

COLLABORATION IN VIRTUAL NETWORKS: REASONS AND BENEFITS

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ABSTRACT

The changes of the conditions in the society that we have experienced during the end of the 20th century are extensive. The transition is characterized by the conversion of a materialistic culture into a new technical paradigm dominated by information technology. Many companies and institutions cooperate today in virtual networks. This is something that becomes increasingly common in order to meet competition and increased demands on technological development. My focus in this paper is on Solution Sharing Networks. In such networks organizations share knowledge and resources around a solution to a specific problem in their environment. In this case the problem is related to the development of software applications (co-design). In a solution sharing network, people thus come together in order to cooperate for a more efficient development of new solutions. Some networks are very successful in their cooperation whereas others have difficulties to get the cooperation work smoothly. It is therefore of interest to further investigate the transformation processes within the networks. The aim of this paper is to identify and discuss possible reasons and benefits of collaboration and co-design in virtual networks as well as to look further into the characteristic of the co-design process in such networks. Analysis will be performed using the social constructivist perspective enhanced by activity theory and the virtual network will be seen as a human activity system according to Checkland. Reasons for collaboration can roughly be divided into different categories and subcategories. There can be internal reasons, that is reasons that depends on circumstances within the organization, or external reasons that emanate outside the organization. Internal reasons may be economy, efficiency problems, competence problems or time problems. External reasons may be pressures from authorities, from customers or from competitors. Many different benefits from collaborating in virtual networks may be identified. By combining different skills, the network may perform tasks that individual members might find impossible on their own. If solutions are shared, individual members can refrain from developing individual solutions and thus not reinventing the wheel over and over again. Software solutions that are used by several different organizations are also tested to a greater extent than individual solutions and should therefore be expected to create a safer environment than solutions that are individually developed. Sharing applications that one organization already is using is also time efficient. Sometimes central authorities may put demands on organizations that may require software applications. In such cases all authorities will require the same or similar solutions. Collaboration to create the necessary applications will then be highly efficient, reduce costs and development time, enable more ideas to influence the application and result in a safer software than if every organization had developed its own software. Sometimes demands may also come from customers instead of a central government, and if these demands are similar for different organizations, they may also in this case gain the same benefit from collaboration as in the previous example. In the paper a few models to illustrate the collaboration are presented.

Keywords: Virtual network, virtual society, social constructivism, collaboration, co-design, activity theory, human activity system

INTRODUCTION

The changes of the conditions in the society that we have experienced during the end of the 20th century are extensive. The transition is characterized by the conversion of a materialistic culture into a new technical paradigm dominated by information technology. The basis for the new paradigm was mainly founded in the USA during the 1970's where Silicon Valley in California was an important actor. Some important characteristics of the societies created by the new technical paradigm include digitalization, miniaturization and deregulation. (Castells, 2000)

Castells (2000) calls the new society that has evolved by these phenomenons *the informational society* or *the network society*. Other names for this society are *information society*, *knowledge society* or *postindustrial society*. Castells (2000) however emphasizes that it is not possible to talk about *one* informational society. Even if those societies all are based on informationalism and restructured capitalism, the new information technology combined with cultural, economical, social and contextual factors has lead to the fact that the recently created societies also differs in their social practices.

Even if "the new society" has many names, there are certain common trends that have been identified by several authors. Höglund and Persson (1985) for example writes that one point of view that is commonly represented in literature is that information and service businesses have grown rapidly and this discussion is emphasized by Castells (2000) when he says that the aim of societal development no longer is production of goods as was the case in the industrial society. The aim for the informational society is instead technical development.

Many authors also mention globalization as an important trend in the new society (Castells, 2000; Giddens, 2003). This trend has lead to great consequences for people as well as companies and organizations. The market has turned global and a new world-wide economy has been created. This trend made possible through information technology has brought a great change in a major part of the market but also changes in the new social practices. Information technology has created more and more complex networks with entities from the same or different cultures. The geographic distances is less important that before whereas the cultural and organizational proximity influence the social practices that are formed.

