COMMUNICATION IN NEW PRODUCT DEVELOPMENT NETWORKS – A CASE STYDY

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ABSTRACT

The purpose of this paper is to present current patterns, problems and tentative solutions to the problems related to inter-company communication in company networks developing high-tech products. Based on a single project case study, communication patterns such as project managers as gatekeepers, weekly project meetings for change management, memos as the main source of information, and e-mail as the main information distribution mechanism are described. Problems such as lack of trust, over reliance on gatekeepers, lack of defined communication methods and lack of inter-company process understanding, are discussed. Solutions presented include focusing on the set-up phase for increasing inter-company understanding and building trust, defining common operating procedures, on-line project monitoring, and building a project repository.

INTRODUCTION

A central issue in new product development (NPD) is effective and efficient communication [10]. Previous research has shown that the better the product development team members are connected to each other and to key external parties, the more successful the project is going to be [14]. Most research in the field of NPD communication, e.g. [1], however, focuses on communication in project teams inside a single company [4]. In present times, it is becoming common for projects to be performed in company networks, dividing the work between several companies.

Communication across company borders poses additional difficulties, e.g., due to factors like lack of trust, differing ways of working, and legal issues. Geographical distance, a factor that hugely reduces communication [2], is almost always present in these kinds of situations.

In figure 1 we have grouped new product development projects into four types according to the geographic and organizational dispersion of project team members. Communication in traditional product development projects (single firm, one location) has been researched carefully over the years (e.g. Allen's studies). Distributed projects, carried out by a single firm, but across several locations, are a newer phenomenon. In spite of this, communication in these projects has already attracted several studies (e.g. [3] and [9]). Many studies have reported how new information and communication technologies, like video conferencing, can support cooperation in distributed projects. The newest trend, networked product development, has not, however, attracted much research yet.

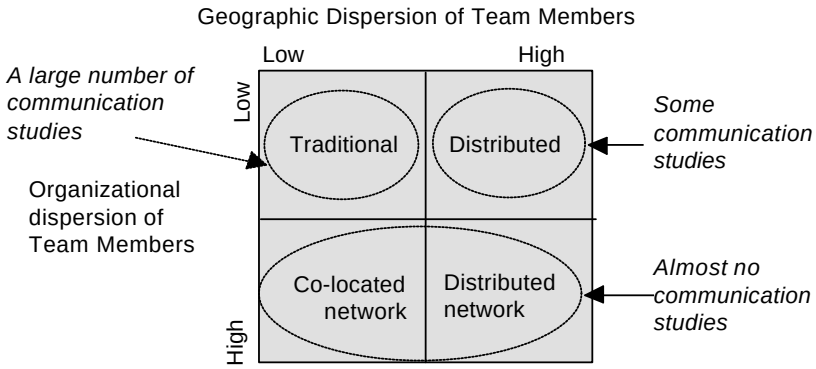

Figure 1. Past communication research of different types of projects. (Framework of project types modified from [7])

In this study we have concentrated on communication in project groups from the two lower quadrants, and call all these projects "inter-organizational" as an opposite to "intra-organizational" projects from the upper quadrants.

In the paper we first describe how companies in a distributed network accomplish information exchange and communication in their new parallel development situation. We then report on the communication problems they encounter, and the reasons for them. Finally, we discuss how current communication patterns could be further improved to alleviate the problems.

METHODOLOGY

Case network

This paper presents a single case study [16] on communication in a product development project carried out by a four-company network from the Finnish consumer electronics industry. The network consists of a customer, ElectroCo, one of its suppliers, PlastCo, and two 2nd tier suppliers, AutoCo and PaintCo. The structure of the network is shown in Figure 2.

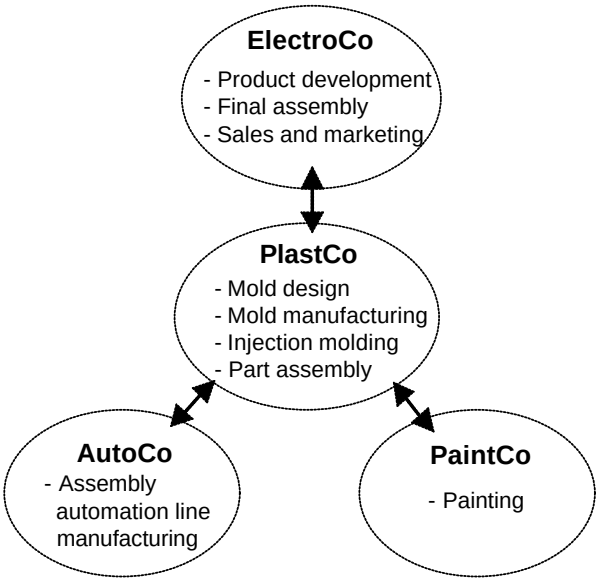

Figure 2. Companies and their tasks in the case network. Arrows in the picture illustrate both supplier relationships and main communication links.

