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Collaboration in Software Development: Lesson Learned from Two Large Multinational Organizations

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Abstract

Collaborative software development, through inter-organizational collaboration or outsourcing, has become increasingly attractive for organizations. However, little is known about the problems associated with collaboration. Therefore, organizations engaging in collaboration need to be aware of the potential pitfalls involved. For this purpose, this study explores problems and important factors for successful collaboration in relation to inter-organizational collaboration in software development in Nokia and Philips. The problems in collaborative software development were communication, unclear agreements, security policy issues, inflexibility over changes, adaptation to the environment, team coordination, misunderstanding of the goals, lack of human resources, difficulties monitoring the work, and commitment. The results suggest that the success factors of collaborative software development are effective communication, careful preparation, technical experts, managers and legal experts involved in contract negotiations, a clear understanding of cultural differences, clear specifications, logical architecture, efficient information distribution between the parties, and the right competences.

Keywords: Global software development, collaboration, software development

1. Introduction

Global inter-organizational software development has become increasingly common (Heeks et al, 2001, Herbsleb et al. 2001). Unsurprisingly, inter-organizational collaboration has become one of the key topics of strategic management research (Weck 2003). Consequently, numerous studies on inter-organizational collaboration have been conducted. Oza et al. (2004) present critical factors regarding software outsourcing, Herbsleb et al. (1999) study coordination and architecture issues, Herbsleb et al. (2003) and Herbsleb et al. (2000) explore communication and distance questions. Other collaboration research encompasses collaboration relationships (Beulen et al. 2002), trust

(Sabherwal 1999), collaboration practices (Paasivaara et al. 2004) and teams (Carmel 1999).

While these studies have touched on problems relating to collaboration (as a by-product of their research), we are unaware of any qualitative studies which concentrate explicitly on problems in collaborative projects or on the factors that make collaboration successful in large IT organizations. This study aims to answer this important problem by exploring the problems and important factors for successful collaboration in Nokia and Philips. Such information is important not only because inter-organizational collaboration is increasing, but also since dispersed projects are argued to be more challenging than traditional localized projects (Carmel 1999, pp. xiii).

This study is organized as follows. Section 2 presents the research settings and methods. The results are presented in section 3, while section 4 discusses the findings of the study in view of the related work. Finally, section 5 summarizes the findings.

2. Research methods and research settings

This paper uses interpretive interviews following a grounded theory method, empirically investigating a phenomenon in its real-life context (Yin 2003, 13). A concern in any interview is that the questions asked may be influenced by the scholars' opinions, views and interests. To avoid this problem, Spradley (1979) proposes that scholars should ask questions which are sufficiently global to enable interviewees to express their experiences and views in their own words. In Spradley's (1979) method, the respondents are encouraged to talk spontaneously about their experiences, without the scholars influencing the respondents' answers, while the scholar conducting the interview records the responses. The primary questions (or "global questions" in the terms used by Spradley, 1979) asked were: what are the problems in collaborative software development projects and what factors have major impacts on the success of collaborative software projects?

The interviews are analyzed using grounded theory. Grounded theory aims to discover or generate a theory or set of hypotheses from the raw data (Creswell 1998, pp. 55-56; Glaser 2004), interviews in this case, without any particular theory in mind. The respondents' original answers are conceptualized as they emerge from the interviews. These categorized views can be loosely regarded as hypotheses that can be tested by future research (cf., Creswell 1998, pp. 57-58).

In this study, grounded theory is applied in the following way. First, extensive and specific notes were written from the interview tapes. From the notes, different categories were identified, and these were written in the margin of the notes (the categories included, for example, communication and data security). After the categories had been identified, their properties were listed and attached below them. All the categories were examined in order to identify an overall phenomenon. Then all the categories and the main phenomenon were grouped together in bulletin board. After this, connections between the phenomenon and categories were explored. Finally, the "storyline" was identified from the description of bulletin board.