There are of course many obvious advantages with cooperation in networks. Castells (2000) writes for example that the cooperation offers a possibility to share costs and risks and keep in touch with constantly changing information. The networks also have a role as gate-keepers. New possibilities are constantly created within the networks and it becomes more and more difficult to survive in the outside world. The basic units today are not the companies or organizations – it is the networks. (Castells, 2000)

The new paradigm has thus meant great changes for the society and for people, companies and organizations and their way to interact with each other. The creation of different networks is something that becomes increasingly common in order to meet competition and increased demands on *technological development*. (ibid) However, some networks are very successful in their cooperation whereas others have difficulties to get the cooperation work smoothly. The aim of this paper is to look further in the co-design process in such networks and also to identify and discuss possible reasons and benefits of collaboration. I have a special focus on Solution Sharing Networks that is described below.

SOLUTION SHARING NETWORKS

A Solution Sharing Network can be described as one type of Solution Group. The latter concept can be used to characterize many different types of groups, however they all aim at solving some kind of problem. There are some common features for all Solution Groups (Movement as Network, 2005):

1. *Formulation or articulation of problems*: Here an important aspect is to create an understanding for the problem area but also to clearly express or define it.
2. *Development of solutions*: This means that the group identifies, tests and develops different ways to solve the problem.
3. *Development of strategies*: Here it is important to map different institutions or instances that can influence the development. It is also important to decide how to handle these.
4. *Implementation of strategies*: In this step the strategy is executed and it is also evaluated. If it is necessary adjustments are made.

There are however different types of Solution Groups. In a *Solution Coordinating Network* organizations with different solutions cooperate and use the solutions to reach a common goal. *Solution Distribution Networks* instead distribute solutions to the audience. In a *Solution Sharing Network* organizations share knowledge and resources around a solution to a specific problem in their environment. The latter kind of network often exists over a long period of time whereas a Solution Coordinating Network may not be persistent due to competition.

This paper focus on Solution Sharing Networks that aims at sharing information and knowledge related to the development of software applications (co-design).

HUMAN ACTIVITY SYSTEMS

There are many different factors influencing development and information interchange in Solution Sharing Networks. Focusing on one aspect may therefore cause dissonance or inefficiency in other areas of the network. A system theory holistic approach is therefore essential to be able to study information related activities in a virtual network. Such a network is a social system that may be viewed as a human activity system according to Checkland's (1999) description that can be summarized by the acronym CATWOE, where

Collaboration in Virtual Networks

- C= Customer, who is the person who will benefit from the activity or those who are influenced by the activities in the system (ibid).

The definition of customer can be used on an individual level as well as on group level. In a Solution Sharing Network the customers are those who experience and take advantage of the added value that is created by the system, that is those who can take advantage of an efficient information exchange. To find further nuances in the context, it might be possible to distinguish between “expected customers” and “actual customers”. The first category consists of all members in the network who can be expected to take advantage of the information interchange whereas the actual customers are those who in reality experience this advantage. This distinction indicates that some members are providers and other members are more of consumers of information in the network. Even if this in some respects may be connected to Vygotsky’s zone of proximal development (see below) the distinction can however in a practical situations have little value since social interaction always may create an added value for all involved.

- A = Actors, those individuals who perform the activities or those who cause the activities. The focus is here on the transformation process. (ibid)

The actors are those who interact and share information in the network. In reality the concept of actor is not homogenous. Different actors can be differently involved in the transformation process.

- T = Transformation, consisting of the means that transform input into output (ibid).

In a Solution Sharing Network input to the transformation process is the individual people and their level of knowledge. The supporting computer system also contributes with information to the input.

- W = Weltanschauung (= world perception), the perception of critical concepts related to the activity (ibid).

The world perception influences the co-design process and can be connected to different *perspectives* as indicated in co-design. In a Solution Sharing Network world perception is created both by a design process and a social process where different perspectives are perceived. At last one or more perspectives are chosen as a base for the activities that initiate the transformation process.

- O = Ownership, that is the organizational body that has the ultimate power and ambition to change and continue the activity. The owners talk *about* the system whereas the actors are located *in* the system. (ibid)

The influencing force can of course have different characteristics. The owners can supply the system with technical support that influences the transformation process, but they can also administer laws and regulations.

- E = Environment, the factors in the surrounding world (context) that could influence the activity. (ibid)

An example of an environmental factor can be the national and international laws and regulations that controls the transformation process.