The customer, ElectroCo, is a global consumer electronics company. ElectroCo is responsible for product development, final assembly, and sales and marketing. ElectroCo's supplier, PlastCo, builds manufacturing tools for the plastics parts, as well as manufactures and assembles the plastics components. PlastCo has started its internationalization, but is still quite small on a global scale, with most of its activities in Finland. Both 2nd tier suppliers, AutoCo and PaintCo, are small local companies. AutoCo is responsible for designing and delivering the assembly automation lines, and PaintCo paints plastic parts before assembly.

The companies have a joint project history spanning several years; ElectroCo and PlastCo have worked together since the early 80s. In its current configuration the network has existed for about two years. All the sites are located in Finland, with a largest inter-site distance of about 500 km.

The consumer electronics industry is characterized by a constant need to shorten project cycle-times, and a rapidly changing environment. Work is increasingly done in parallel with early subcontractor involvement. In the network studied, every new project involved suppliers earlier than before; in recent projects the suppliers were involved already in the concept design phase. The project we studied was the first in this network in which suppliers were involved before making the first injection molded prototype. This increased their possibility to influence the design of the final product.

Data collection and analysis

Data was mainly collected with the help of process simulation [6][11][12]. In addition, semi-structured interviews and studies of company documentation were used both to get data for planning the simulation session, and for validating the findings.

Process simulation

A process simulation session is a structured discussion, during which the participants simulate their own real work activities. The simulation is based on a simplified model of the work process under study, which is simulated in accelerated time during the session [12].

We had several reasons for wanting to use process simulation for data collection. First, in addition to allowing us to collect data, the process simulation also works as a process intervention with direct utility for the involved parties [6]. Second, it is an economic way of collecting large amounts of rich data that can be partly validated during collection since all stakeholders are present at the simulation session. Third, we wanted to experiment with using the process simulation as a method for data collection – earlier studies have mainly focused on the use of the process simulation for process intervention purposes.

Preparations for the simulation session

Before the simulation session, we made a process description of the case project with the help of seven project team members, four from ElectroCo and three from PlastCo. We used a simple modeling process, sticking post-it notes to the walls of a meeting room. We modeled the process and the information flow between the different stakeholders.

After the initial process modeling session, we validated and refined the model by interviewing nine persons, four from ElectroCo, four from PlastCo and one from PaintCo. Interviewees consisted of project team members, i.e., project managers, salespersons and engineers. In these semi-structured interviews, we also asked about current communication patterns and problems in addition to validating the model. About one week before the simulation session one-hour long information sessions were held in the participating companies.

The process simulation session

The actual process simulation session took place when the project was approximately halfway through the product development phase. The simulation covered the time period from the first prototyping stage when PlastCo joined the project, to the specification freeze. (Figure 3.)

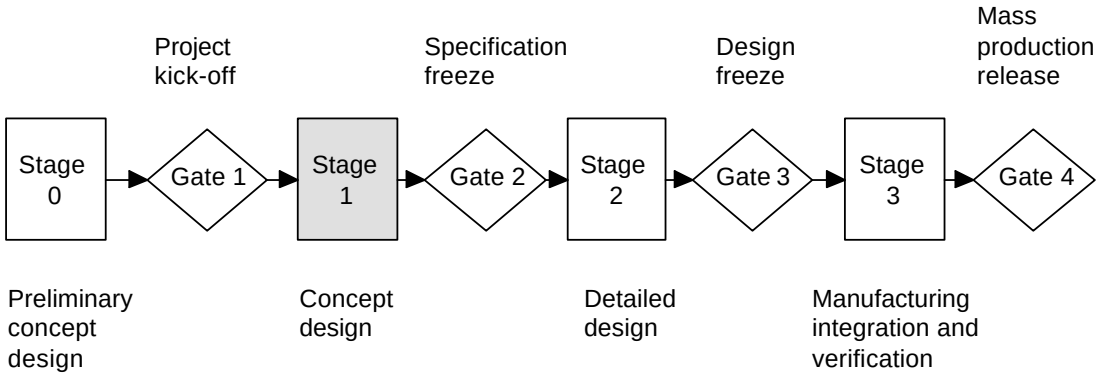

Figure 3. Main stages and gates in the product development process. The process simulation covered stage 1, i.e., the concept design phase, during which the product prototypes where designed and manufactured.

The one-day simulation session had 41 participants, 22 from ElectroCo, 18 from PlastCo and one from AutoCo. Unfortunately the representative of PaintCo was unable to participate. Of the participants, 19 were members of the case project team, e.g. project managers, designers, production persons, salespersons, quality engineers and materials experts. The rest of the participants were observers. These included designers from other projects, process developers and managers. The simulation session setting is shown in Figure 4.