Data was collected from Nokia and Philips. These companies have long-term experience of collaboration. Through help from these companies, five leading experts on collaboration within the companies were identified and interviewed. These experts had several years of experience in customer-supplier collaboration (from the customer's side), in multisite software development and joint ventures. Three of the interviewee's had over ten year's of experience of collaborative projects. The interviews were recorded in January and February 2005 in Finland and the Netherlands. The interviews lasted from 45 minutes to 120 minutes and were based on the overall experiences of these experts on collaboration in Nokia and Philips, not on any particular project or partnership. Four experts were interviewed from one company and one from the other.

3. Results

3.1 Problems in collaboration

3.1.1 Communication

All the experts saw communication as the most critical issue in collaboration: in order to achieve a successful result, the communication must work properly. One expert refused to call communication a problem, stating rather that is a minimum requirement that "has to be carried out well". According to the interviews, learning to communicate with each other in a global environment takes time. If the cooperating parties do not have the opportunity to meet face to face with all the team members, then working together is harder. When the team is working in the same building, communication seems to be much easier, another expert said. Because of the long distances involved, meeting face to face is not always possible. One expert said that they use phones, e-mail and NetMeeting for long-distance communication. With e-mail you can reach many people with the same amount of effort. However, the experts noticed that e-mail seems not to be a sufficient communication tool by itself. E-mail can be misunderstood and people can easily feel offended if they do not understand the message correctly. Furthermore, you cannot be sure that it will reach its destination. Experts said that the telephone is used in personal communication and in conference meetings, along with NetMeeting-style programs. They saw bad lines, and the fact that communication is not that efficient without actually seeing another as possible problems with communication by telephone. Because you cannot use gestures and you cannot see the impact of what you are saying, there is a higher possibility of misunderstanding. Two experts said that they have had problems when speaking with foreign partners. When the line is poor and the person you are calling has a very strong accent it is difficult to understand one another.

"Our partners have strong accents and the telephone line is also poor. So when they speak there can be words missing because of the bad line. When we start working on a new project and we do not know all the details yet, it is extremely difficult to communicate with people from a different culture and with a different language."

The experts felt that NetMeeting is quite suitable for collaboration, although one expert said that people do not necessarily pay attention when something is presented via NetMeeting or a PowerPoint presentation, but instead read their e-mails at the same time. When you use a traditional flip chart everybody in the room focuses on that, he continued. A conference call combined with a Web camera is not very useful, according to the

experts, since the quality of the picture is low. Other possible communication channels were a project webpage, and tools for sharing files. Experts considered these tools to work more or less without problems.

3.1.2 Unclear agreements

One of the experts said that unclear agreements are among the biggest problems in customer-supplier collaboration. The agreements are made on a high management level with the legal staff, and the software development level is usually left out of these negotiations. After the agreement is made, the technical experts are invited to come along. At that point it is usually too late to include any important details in the contract. The experts observed that the high management level hardly realizes these problems because the personnel change quite often and it can almost be described as a virtual organization.

3.1.3 Security policy issues

Two experts saw security policy issues a major question in collaboration. They felt that they held them back from operating with a full arsenal on the project, as one of them explained:

"It would require a clear strategic vision from the company to show what kind of information you can share, and how you can state it."

Another two said that in their work, all the necessary information is shared and the contracts protect the security issues.

3.1.4. Inflexibility concerning changes

Changes to the product cost money. One expert said that when the need for changes regarding the product or system arises in a collaborative software development project, the first question is: "*who* [we or the partner] *is going to pay for this?*" The expert argued that changes in the product are easier to implement in-house than in the case of partnership (as in the case of collaborative software development).

3.1.5 Adaptation to the environment

One interviewee observed that subcontractors might have difficulties adapting to the customer environment:

"[It is problematic] *if the supplier-organization is not mature enough to adapt itself to the environment in which they are operating. And it is not that they would not want to but the fact that it is so expensive for them. They cannot assimilate themselves with the customer-organisation. It is only about the lack of processes, responsibilities and these kinds of things, things that the CMM-model tries to increase. It is too expensive for the supplier."*

3.1.6 Team coordination

One expert said that team coordination is an extremely important issue in order to get people working effectively with each other. When you are working with other companies, which can be very hierarchical, coordination can be difficult. He noted that team members should meet each other as early as possible. They should also take part in preparing the project agreement in order to make it more specific from a technical point of view.