An interesting fact for Solution Sharing Networks is that a specific member can have several different roles according to Checkland's classification. A member can be a customer, that is benefit from the activities at the same time as the same member is an actor and even possess decision power to change and continue the activities, that is to be seen as an owner.

CO-DESIGN – PHILOSOPHICAL INFLUENCES

The transformation process in a Solution Sharing Network can be characterized as co-design. The origins of co-design can be traced to the thoughts of the philosopher Kant. He tried to find a compromise between the two perspectives idealism and realism by introducing “a priori ideas” by which the individual interprets the real world. (Forsgren, 2004) This is often referred to as constructivism and the thought is thus that we can not experience a phenomenon entirely objectively since we have these “a priori ideas”. For example we always experience phenomenon situated in time and space. This implies that an individual always have a certain *perspective* on reality (ibid).

C West Churchman was one of the first thinkers that recognized the importance of co-design. He developed a knowledge philosophy (systems thinking or the systems approach). The basis for his philosophy is that we can look at the world or reality in a number of different ways and that the views can differ depending on the level of detail. It is important to notice that it is the viewer who *designs* the views, the individual is thus active in the process and individual goals may change from day to day or week to week. (ibid) Here the connection to a constructivist perspective is obvious. Constructivism states that the individual actively creates meaning through a process where impressions are compared with earlier knowledge.

The number of possible perspectives is not finite but at some point the individual must select which of the perspectives that should be implemented in the specific context or situation. Without this selection the individual can not perform an action. The selection of the most appropriate view is a design process as well as a co-process. (ibid) Here it is possible to see a movement from constructivism to social constructivism. The social character of knowledge is emphasized and the meaning of culture in the social process has a major influence. The culture as well as the social process has a great impact on the choice of perspectives.

It is however important to notice that since co-design actually is a perspective, it can not be described as the truth. Instead we can look at it as “one possible design” (ibid). It is thus not a universal solution but a perspective and weather it is appropriate or not must be determined according to the situation. Since development in a Solution Sharing Network is dependent on collaboration and co-design, this perspective can however be used to illuminate the transformation process in such networks.

CO-DESIGN IN PRACTICE

Co-design in practice is a concept describing a broad phenomenon, and today the concept is used within the area of information system with many different meanings and interpretations. Sometimes co-design is used for products like hardware and software. Other interpretations of the concept are co-design of a business or an information system. (Olausson and Haraldsson, 2005)

Olausson and Haraldsson (2005) present three strategies for co-design of computer systems. The first involves the clients where more than one actor (subject) is involved in the activity. The second strategy instead involves more than one object that is for example that more than one system is designed at the same time. The third strategy is the combination of these two strategies. In this paper the perspective on co-design focuses on development, which is several actors (subjects) collaborate to create solutions for problems (objects).

SOCIAL CONSTRUCTIVISM AND ACTIVITY THEORY

Since my paper aims at investigating co-design in a Solution Sharing Network it is important to illuminate the social character of knowledge. The social constructivist perspective builds on the principle of social construction and the ideas can be traced back to classical sociology and philosophy (the thought can for example be seen in the works of Marx, Weber and Durkheim.) Today social constructivism can be characterized as a broad theoretical school and the variation between different author's descriptions are obvious. Aspects that are important in most descriptions are however the importance of social environment and that the individual development is influenced by culture and social context. Social constructivism also has the ontological position that the world is constructed through the knowledge of the individuals and that the social culture that is present in the context.

Important contributors to the social constructivist perspective are for example Jerome Bruner (late) and Vygotsky. Vygotsky (1986) criticized the mentalistic tradition (the cognitive theories) in that it tried to explain consciousness by the concept of consciousness itself. To be able to explain consciousness Vygotsky said that the explanatory principle must be based on other parts of the real world. He suggested that socially meaningful activities could play such a role. (Kozulin in Vygotsky, 1986) For Solution Sharing Networks, some of these activities could be related to development concerning the mutual interest that was the basis for forming the network in the first place.