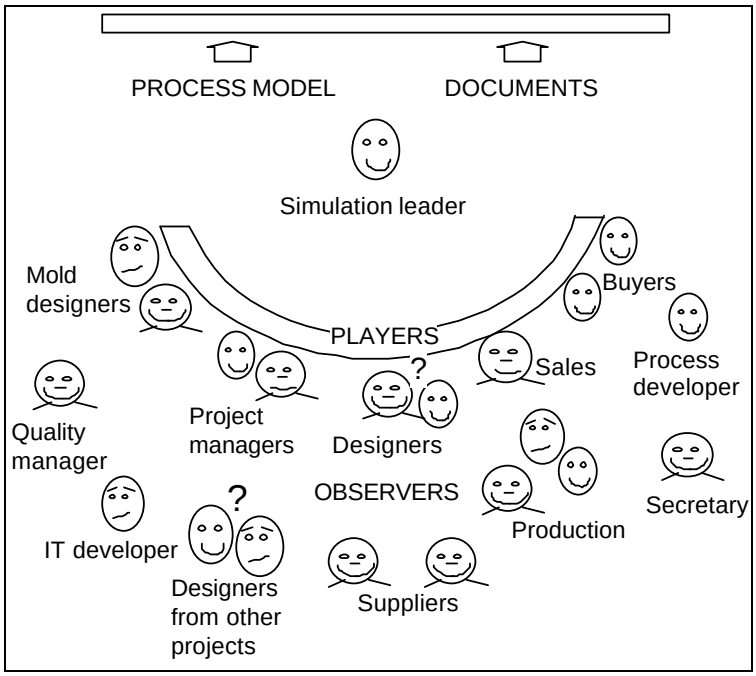

Figure 4. A model of a simulation session setup and participants (modified from [6]).

The agenda of the simulation day consisted of four parts: presentations, simulation, group work and filling in a questionnaire. First, researchers presented the objectives of the day, then the participants introduced themselves and after that representatives from ElectroCo and PlastCo gave short presentations of the processes of their respective companies.

After the presentations, the process simulation was started under the leadership of one of the researchers. The simulation followed the process description, which was projected on the wall. The most important documents were projected with an overhead projector. During the simulation, project team members described their work activities, communication flows and problems encountered. Many improvement ideas were suggested and discussed during the simulation. Observers were encouraged to comment, suggest new ideas and bring forward their experiences from other projects. To collect all improvement ideas and problems, participants were given post-it notes, on which they could write down their thoughts. These notes were then collected on the walls. After the simulation, almost one hundred notes were on the wall. In addition to these post-it notes, the whole session was videotaped. A scribe also took notes of all comments; these were synchronized with the videotape.

After the simulation, participants were divided into groups to select and present the most important improvement ideas. Finally, after the group work presentations, everyone filled in a questionnaire with both closed- and open-ended questions about the simulation and process improvement needs.

We analyzed the data by grouping all verbal information – interview notes, the post-it notes from the simulation session, and the open-ended questions from the questionnaire – into categories based on which we did preliminary conclusions.

RESULTS

Change from serial to parallel mode of operating

As in this case project suppliers were involved earlier than in previous projects, continuous communication was required. This caused a need for new communication patterns. In the early days of cooperation, the network had used the "over-the-wall" approach, giving information to the next development step only after the completion of the first [15]. PlastCo received designs from ElectroCo and then produced a mold and products according to them (Figure 4). In the project under study, the interaction between ElectroCo and PlastCo resembled what Wheelwright and Clark [15] call integrated problem solving (Figure 5). In this mode of communication, the downstream group is involved at the moment the upstream group starts working, thus getting a flying start for their own work. The communication patterns between PlastCo and its suppliers were not yet that developed.

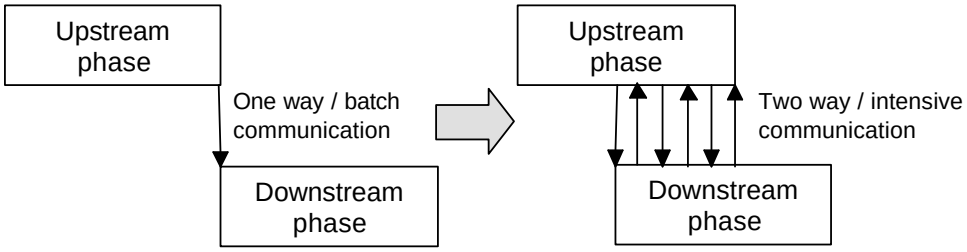

Figure 5. The direction of change in our case network is from a serial mode of working to parallel product development.

Current communication and information exchange patterns

We found four main principles that describe the current communication in the network: 1) project managers as gatekeepers, 2) weekly project meetings for change management, 3) memos as the main source for project status and change information, and 4) e-mail as the main medium for distributing written communication.

