul style="list-style-type: none"> • Knowledge of professionals • Content • Experience • Social network
<i>Interproject knowledge transfer</i> - Sequential - Parallel	<i>Sequential</i> <ul style="list-style-type: none"> • Experience project management • Starting up VO • Finding partners/ funding • Networking 	<i>Sequential</i> <ul style="list-style-type: none"> • Experience of project management • Networking • How to run a VO 	<i>Parallel</i> <ul style="list-style-type: none"> • Experience • How to start up and run such a project • Content (innovative construction) • Project organisation structure • Knowledge management ideas

Table 2: Knowledge transfer and content of all three case studies A, B and C.

4. Interpartner knowledge transfer

Besides the mother companies who financed the projects, there were several other companies involved. The involvement of these companies was mainly in delivering expertise (in the form of people, i.e., PhD students or consultants) to the internal project group, in order to complete the project goal. The participants of the projects were hired for a certain period of time, in order to fulfil a certain task (this could be development, research,

implementation, management or control tasks). These participants gained experience and expertise of working within the projects and this personal knowledge was taken along once these participants left the organisation. A large amount of the participants had a back-office or a private organisation to which they returned. These back-office organisations often had several ways of retrieving part of the knowledge that was gained in the internal organisation, for example by seminars, documentation, publications, teaching and experience. On the other hand there were participants with no back-office, who were self-employed or who were seconded by temporary employment agencies. These members exploited the knowledge they learned in the collaborative organisation in the form of consultant assignments or seminars towards other organisations. Some members of for example case C mentioned that they would leave the organisation and had started their own company in order to sell the expertise they had gained in case study C. Furthermore, in Case A and B consultants worked who would exploit their learned knowledge to other assignments or to their back-office.

“I do this work as an assignment for my own company that I just started. For my own company, I want to use the three years standing for this project, so that I also earn some money. I do not have other customers, but I am very interested in this project and hopefully I can make some new contacts for the future” (Case A: MP6).

<i>Levels/ Case study</i>	<i>Case A</i>	<i>Case B</i>	<i>Case C</i>
<i>Individual learning</i>	<ul style="list-style-type: none"> • Face-to-face (little) • Self study 	<ul style="list-style-type: none"> • Face-to-face (little) • Self study 	<ul style="list-style-type: none"> • Face-to-face • Documents/ handbooks • Work meetings • Self-study (reflection)
<i>Organisational learning</i>	<ul style="list-style-type: none"> • Meetings • Team buildings • Conferences • Intranet 	<ul style="list-style-type: none"> • Meetings • Team buildings • Conferences • Intranet 	<ul style="list-style-type: none"> • Intranet • Documents/ handbooks • Meetings • Bilateral meetings
<i>Interorganisational knowledge transfer</i>	<ul style="list-style-type: none"> • Documents / book • Conferences • Face-to-face • Sponsor meetings • Employees from mother company hired for VO. 	<ul style="list-style-type: none"> • Documents / book • Face-to-face • Sponsor meetings 	<ul style="list-style-type: none"> • Face-to-face • Formal documents • Employees from mother company hired for VO.
<i>Interpartner knowledge transfer</i>	Members brought knowledge back to their own company. In form of personal expertise and social network.	Members brought knowledge back to their own company. In form of personal expertise.	Members brought knowledge back to their own company. In form of personal expertise, seminars, workshops and a social network.
<i>Interproject knowledge transfer</i>	Knowledge transfer from project A to project B by the management group.	<ul style="list-style-type: none"> • Personal and tacit knowledge from management. • Social contact network 	<ul style="list-style-type: none"> • Exchange of experts • Documents • Discussions on top level about practical matters of knowledge management.

Table 3: *Media types through which knowledge is transferred in case study A, B and C.*

5. Interproject knowledge transfer

The last knowledge transfer level could be viewed between different project organisations. Two forms are denoted. The first form is sequential interproject knowledge transfer, in which experience and knowledge of a project are used into successor projects, after the disbanding of the project. The second form is parallel interproject knowledge transfer, in which experience and knowledge are shared between projects who run parallel of each other and where both projects can win of the knowledge sharing. Between case A and B, sequential interproject knowledge transfer was available. Case study B was a successor project of case A, and the management (and the management of the initiating organisation behind both projects) of case A transferred knowledge about how to start up such a geographically dispersed project into the second case study.