By adopting a cultural way of thinking and acting the human being changes his or her psychological functions such as memory, perception and thinking. (Hydén, 1996) Those functions are called the lower mental functions that through psychological tools (that are internally oriented) are transformed into higher mental or cultural functions (Kozulin in Vygotsky, 1986) The constructive principle of the higher mental functions lies however outside the individual, in psychological tools and interpersonal relations. (ibid) In that way the human being learns to perform individual actions through performing actions together with other people (social activities). The learning individual thus *internalizes* the more complex structures. The psychological development proceeds like this from childhood when the child learns the

communicative meaning of an action through others. Higher mental functions can thus be seen as products of *mediated* activity. (Kozulin in Vygotsky, 1986) The difference between what the person can perform himself or herself and together with other people is called the zone of proximal development (ZPD) (Vygotsky, 1986).

A serious problem with a perspective on knowledge creation that builds on internalization and externalization is to explain how new cultural development is possible. That an individual learns from the zone of proximal development according to Vygotsky means that he or she learns knowledge from someone else in the group, thus the knowledge is thus already present. How can the a society develop? Activity theory (as described by Engeström (1987) tries to solve that problem and he rephrases Vygotsky's definition: The zone of proximal development is

the distance between the present everyday actions of the individuals and the historically new form of the societal activity that can be collectively generated as a solution to the double bind potentially embedded in the everyday actions. (ibid, ch 3)

A “doble bind” occurs when individuals get two contradicting messages (Bateson 1956 in Engeström 1987). To solve this situation it is necessary to reflect and to create a *new* activity that develops the society.

Engeström (1987) thus emphasis the collective knowledge and he also makes a distinction between *social actions* (as described by Leontjev) and *activities* which can be seen as a larger component. The latter can include several individual actions as well as social actions. Activities can also explain *individual actions* where the purpose otherwise would be difficult to visualize.

Engeström (1987) also presents a model of human activity: The model shows that in the production process where the subjects use instruments to create objects. Objects are also consumed by the subjects in the society. There are also rules that influence the social interaction between the subjects in the society. The objects are also distributed through division of labour between the subjects in the society.

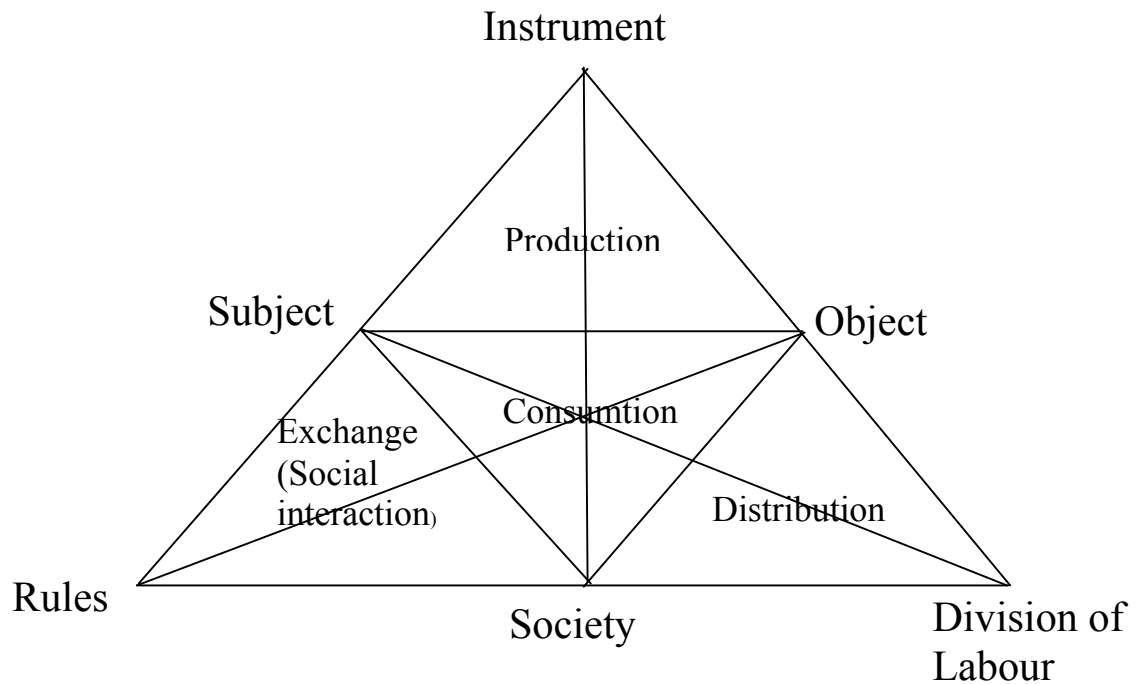


Figure 1: Engeström's model of human activity

The social constructivist perspective in combination with activity theory can be used to create an understanding for the transformation process (co-design) in a Solution Sharing Network. However to illuminate the process it is also important to connect it to the output, in the shape of advantages and disadvantages, that is described below.