Project managers as gatekeepers

The information flow between companies, especially between ElectroCo and PlastCo, was mainly channeled through the project managers, who worked as gatekeepers [1][14]. The main part of the documentation and other information was first delivered to the own firm's project manager, who then sent it to the partner firm's project manager, who finally distributed the information inside his own firm (Figure 6.). This pattern was especially strong between ElectroCo and PlastCo.

The communication between PlastCo and its suppliers mainly conformed to the same pattern, however, commercial communications such as orders and invoices were not sent through the project manager (the dashed arrows in the figure).

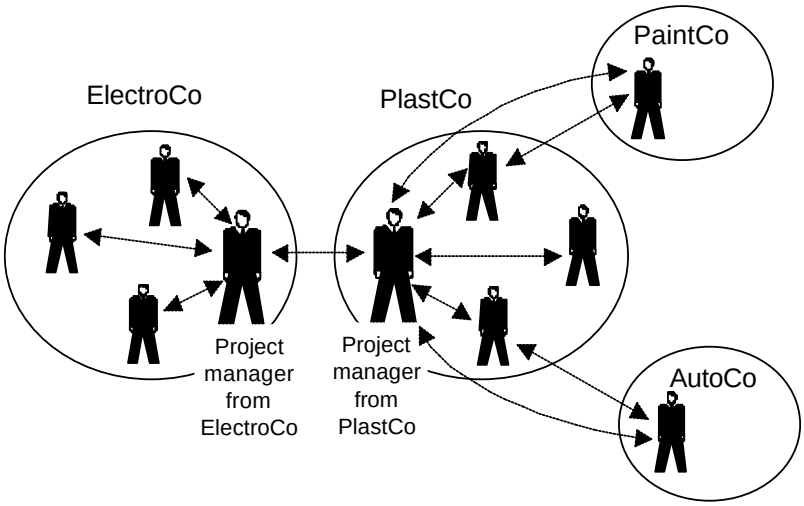

Figure 6. Communication channels between and inside case companies.

Besides documentation, also all other kind of communication mainly used this pattern. Direct communication between project members from different firms was not explicitly forbidden, but it was not encouraged either. It was considered important that project managers knew everything that was happening and that nothing, not even small things, were agreed directly, "behind their backs". In addition to this "rule", direct communication would have been difficult because the project members did not know all relevant names and functions of other project staff across company borders. In the questionnaire, which was filled in at the end of the process simulation session, we got comments such as: "In the simulation I met for the first time several persons that I have been working with."

Weekly project meetings for change management

The fair geographical proximity of ElectroCo and PlastCo made it possible to have on-site weekly meetings between the two companies. In addition to the project managers, other staff that was deemed needed from both companies, occasionally also from PaintCo and AutoCo, was invited. Both organizations found regular meetings to be a very useful information sharing mechanism; earlier meetings had been scheduled more occasionally, on a need basis. For example, all changes to ElectroCo's product designs were discussed beforehand in these meetings and PlastCo could

comment on the changes and suggest alternative solutions from the point of view of manufacturability. In the simulation session several persons stated that by having these meetings and discussing all changes together, they have both speeded up the project and avoided a huge number of product change related mistakes.

Memos as the main source of project status and change information

The main source of information on project status and changes were the memos that the project managers from either ElectroCo or PlastCo wrote during the weekly inter-company meetings. The writing or distributing of these memos was not systematic. The project managers sent the memos by e-mail to the meeting participants and to other internal project members that they thought might need the information; occasionally PlastCo's project manager sent the memos also to AutoCo and PaintCo. The memos contained information, e.g., about changes to the product, mold or timetable, and activities that should be done. Several persons in the simulation session expressed a need to get these memos, in order to keep up-to-date with the happenings in the project. These project members were afraid that they might miss some information and waste their efforts while working with outdated information. Those kinds of situations were not new to these persons; they had happened frequently in the past. The memos were also the only source of information on schedule changes, even though they contained only the new deadlines, not comparisons to old schedules nor any analysis of the effects of the changes to other tasks or partners.

E-mail as the main medium for distributing written communication

The mail mechanism for sharing written information was e-mail. It was used both directly for short messages and for sending documents as attachments. Also the memos from the weekly meetings were sent as e-mail attachments. Only offers and orders were considered too sensitive to send by e-mail. For these, fax and regular mail was used. Phone calls were also used frequently, especially when the matter was urgent. Some simulation session participants commented that issues agreed on the phone were too easy to forget, and that they therefore preferred e-mail, which leaves a written trace. Product documents, like 3D- and 2D-files, were sent through a direct electronic connection.