3.1.7 Different views

Understanding the documents and goals of the project properly is a serious problem in collaborative projects. Every expert mentioned this during the interviews:

"Views can be very wide-ranging if we do not spend enough time making everything clear for everyone. And when we do not share equal views of the application, the project or the purpose of whole undertaking, the project can fail purely on that."

One expert said that when the collaborative partner (subcontractor) joins the project, the specifications could be rewritten alongside the subcontractor, just to develop a shared view. Another said that one must talk constantly (e.g., once a week) about the specification to clarify the picture.

3.1.8 Unavailability of human resources

When people from several companies work on a project, the risk that personnel will change during the project becomes higher. One expert's opinion was that when the same people stay in the project, the work is much easier.

There might also be advantages in buying services from another company. You do not necessarily have to worry about the missing human resources:

"When working with our own employees and, for example, somebody that you need from another unit is on vacation, there is not much that you can do. You just have to wait a month for him to return to work. But in collaborative projects, when a supplier says something like that you can just ask why he is telling you about it – it is not your problem."

3.1.9 Monitoring the work

One expert explained the problems relating to monitoring the work:

"We have had problems monitoring the progress of the work. In the beginning we did not make regulations about how the code, output and documentation should be maintained so that we could instantly see what had been done, so we could monitor the work online. Sometimes when I was busy doing other things and did not have time to supervise the work I just had to trust that everything was going okay. I just had to trust that everything was going to be like it had been discussed. When you are in the same building it is so

much easier – you can chat to people when you see them – but now all of this needs to be taken care of and you have to pay more attention to it."

3.1.10 Commitment

One expert said that lack of commitment could be a huge concern in a collaborative project. When not every party is fully committed to the project, the chances of success decline dramatically. Another expert highlighted the fact that in the beginning, the parties try to create a win-win situation to assure everybody's motivation in the venture. When a project is a win-win situation for all the partners, the motivation is usually high and chances of success are better. As an example of this, one expert told of a case where a supplier, after having developed the software, exploited it in their own product. At the same time the price for the customer was lower.

3.2 ***Perceived success factors***

3.2.1 Effective communication

The experts agree that communication in collaborative projects is more important than in local, traditional projects. They also agreed that at the beginning of a project it is important to meet the team members. "If you really want to develop something new it is the only way to make it work" (according to one of the experts). One expert also said that meeting the people face to face helps to produce a mutual vision of the final outcome. He also pointed out that a kick-off session should be arranged early enough. One expert said that, nowadays, meeting face to face is not as usual as it was before. Previously you could regularly fly to two-hour meetings, but now the meetings are virtual, he noted.

All the experts said that constant meetings (e.g., once a week) are needed, even when there are no urgent issues to discuss. However, these weekly meeting should have a compact time limit (strictly 1-2 hours or less) to keep them efficient, one expert stressed. Another expert said that external partners should also be invited to these meetings in order to maintain a good spirit among the project team:

"Once a week we have a two-hour meeting. Some people invite external partners to the meetings only if it is needed. In order to maintain the team spirit I always invited everybody. I think that we have a mutual target in the project. In my meetings people used to bring their personal SWOT-analyses. In a SWOT-analysis every member of the team explains what they have been doing during the past week and what they are going to do the following week, and point out possible problems related to their work. We try to solve these problems immediately in the meeting, or at least to suggest how they can be solved later."

In the case of virtual meetings where people participate from different geographical sites, a good phone line and file sharing in a computer pane are sufficient. There is no need for a videoconference, one expert said. Overall, NetMeeting is workable, but where problems come up, meeting face to face usually gives the best results, the expert pointed out.

3.2.2 Careful preparation

All the experts believed that the preparations for a collaborative project should be carried out more carefully than in traditional projects. One expert said that it is better to start the work with one's own people and prepare it over time. Another said that the communication with the other party should start as soon as possible. The main thing is that the preparation stages get enough attention.