ADVANTAGES AND DISADVANTAGES WITH COLLABORATION

To be able to discuss advantages and disadvantages with collaboration and co-design in Solution Sharing Networks it is important to also analyze to research that has been performed in relation to other groups. Katz & Martin (1997) ask why collaboration in *research environments* has increased. They identify several aspects that may have contributed to this development as for example costs. They especially emphasize the importance of technology and here it is possible to compare with Solution Sharing Networks. The rapid technical development makes it difficult for individual organizations to repeatedly invest in the resources that are necessary to meet demands from customers, society or authorities. Therefore an increasing number of organizations come together in virtual networks which Castells (2000) regards as a typical characteristic for informational societies. An example of that development is that local authorities collaborate in a network to create CRM-systems as demanded by the central government (Lind, 2005).

Katz & Martin (1997) also describe advantages and disadvantages with collaboration where certain advantages is connected to knowledge and activities – the participants can share knowledge, technology and skills. Another advantage is that the cooperation brings together several opinions and perspectives and these may be combined to create new perspectives. Kats and Martin (1997) also mean that if people cooperate in decision situation the decision quality will probably increase. The authors also adopt

system science perspective when they write that collaboration as an activity leads to creativity – collaboration gives something more than the sum of the parts. (ibid) What the authors emphasize is that it is possible to create something new by combining different perspectives, something that is impossible to reach by merely combining different parts. Another advantage mentioned by the authors has a social character – it is a way to reduce social isolation.

Katz and Martin (1997) also identifies disadvantages with collaboration. Costs as for example travel expenses, transportation costs and time aspects are example of such disadvantages. The technological development however makes factors as travel expenses and transportation costs less relevant. But there may still occur disadvantages related to bureaucratic rigidity.

SUCCESS FACTORS AND BARRIERS FOR COLLABORATION

Sonnenwald (1995) emphasizes the complexity of the communication patterns that are present when different actors collaborate by introducing the concept *contested collaboration*. There are differences in for example expectations, individual goals and professional language that can create difficulties for collaboration between group members. The differences may lead to situations where group members challenge each others contributions. This process is however not only negative – it can also enrich the cooperation. (ibid) It is easy to see that such processes may carry the development forward and at the end lead to better solutions.

An important aspect for a well functioning cooperation is a common vision. Hara et al (2003) writes for example that it is important for the participants in a network to be aware of a mutual goal and the benefits of sharing knowledge. It is however difficult to find methods to determine peoples visions (Elkjaer, 2001).

A way to characterize the work with the mutual vision is the concept commitment. Hoff & Weenen (2004) talks about three different kinds of commitment:

- *affective commitment*, that relates to the degree of connection between the member and the organization and the degree of participation that the member experience; affective commitment gives the member a feeling of wanting to continue the interaction in the network
- *economical commitment*, that relates to the costs that are connected to leaving the organization compared with the benefits that a continued commitment gives; economical commitment makes the member feel forced to stay in the network
- *normative commitment*, that is connected to a feeling of duty towards the organization; normative commitment gives the member a feeling of obligation to remain in the network.

These commitment kinds should not necessary be regarded as three separate forms of commitment. A normative commitment may create an affective commitment.