Communication problems

Based on the process simulation and the interviews, we identified seven communication related problems: 1) a lack of trust leading to information hiding; 2) a lack of understanding of partners' information needs and information generation; 3) a lack of agreed upon communication mechanisms and an over reliance on key individuals; 4) misguided use of information-push mechanisms; 5) non-working network-level document management; 6) a misfit between process information demands and information availability leading to a reversal of the order-delivery process; and 7) slowness of organizational adaptation to new communication needs in parallel development. Each of these is further discussed in the following sections.

Lack of trust leading to information hiding

Despite the long history of cooperation between ElectroCo and PlastCo we would not yet classify the relationship between these case companies a partnership, because there is still a lack of trust leading to information hiding. Due to the nature of its business, ElectroCo wants to prevent any information from leaking out, especially information concerning new products. For this reason the suppliers are given only the least amount of information needed as deemed by ElectroCo – in practice they often receive too little information. On the other hand, PlastCo wants to protect its know-how from leaking to its customer. And to be trustworthy, PlastCo has to be very careful

when giving the information they get from ElectroCo to its own suppliers. PlastCo therefore also rather gives too little information than too much.

This atmosphere of lack of trust and poor sharing of information is stronger than the legal agreements between the companies: for example, a project member from PaintCo claimed: "I do not get all the documents made by ElectroCo, even though we have agreed on that with PlastCo, because people in the field do not know about the written agreements and are too afraid to give us the documents".

Lack of understanding of partner's information needs and information generation

Project team members are not familiar with the partner firm's processes or operating habits. The project members often do not know what kind of information the partner would need or what kind of information the partner could provide and when. In practice this leads to existing information not reaching the partner needing that information. For example, a project member from PaintCo complained: "I would like to automatically get all the information concerning painting that the project manager of PlastCo gets from ElectroCo. Now I have to ask for the information and it takes time. One reason for this is that PlastCo does not know what information we need."

Lack of agreed upon communication mechanisms and over reliance on key individuals

The communication in the network is heavily dependent on the project managers' ability to share information. Since the project managers are very busy, and the distribution of information is not agreed upon, information does not always flow quickly enough. In some cases, as discussed above, the information might never reach the people needing it. The reliance on project managers is also problematic since they travel a lot and are not always able to distribute information. In this information delivery chain from person to person, information is easily delayed and sometimes even lost. Many project members expressed a wish for making relevant information transparent to the whole network instead of relying on single busy individuals for information sharing.

Misguided use of information push mechanisms

Besides complaining about not getting all information needed, a few part-time project members came out with an opposite complaint: they got too much information via project wide, intra-company mailing lists. These persons worked with several projects, so they were not interested in all details.

Non-working network-level document management

At the network level, there was no working mechanism for document and version management. This led to situations in which it was unclear, e.g., which version of a drawing was the newest. Inside PlastCo mainly paper documentation was used. Both ElectroCo and PlastCo had electronic archives for documents, but they did not cover all documentation. Also, documents were not updated frequently enough and it was difficult to locate documents. In practice, many project members had their own personal archives, typically as paper documents. For example, the project manager from PlastCo mentioned: "I have all project documentation, except product files, as paper printouts in my folders. Actually, that is the only place in PlastCo where the whole project documentation can be found".

Reversal of the order-delivery process

For a supplier, like PlastCo, AutoCo or PaintCo, it is often very difficult, sometimes impossible, to write an accurate offer requested by the customer, because the supplier does not have all the information needed for making that offer. The customer does not have that information either,

because there is no one who would know in the beginning of the product development project exactly what kind of product it is going to be, how much effort is needed from the supplier, what material is needed or what kind of assembly automation line should be ordered. The supplier has to make a lot of estimates, which might be fateful, because a supplier often offers a too low instead of a too high price, in order to secure the deal.

Moreover, for the customer it is difficult to order in advance, because the customer knows exactly what to order only after the actual delivery. According to the process simulation participants, an actual reversal of the order-delivery process has taken place several times in earlier projects: e.g. the order for a mold has arrived from the customer only after the mold has been used in production and the first parts have been delivered to the customer. Also in our case project, the prototype mold had been used before the order arrived. Late orders cause a lot of problems to suppliers since they cannot send invoices before getting an actual order. This leads to a situation where the suppliers carry a large financial risk since they never can be totally sure to actually get an order for the work already done.

Slow change of staff attitudes

The case companies have moved fairly quickly from a serial mode of product development to parallel development with early supplier involvement. However, people's attitudes do not change that fast. Project members from the suppliers were used to getting all information they needed in one batch, after which they could proceed without any customer-initiated design changes. Now, they have to start with preliminary information, with the rest coming in pieces, and a constant risk of information change. A project member from PaintCo stated: "It would be much easier to get all information in one batch." It is difficult for these people to understand that the situation has changed drastically, now they are taken to project in the middle of the product development phase, not after it. A mold designer from PlastCo said: "I know that the situation has changed. Anyway, it is difficult to understand that when I have just finished the mold design, ElectroCo wants to change the design and I have to abandon my earlier work and start it all from the beginning, even though I had done the best job I could!"