In case C, parallel interproject knowledge transfer was perceived, where knowledge, experience and people were shared to a certain extent between two projects who performed similar tasks.

“In case C and a similar project (D), people are exchanged for the super structure of the projects. The success of project D is dependent of project C and the success of project C is dependent on project D. Contractors of project D can learn a lot from project C. However, this is an attitude matter. The attitude of people has to change, so that they are interested in learning of other projects” (case C: PL18 & PL19).

5 Discussion and contribution

There is a large amount of literature on VOs, but this literature is ambiguous, normative and conceptual. Therefore, the focus of the research is on investigating collaborating organisations that work together in a project with a certain degree of virtualness. Virtualness is defined as the amount of geographical dispersion and the use of ICT for communication and co-ordination. A high degree of virtualness implies a complete dispersion of the workforce and an extensive use of ICT to communicate (case A has a rather high degree, while B and C have a moderate degree of virtualness). The aim of collaborations is often to share competencies and skills in order to create a synergetic effect in the form of a product or research. However, little is mentioned about how knowledge between the participants can be shared or transferred in a virtual setting. From knowledge and learning literature it becomes clear that most knowledge sharing (of both tacit and explicit knowledge) occurs once members are working close together, share a similar language, and interact with each other (cf. Nonaka 1994, Daft & Huber 1991, Davenport & Prusak 1995). A high degree of virtualness might be viewed as inhibiting knowledge transfer within such an organisation. Furthermore, from project literature it is stated that projects are transient and they cannot become repositories for knowledge within the organisation (Turner & Keegan 1998). This statement also counts for the focal projects. The organisations in question are temporary co-operations between several participants and autonomous partners, and once the goal has been fulfilled the organisation disbands. What will then happen to the knowledge that has been developed within the collaboration?

From empirical research, we found that, knowledge transfer on a long-term basis could be viewed on five levels: (1) Individual; (2) Organisational (within the project); (3) Interorganisational (between the mother partners involved); (4) interpartner (between the “service” companies involved) and (5) Interproject (between different projects). It was found that professionals, hired into the core organisation, broadened and deepened their knowledge in their own field and gained experience of working in the co-operation. Literature often states that the goal of a co-operation is to create a synergetic effect through knowledge transfer. However, little knowledge was shared and developed organisationally. People assume individuals hired for the project, as members of the project. However, from the case studies, these individuals of the core group were hardly involved in the project as an organisation and little commitment was perceived. This corresponds to studies performed by Jarvenpaa and Shaw (1998). On the other hand the interdependency of the task and the content of the task plays a role. In case A and B there was little interdependency, members could work rather individually on their task and were not dependent on others. Members could work from where ever they preferred and came to formal meetings to present their work. While in case C, the interdependency was higher and therefore, members needed to meet and transfer information and knowledge more often. Especially in the initialisation phase of project C, a large amount of interaction (face-to-face) was necessary in order to develop the project organisation.

Proposition 1: When there is a high degree of task interdependency and many interactions are required, an organisation with a high degree of virtualness is not very suitable for transferring tacit (and explicit) knowledge.

Another aspect that plays a role for knowledge transfer, is the duration of the project organisation. Case A and B lasted three respectively one year, while case C lasted 10 years. In case B there was no time to implement routines for information distribution or develop a common jargon. In case A, members tried to develop a common jargon for communication, however, it took some time before this was accepted. People needed to get to know each other, to be able to trust each other and to develop procedures and norms within the project.

Proposition 2: The duration of the collaborative project is of influence to knowledge transfer, where a longer duration has a more positive effect on knowledge transfer compared to a very short project.

Interorganisational learning between the partners of the project organisation (the mother organisations and financial sponsors) was mainly by receiving formal documents and partly by placing some of their employees in the internal project. Interpartner knowledge transfer occurred through the members and consultants involved in the actual work of the organisation. A number of members mentioned that they would exploit the knowledge gained in the organisation within their own company or their own mother organisation (consultancy firm). Interproject knowledge transfer was viewed as important in order to exploit the knowledge developed in a project. Knowledge was transferred to new projects, mainly with help of the project-management and with help of a (social) contact network where management knew where to find the right knowledge. The knowledge that was shared between projects was mainly in the field of project control, financial aspects, forming the organisation, recruitment of participants and management ideas. In the empirical findings, it was viewed that parallel knowledge transfer between similar projects could be possible. For reasons of knowledge and information disclosure between parallel projects, it might help when the projects are managed by the same mother organisations as in case study C. Otherwise, rather clear contracts and negotiations have to take place about what kind of information and knowledge can be shared between parallel projects