The research of Hara et al (2003) also identifies other important aspects for a well functioning collaboration. Such aspects include for example that the members

different expertise areas complement each other, that people are interested in the thoughts and ideas of other members and that these have a value that can be shared by all members in the network. One member may for example possess extensive theoretical knowledge, whereas another member has great practical experience. By combining these skills it is possible to reach an understanding beyond what each individual could reach. Another important aspect for successful collaboration is that the participants should have access to each other. This can be solved through geographical proximity that makes it possible for the members to share and become aware of each others work. Geographical proximity is also considered to increase the possibilities for collaboration and it also has a positive influence on personal relationships. A third aspect is that it is important that the participants start their work at about the same time. Shared experiences facilitate strong relationships. (Hara et al, 2003)

The importance of the geographical proximity can however be questioned. The new technology may instead have created necessary conditions to facilitate interaction over long distances. Katz & Martin (1997) also write that collaboration between actors of the same rank is more common than between actors with different ranks. An interesting question is therefore if the organizational and social proximity today is more important than geographical proximity.

What is said above shows that collaboration demands concordance as far as different important characteristics are concerned. Different stages of the collaboration may however probably be related to different success factors. In the beginning of the work working routines, writing styles and priorities correspond. But as the cooperation develop, other factors also become important. It could for example be management questions and attitudes towards a mutual knowledge area. As time goes on the personal relationships and friendships become increasingly important.

RESULT

Reasons for collaboration can roughly be divided into different categories and subcategories. There can be *internal reasons*, that are reasons that depend on circumstances within the organization, or *external reasons* that emanate outside the organization. Internal reasons may be economy, efficiency problems, competence problems or time problems. By combining different skills, the network may perform tasks that individual members might find impossible on their own. If solutions are shared, individual members can refrain from developing individual solutions and thus not reinventing the wheel over and over again. Software solutions that are used by several different organizations are also tested to a greater extent than individual solutions and should therefore be expected to create a safer environment than solutions that are individually developed. Sharing applications that one organization already is using is also time efficient.

External reasons may be pressure from authorities, customers or competitors. Sometimes central authorities may put demands on organizations that may require software applications. In such cases all authorities will require the same or similar solutions. Sometimes demands may also come from customers instead of a central

government, and if these demands are similar for different organizations, they may also in this case gain the same benefit from collaboration as in the previous example.

The transformation process in a Solution Sharing Network is illuminated in the following model.