Despite these obvious problems, also positive comments were heard. For example, a mold specialist commented happily: "Designers from ElectroCo have accepted many of my ideas to change the design for easier manufacturing."

These comments show that good things for suppliers, like the possibility to influence the design for easier manufacturing solution, are easy to accept, but the bad things like changes and not getting all information at once, are very difficult to understand. Many project members from PlastCo felt that ElectroCo was just so mean that it did these changes without caring what kind of trouble they cause to PlastCo. Partly they were right; designers from ElectroCo seldom knew how much trouble a tiny change might mean to PlastCo.

The simulation session helped to close at least part of this gap of understanding between the partners. We got comments like this: "Now I understand much better ElectroCo and its endless design changes in the beginning".

Suggested improvements

The most important improvement area for this network is lead-time, i.e., increasing the speed at which the network can bring new products into market. Effective and efficient inter-departmental communication has been found to correlate with new product development lead-time within a single company, e.g. [8]. We hypothesize that this result also holds for company networks; by enhancing communication, we think that this network and other similar networks could make a huge improvement in lead-time. In this chapter we present four means to improve communication:

1) team building and understanding the partner; 2) defining common operating procedures; 3) on-line project monitoring; and 4) a common project document repository.

Team building and understanding the partner

Understanding the processes – especially the needs for and the generation of information in a partner company – is a prerequisite for fruitful communication. Personally knowing the team members and their roles makes the initiation of contact easier.

A joint team-building workshop in the beginning of a networked project could both help understanding the partners' processes and help team members to become acquainted with each other. A process simulation could also be used during such a workshop. Our experience from three simulation sessions indicates that it is a good method for partners to meet, to learn about each other's processes and to further develop their cooperation. From the simulation, described in this paper, we got comments like: "In the simulation I saw how little the partner knew why we operate the way we do."

We think that the process simulation method could be used not only to simulate existing processes, but as a way of practicing new common ways of communicating and cooperating.

Common operating procedures

In our case network, project groups typically just jumped into new projects and started working without first planning how to work together and what kind of common procedures to use, e.g., for information sharing and change management. However, advance planning might be useful. Before starting a new project, team members should agree on common operating procedures. Especially, designing efficient communication patterns is important. These patterns include communication channels, i.e. who delivers, what information, when and to whom, who should communicate with whom and how should the broader project team be informed. Change procedure is an important one and should be designed carefully. Designing and informing about these patterns can be done e.g. in a joint team-building meeting in the beginning of the project. For networks with a long lifetime, the common operating procedures should probably be defined at the network level, not at the project level.

Online project monitoring

Project members in a networked project are very eager to know how project is advancing in other parts of the network, because changes to one partner's schedule almost always have effects also on the schedules and work of the other partners. When they know how the others are advancing, they can better schedule their own tasks. For example, mold designers need to know when they are going to get new product files, so that they can be ready to do changes right away, and production engineers want to know when the mold is going to be ready for test runs, so that they can reserve the right resources for the runs. In our case, the only means to know in advance was to constantly ask upstream groups.

Several persons in the simulation session wished for an online project schedule for the whole network. This schedule should be constantly updated, otherwise people cannot trust it and they have to ask anyway. The impact of schedule changes to schedules in other parts of a network is necessary to include, but also challenging. Even updating such a common schedule in the weekly meetings, would be a huge improvement – at least according to some of our case project members. This idea was also met with criticism – one project manager indicated a need to have two schedules – one internal and one to show to the suppliers; this is yet another indication of the lack of trust within the network.

Project repository

Several persons in the simulation session and in the interviews wished for instantaneous access to the newest information – the objective should be transparency of all common information, not only schedules, to every network member. A joint project repository for all documents and other information was suggested. Using Internet technology, the whole project documentation could be available from one place regardless of its physical location. Information-pull mechanisms, instead of information push, could be used. Thus, everyone could search for and follow the information he or she is interested in and nothing else.

DISCUSSION

Communication differences in intra- and inter-organizational projects

Communication in inter-company product development teams seems to have both all the same problems as intra-company teams, but maybe in a more severe form, and also their own special problems. Geographical distance, that e.g. Allen [1] [2] has broadly researched in intra-organizational projects, exists quite often also in inter-organizational projects. However, solutions that new information and communication technologies provide to support these geographically distributed projects are much easier to take into use inside a single company than between several companies, since there is typically no need to integrate several different IT systems.

Daft and Lengel [5] suggest that cooperation between departments needs rich media. We think that this is also important for successful inter-company cooperation. Lack of trust, that e.g. Wheelwright and Clark [15] report between departments, is very deep in our case network. Building trust and an open atmosphere in the beginning of a networked project requires a lot of efforts at all levels of organization. The goals of separate companies might also be hard to harmonize. The goals of different departments may also be different, but normally a company has, at least in a larger scale, coherent objectives. When dealing with networks of independent companies achieving a shared goal can be challenging.