Case A had the highest degree of virtualness (complete dispersion and moderate use of ICT), while case C had a more moderate degree of virtualness. Case B was completely geographically dispersed, but ICT was hardly used

for communication and in between the formal meetings, there was no contact between the members (this was due to the low interdependency of the task). A more general conclusion can state the following:

Proposition 3: The higher the degree of virtualness (complete geographical dispersion and a high use of ICT), the more difficult it becomes to transfer tacit knowledge. However, tacit knowledge can be transferred towards the involved parties, through human experts seconded to the virtual organisation³.

Tacit knowledge becomes more difficult to transfer within the project once the virtualness degree is high, because people meet each other less often in person (which according to literature is positive for transferring tacit knowledge, e.g., Nonaka 1991). However, in the case studies some examples of tacit knowledge transfer were found. In certain cases human experts were seconded by their mother organisation to the co-operative project and they learned and brought back this knowledge to their mother organisation. Most knowledge transfer between the different parties was based on explicit knowledge, however, some knowledge transfer could be more tacit. Especially the interpartner knowledge transfer is based on people who take their knowledge and expertise back to their own company. They can exploit this knowledge (both tacit and explicit) to other companies when they are personally involved in the exploitation task. For interproject knowledge transfer both case studies A and C tried to use participants from their own organisation for new (parallel or sequential) projects, where they could apply their expertise and skills. In case A, the management group was transferred to case study B. In case C, a part of management and people with specific skills interesting to the similar project were transferred. In these cases one could perceive both explicit and tacit knowledge transfer through people. By lending out expertise (in the form of human experts) tacit knowledge could more easily be transferred to organisational partners (both mother organisations and back-offices) involved in a co-operative organisation with a degree of virtualness. Knowledge in organisations with a degree of virtualness can be transferred in the form of experience, lessons learned, an even in the form of human expertise towards other organisations and other projects.

The contribution of the paper is that from the empirical research of three case studies, it became clear that knowledge could be transferred within an organisation with a degree of virtualness, but this might be different than for more classical organisation structures. Little is mentioned in VO and knowledge and learning literature about learning in geographically dispersed and co-operative organisations (exceptions are viewed in interorganisational learning and interfirm learning of Hamel 1991). This research could contribute with ideas of knowledge transfer for organisations that have a degree of virtualness. These ideas and concepts can be tested and developed further in future research.

Proposition 4: A virtual organisation is not very suitable for transferring and storing organisational knowledge, however, knowledge is more transferred to the involvees (mother companies and service companies) and to (future) virtual projects.

Little organisational knowledge is developed and maintained. The focal organisations consisted of experts who were hired to fulfil a certain task and once they end this task, they left the organisation. However, from the case studies, the knowledge developed within the organisation by these experts was hardly transferred or memorised, but left the project together with the expert. Therefore, the project should not focus on organisational memory and organisational learning, but should more focus on knowledge transfer towards the partners who are involved in the co-operation. This was also viewed from the empirical studies that applied interorganisational, interpartner and interproject knowledge transfer. Although the content of the knowledge transfer differed per case study, there was knowledge transfer towards the mother organisations, the other companies involved during the project and towards other (virtual) projects (both sequential and parallel projects). Furthermore, making these concepts on transfer of knowledge more explicit for the involved parties in the co-operative organisation with a degree of virtualness can create win-win situations for all involved parties, so that they can receive the knowledge they prefer. Making the possibilities and benefits of knowledge transfer explicit to participating parties could increase motivation and commitment of participants, since they can all gain from working within such an organisation structure.

Besides denoting that knowledge is shared and that there are several levels for the organisation on which knowledge transfer occurs, it might be interesting to investigate the content of the knowledge transfer at the different parties more closely. It would be interesting to look at the participant's side of the organisation, what kind of knowledge they transfer and apply from the organisation into their own organisation or in future projects. Are there conscious strategies in order to transfer, collect and apply the project knowledge? Within the case studies, knowledge transference towards the mother organisations was put in contracts and negotiations. However, transfer to other parties involved was not discussed or a conscious choice, but, grew over time.

³ The virtual organisation is viewed as a co-operative organisation structure with a high degree of virtualness (complete dispersion of the workforce and high use of ICT for communication and co-ordination).

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