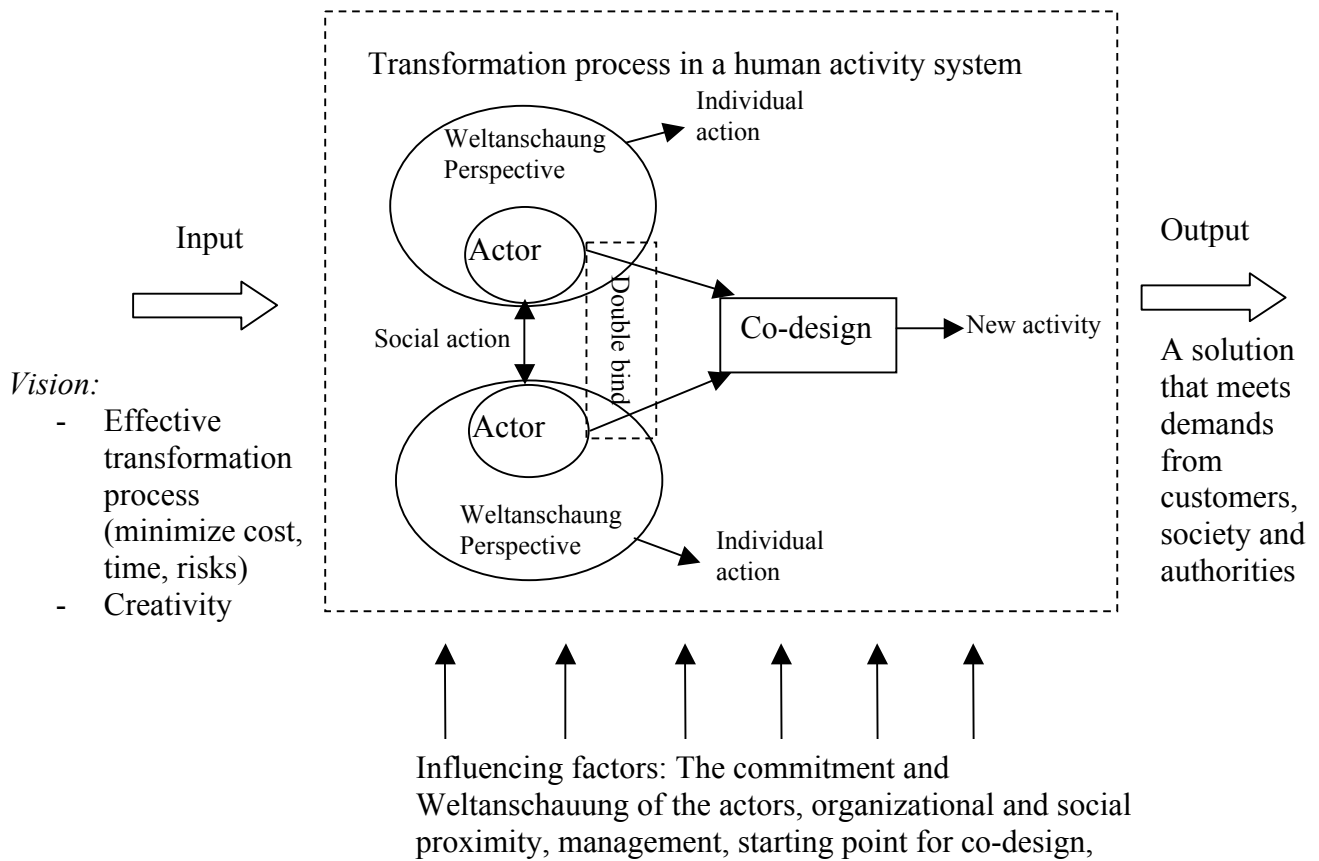


Figure 2: The transformation process in a Solution Sharing Network

The model shows that the input to the transformation process is a common vision of certain benefits that was the basis for forming the network in the first place: the members have a vision that through the interaction in the network they will be able to make the transformation process more efficient through creativity. Other goals are to minimize cost, time and risks.

In the process two actors (subjects in design) interacts with each other through social actions. When a social action occurs, specific perspectives (Weltanschauung) are communicated from one actor to another. Through this communication a specific actor can thus gain knowledge from the zone of proximal development according to Vygotsky. The social action leads later to individual actions and the boundaries for the zone is thus moved.

Collaboration in Virtual Networks

Sometimes actors can get two contradicting messages (a double bind). To solve this situation it is necessary to reflect and to create a *new* activity that develops the society. This influences the *Weltanschauung* of both actors.

There are also some factors that influence the process such as for example the commitment and *Weltanschauung* of the actors. The commitment can be affective, economical and normative and it is important that the *Weltanschauung* includes competences from different areas. The organizational and social proximity, management and *when* different actors get involved in the process are also important for the success in the network.

The output of the process is a solution that meets demands from customers, society and authorities. The figure below shows the transformation process in relation to society.

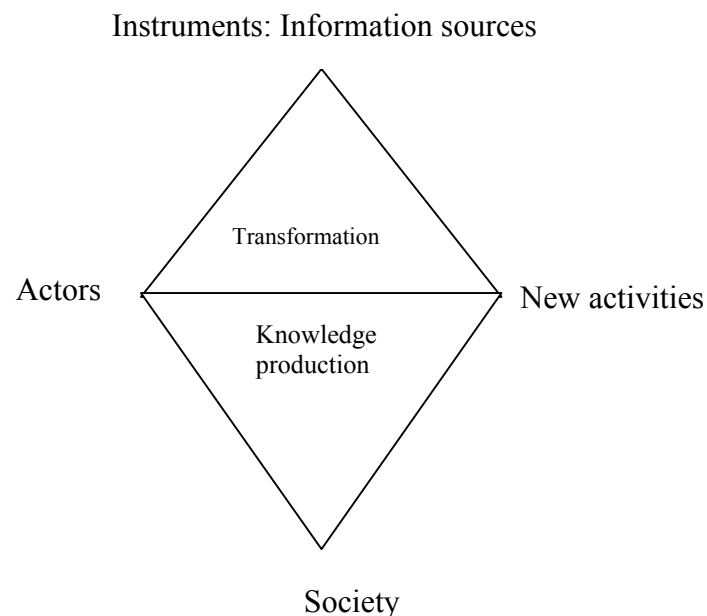


Figure 3: Development in a Solution Sharing Network

The figure shows that the actors (subjects) that are involved in the transformation process (knowledge production in the society) use instruments to create new activities. These are then made available to the society as a whole.