Processes and operating procedures, including communication, may differ both between departments and between companies. Inside a single company, however, it is easier to standardize the operating procedures than between companies. Companies may do projects with several customer and supplier firms. It is almost impossible to standardize the operating procedures for dealing with them all. The next sections discuss each of these in more detail.

Lack of trust and information hiding

The process simulation session revealed that there is still a lot of information hiding and lack of trust between co-operating companies. Wheelwright and Clark wrote about the lack of trust inside a single company when integrating upstream and downstream groups. They talk about joint responsibility and whether product engineers can trust that manufacturing is willing to cope with the changes coming from development and whether process engineers can trust on their part that product engineers will help them to overcome manufacturing difficulties.

However, between the cooperating companies secrecy and lack of trust are probably even more severe and broad problems. For example, in our case study, ElectroCo was afraid that suppliers might, by accident or even on purpose, leak product design data to outsiders. For this reason, ElectroCo preferred giving too little than too much information. On the other hand, some people felt that PlastCo was afraid to lose part of its own know-how to ElectroCo. So, the attitude of hiding existed on both sides. In the questionnaire, there came out several comments that cooperation between these four companies would need more trust and less secrecy to succeed.

Open atmosphere would surely enhance information flow and communication in a networked project.

Communication media

Daft and Lengel [5] classify inter-departmental relations according to difference and interdependence between departments and suggest suitable communication medias for each relation type. Inter-organizational product development projects are quite close to their combination of high difference and high interdependence between parties. For communication in this kind of relation, writers suggest rich media to resolve differences and large amount of information to handle the interdependence. In terms of media choice, especially face-to-face communication and meetings are suitable. The same could apply also to an inter-organizational situation, where team participants come from a differing environment and might have difficulties to understand each other. Also, in our case project, team members had found rich media, i.e., weekly meetings the best way to coordinate their work and stated that these meetings prevented many problems from occurring.

Imperfect goal alignment

The objectives in a single company are normally the same, e.g., to profitably produce and sell and add shareholder value. Departments may of course have their own more specified goals and departments may even compete with each other. However, in company networks the objectives for cooperation quite often differ, e.g., the customer may want to buy manufacturing as cheaply as possible and the supplier may want to build a long-term cooperation. These imperfectly aligned objectives might affect openness of communication and also complicate understanding the partner.

Process mismatch

Independent companies in a network quite often have their own processes and operating procedures, also for communication and information flow. Between departments, in a single company, the same may be true; the border between them can be as hard to cross as between companies. On the other hand, if a company wants to standardize its processes, or take a communication process into use across all projects, it is much easier to do than in a network. There are at least two reasons: first, one single company in a network cannot determine how the other members operate. Second, in a network, one company might have several customers from different industries and also several suppliers, so unifying processes across all these companies and industries is almost impossible. In practice, it is quite often the suppliers who have to adjust to the operating procedures of their customers, instead of the other way around. This leads to a situation where suppliers have to operate differently towards every customer. In the simulation session we got comments that the operating procedures differ also in all projects with the same customer, because every project manager is used to operate in his or her way and no one has even tried to unify these procedures. The players expressed a clear need for unifying the procedures.

Problems in using information technology

Company borders also pose challenges for the usage of supporting information technology, like product data management (PDM) systems, in a network. The simulation participants expressed a need for having all information in one place. A common product data management system for the whole network would be ideal, but realizing it would be extremely challenging. Many firms already have their own PDM systems. In general, the systems are not compatible with each other. A small, networked firm may end up in a situation in which all its customers have different systems; it is of course impossible for a small firm to use or acquire several different systems.

On the other hand, the customers will not let suppliers to use their systems, because of a fear of leakage of confidential information. The systems themselves would provide mechanisms for hiding information, but the problem is more related to feelings and attitudes. In our case network, people seemed not to trust information technologies – they wanted the own information physically located inside their own company. Technically it is possible to build a distributed solution, in which information is physically located inside every firm's own system, but still can be fetched through a common user interface, and which would meet the security demands of companies in our case network.

Agreements in networks

Agreements between networked companies should take into account the changed situation where all information is not available in the beginning of a project. In intra-organizational projects agreements are not normally a problem. Making agreements with several partners in projects that start off with unclear and changing goals is a challenge that still needs to be tackled. In the British construction industry, a new way of contracting, the New Engineering Contract (NEC) has taken some promising steps towards new contracting principles for projects with inherent uncertainty [13].

The process simulation as a research method

We found the process simulation to be an effective and efficient method for collecting and partly validating rich data from several sources in one session. When most stakeholders are present, contradictory opinions can be discussed and often resolved. The process simulation is also beneficial to the companies as it also works as a process intervention, often leading to improvement in the ways of working.