One interviewee noted that it is important to get the right people together as soon as possible before signing the contract:

"A good method would be to make the legal contract point to technical documentation and to the real plan, so that this is a part of the deal."

According to the interviews, the first thing that you should do is get to know each other: when you collaborate with people that you already know you save time and effort. According to one expert, the companies should have a policy that helps to get to know the new partners. It could be very useful to set up a workshop for a few days before actually starting the project and before the kick off session, he also said.

3.2.3 Understanding cultural differences

The experts pointed out that the more you know about your partners and their ways of working the better. For example, every nation has its own culture and you have to know it in order to make collaboration work:

"Indian people never say 'no'. You tell them to do something and if they don't know how, they stop. You have to understand that that's their culture. They have to understand that reviewing something is not punishing something."

Another interviewee also described his experiences of different cultures:

"You have to be careful when you communicate in order to avoid misunderstanding. In the Far East there are these 'loss of face' issues so you have to be careful. If you just talk about the project and criticize without thinking, it might cause troublesome situations."

The expert said that the cultural aspect works the other way round too. If the collaborative partner does not know your culture it might become a problem. Sometimes the situation is extremely concrete. One expert gave an example in which his company invited the subcontractors to visit his country to learn about the end-product where the software would be developed:

"[X] years ago we started to develop software for [a common electronic device] *in India. Well educated, very intelligent software engineers. They did not even know what [this device] was! Those guys make software for [the device] – what do you do? What do you need to do? You need take them here* [to my country] *to see what it is, open the box, get them through a course [about what the device is and how it works] (…) and then they start to understand what is done with hardware and what is done with software, and to understand what is expected from it."*

The key to understanding the partner's goals and way of working is communication, the experts pointed out. This makes it easier to develop a mutual vision of a project, and create a win-win situation. When there is a win-win situation the motivation is usually high and the chances of success get better, one expert said.

3.2.4 Clear specifications

The experts believed that in order to avoid misunderstanding and create a mutual vision of the project, specifications should be unambiguous and clear. According to the experts, disorganized specifications cause often problem situations. It seems to be difficult to avoid misunderstanding that arises from insufficient communication and unclear or incomplete specifications. One expert described a recent situation where a month earlier people were gathering requirements, but when they returned to the subject, there were difficulties understanding it. He suggested that there could be a facilitator, who would collect all the requirements and take care of them:

"In practice, when you are writing requirements on a flip chart, you group them and link them together and it all seems clear as day. But when you really start applying the requirements and thinking about them it is not that simple any more. At worst, you can end up fighting with each other about the system and it can get complicated. You should have a separate competence for gathering the requirements, some kind of competent facilitator who will gather the requirements."

3.2.5 Logical architecture

One expert said that logical architecture is the most critical factor in collaborative projects. In multisite projects, when the architecture is connected with other areas, such as requirements, interfaces, software configuration management, and interface management, it must be well designed, the expert said. He also thought that these issues are quite project-specific. Sometimes everything goes smoothly and sometimes the architecture is very problematic.

"If we have a clear and logical project plan and logical system architecture, and we can link these things to other sectors, geographical dispersion of the work does not do as much harm. But if we do the parts separately, not thinking about the software architecture and how it all works together, we may face problems later."

3.2.6. Effective diffusion of information

The experts said that effective diffusion of information between all the members of the team is also a very important issue in collaboration. Everybody must stay updated on the latest news in the project, one expert said. This is strongly related to communication. One interviewee said that they are moving towards webpage-based spread of information that every member can access.

3.2.7 Competence

The experts agreed that competence is one of the reasons that companies collaborate with each other. They observed that when you get talented people in your project you can get successful results. However, one expert pointed out that sometimes these competence issues are left as secondary values. For example, if you can get cheaper programmers somewhere you choose them, even if you know that there are going to be more bugs in the code, he said. Or if you have to get the product ready for the Christmas market, for example, you get the resources where they are available and do not pay as much attention to quality issues, he continued. According to the interviewees it can be said that competence is a very significant reason for collaboration. The companies do not have to keep so many professionals on their payroll. They can focus more on their core business and buy certain competencies when needed, one expert said.