CONCLUSIONS

In this paper the transformation process (in form of co-design) in Solution Sharing Networks has been illuminated. The transformation process in such networks aims at exchange perspectives that change the *Weltanschauung* of the actors. Transformation of knowledge takes place through social actions that later leads to independent individual actions.

Even if this is a two-way communication process, it is the knowledge of one individual that is communicated to the other. But true *development* can not occur through such actions since this kind of knowledge already is available within the network. For development to occur, it is necessary to develop new activities through co-design where different actors collaborate to reach results that can not be reached using only one actor perspective. Co-design can be understood from a systems science perspective, where the new activity has been created through social interaction leading to something more than the sum of the individual actor perspectives. This is what Engeström calls the zone of proximal development.

The reason for development is that double-binds occur in everyday actions. This can be seen as problems but in this case problems are not seen as something entirely negative but as a basis for development. Reflection is however necessary to solve these problems and therefore possibilities for reflective thoughts, such as for example brainstorming or group discussions should be introduced.

Some important influencing factors are the commitment and Weltanschauung of the actors, organizational and social proximity, management and starting point for co-design.

Reasons for collaboration can roughly be divided into different categories and subcategories. There can be *internal reasons*, which are reasons that depends on circumstances within the organization, or *external reasons* that emanate outside the organization.

The model presented in this paper can be used to create an understanding for the interaction process in a Solution Sharing Network. This understanding can be important both for designing computer systems and the social practices in such networks.

REFERENCES

- Bateson 1956 in Engeström, Yrjö (1987): *Learning by expanding*.
<<http://lhc.ucsd.edu/MCA/Paper/Engestrom/expanding/toc.htm>> read 2007-04-25
- Castells, Manuel (2000): *Ekonomi, samhälle och kultur. Band 1: Nätverkssamhällets framväxt*. Göteborg: Daidalos
- Checkland, Peter (1999). *Systems Thinking, Systems Practice*. Wiley, Chichester
- Elkjaer, Bente (2001): "The Learning organization: An Undelivered Promise" i *Management Learning* vol 32(4) s 437 - 452
- Engeström, Yrjö (1987): *Learning by expanding*.
<<http://lhc.ucsd.edu/MCA/Paper/Engestrom/expanding/toc.htm>> read 2007-04-25
- Forsgren, Olov (2004): *Co-design i Practice: Building on the Churchmanian Philosophy of Knowledge*. Borås: IDA, University College of Borås
- Giddens, Anthony (2003): *Skenande värld : hur globaliseringen är på väg att förändra våra liv*. Stockholm: SNS
- Hara, Noriko, Solomon, Paul, Kim, Seung-Lye & Sonnenwald, Diane H. (2003): "An Emerging View of Scientific Collaboration: Scientists' Perspectives on

Collaboration in Virtual Networks

- Collaboration and Factors that Impact Collaboration” i *Journal of the American Society for*
Höglund, Lars & Persson, Olle (1985): *Information och kunskap. Informationsförsörjning – forskning och policyfrågor*. Umeå: INUM AB Publishing Division
Information Science and Technology—August 2003, p 952-965
- Katz, J Sylvan & Ben R., Martin (1997): ”What is research collaboration?” I *Research Policy*. 26 (1997) 1-18
- Kozulin in Vygotsky (1986): *Thought and language*. Cambridge, MA: Harvard University Press
- Lind, Ann (2005): Successful knowledge creation in virtual communities. Influencing factors and driving forces. Master thesis in informatics. University College of Borås
- Movement as Network (2005): <http://www.movementasnetwork.org>. Read 2005-11-25
- Olausson, Jan & Haraldson, Sandra (2005): *Process oriented IS – co-design of business and IS*. Paper presenterad vid den International Workshop on Communication and Coordination in Business Processes, Kiruna, Sweden, June 22
- Sonnenwald, Diane H. (1995): “Contested collaboration: a descriptive model of intergroup communication in information system design” i *Information Processing and Management*. 31, 859-877
- Vygotsky, Lev (1986): *Thought and language*. Cambridge, MA: Harvard University Press