On the negative side, we found problems common in group settings: some persons might dominate the situation too much, people might be afraid of bringing forth certain problems since their bosses and customers are present, and shy people tend not to participate. We think that many of these problems can be alleviated by careful preparation and facilitation.

In order to succeed, the simulation session has to be well prepared; it helps if the facilitator has an understanding of the process and problems beforehand. It is important that all key stakeholders are present, and that the process being simulated is in fresh memory. When choosing the simulation topic, a difficult balance between breadth and depth has to be struck. When one purpose of the simulation is to allow for data collection for research purposes, it is important both to recognize that this needs to be taken into consideration when planning the simulation, and that it sets tight demands on the facilitator, since discussions easily tend to drift off topic.

Future research

In the future, we plan to extend this work by further studying other cases if distributed inter-company product development projects. Comparing communication patterns in successful and unsuccessful projects would provide useful information for better managing networked projects. Also, comparing communication in different phases of projects and across different types of projects would deepen our understanding of inter-project communication dynamics.

In the future we are going to concentrate on the set-up phase of networked projects after the partner selection. We will study what should be agreed on in the beginning of a project about operating procedures, especially concerning communication. We plan to design efficient procedures for communication and information flow and to test them in case projects. Also, we will study how team-building meetings could help in improving communication and what these meetings should include to be useful. Process simulation proved to interesting as a research method; we also plan to test how it can be used to train people for future inter-company projects.

REFERENCES

[1] Allen, T.J. (1977) Managing the Flow of Technology: Technology Transfer and the Dissemination of Technological Information within the R&D Organization. Cambridge: MIT Press.

[2] Allen, T.J. (2000) Architecture and Communication Among Product Development Engineers. Proceedings of the 2000 IEEE Engineering Management Society, EMS – 2000, Albuquerque, New Mexico.

[3] Boutellier, R., Gassmann, O., Macho, H. & Roux, M. (1998) Management of dispersed product development teams: the role of information technologies. R&D Management, 28, 1, 13-25.

[4] Brown, S. L. & Eisenhardt, K. M. (1995) Product Development: Past Research, Present Findings, and Future Directions. Academy of Management Review, Vol. 29, No. 2, 343-378.

[5] Daft, R. & Lengel, R. (1986) Organizational Information Requirements, Media Richness and Structural Design. Management Science, Vol. 32, No. 5, May.

[6] Forssén-Nyberg, M. & Luhtala, R. (1996) Increasing customer satisfaction – building a simulation game for the work process of a newspaper. From: The Simulation and Gaming Yearbook, Volume 4. Games and Simulations to Enhance Quality Learning. Ed. Saunders, D, Persival, F. & Vartiainen, M.

[7] Katzy, B., Evaristo, R. & Zigurs, I. (2000) Knowledge Management in Virtual Projects: A Research Agenda. Proceedings of the 33rd Hawaii International Conference on System Sciences – 2000.

[8] Kessler, E. & Chakrabarti, A. (1996) Innovation Speed: A Conceptual Model of Context, Antecedents, and Outcomes. Academy of Management Review, Vol. 21, No.4, 1143-1191.

[9] McDonough, E., Kahn, K. & Griffin, A. (1999) Managing Communication in Global Product Development Teams. IEEE Transactions on Engineering Management. Vol. 46, No. 4, November.

[10] Moenaert, R. K., Caeldries, F., Lievens, A. & Wauters, E. (2000) Communication Flows in International Product Innovation Teams. Journal of Product Innovation Management, 17: 360-377.

[11] Pankakoski, M. (1998) Knowledge Sharing and Value Reproduction. The Work Flow Game as a Case Example. Doctoral Thesis, Helsinki University of Technology, Work and Organizational Psychology, Report No 6. Hakapaino.

[12] Ruohomäki, V. (1994) Simulation games and their effects – the Work Flow Game for the development of administrative work. Licentiate thesis, Helsinki University of Technology, Industrial Economics and Industrial Psychology, Report No 156. (In Finnish)

[13] Thompson, R.M., Vorster, M.C. & Groton, J.P. (2000) Innovations to Manage Disputes: DRB and NEC. Journal of Management in Engineering, Vol. 16, No. 5, September/October.

[14] Tushman, M.L. & Katz, R. (1980) External Communication and Project Performance: An Investigation into the Role of Gatekeepers. Management Science. Vol. 26, No. 11, November.

[15] Wheelwright, S.C. & Clark, K.B. (1992) Revolutionizing Product Development. Quantum Leaps in Speed, Efficiency, and Quality. New York: Free Press.

[16] Yin, R.K. (1994) Case Study Research, Designs and Methods. Thousand Oaks, California: Sage Publications.