3.2.8 Other important factors

One of the interviewees stressed that interface management, software configuration management and requirement specification should be done well, and links between them should be discovered. In software projects the interface should be implemented well so that you can easily understand how the system works. This means that there should be good monitoring and debugging features built in, the expert exposed.

One of the experts summarized his views of what should be done in collaborative projects:

"Basically we know what to do: make very clear agreements, understand each other's goals and way of working, put the people together and communicate, communicate, communicate. (…) You can almost compare to it to, let's say, good review technique. The review itself is not such a difficult job from the point of view of complexity, but the discipline of it is complicated. What was the input for this piece? What were the requirements? How have they been translated to the design? What will the output of the design be? (…) That is reviewing. Who does that with such discipline? Almost nobody. (…) You should do it that way, and if you do it that way it's not that difficult. It requires a certain concentration and a certain discipline. If you do that you are a good reviewer. So you don't need any special methods or special techniques to do it. It's a matter of explaining that this is how you should review the document or piece of code. The same goes for culture… It's mainly a matter of listening to each other. How do you do that? Ask the right questions, understand each other"

4. Discussion

This section compares the results of the study with related research on collaboration.

4.1. Problems regarding collaboration

4.1.1 Communication

Communication problems were also found by extant studies. Herbsleb et al. (1999) state that geographically dispersed teams face "extraordinary communication and coordination problems" (Herbsleb et al. 1999, pp. 63). Similarly, Carmel (1999) sees loss of rich communication as one of the main aspects that pull the global software team apart and harm its performance (Carmel 1999, pp. xi). In fact, Herbsleb et al. (2001) state that informal hallway conversation is effective, and developers not located on the same site have low chances to practise it, and Paasivaara et al. (2003) report that mutual social events would help in building the relationship, and with communication.

Oza et al. (2004) and Herbsleb et al. (1999) saw language as among the biggest difficulties in customer-supplier relationships. Conversations in a foreign language require time and energy (Herbsleb et al. 1999). In our study, one expert compared a two-hour telephone conversation to a ten-kilometre run.

Carmel (1999, pp. 96) points out that e-mail is the most important communication tool, Paasivaara et al. (2003) highlight the use of chat, while Herbsleb et al. (2000) mention instant messaging and groupware applications. Kobitzsch et al. (2001) consider videoconferencing to be a necessity, whereas Paasivaara et al. (2004) and Hebsleb et al. (1999) report that videoconferencing does not bring any added value to communication and is not used in any of their target projects. This view is consistent with the findings of our study.

4.1.2 Unclear agreements

Bjerknes et al. (2000) also point out the problems raised by unclear agreements (Bjerknes et al. 2000, pp. 1). Beulen et al. (2002) observe that contracts need to be flexible due to today's decreased time to market and fast technological developments, but that it is not easy to add that flexibility into the contracts (Beulen et al. 2002, pp. 8).

4.1.3 Security policy issues

According to Herbsleb et al. (2001), in outsourcing agreements the fear of losing "intellectual property or other proprietary information about products or schedules leads to restricted or filtered communication" (Herbsleb et al. 2001, pp. 18). Herbsleb et al. (1999) report a lack of trust between sites. It leads to a reluctance to share information and to a situation in which sites do not consider themselves as partners. Similar issues were also mentioned by our interviewees.

4.1.4 Inflexibility concerning changes

According to Beulen et al. (2002), a supplier is not usually rewarded for any extra output or for improving the levels of their services. In this study, the interviewees connected this issue to inflexibility concerning changes, meaning that changes require money and if you can pay for changes there is no problem. The results of our research also suggest that

agile or internet-speed development, where late changes in requirements are typical (Baskerville et al. 2004), are more problematic in collaborative software development than in in-house (within one company) software development projects.

4.1.5 Adaptation problems

Bjerkens et al. (2000) offer a guide to both customers and suppliers for improving the process. The customer can show real commitment throughout the project, and establish the project culture. The supplier can offer a course in being a customer, it can be a facilitator in the process and offer for the customer to take part in milestone evaluation. Together they can both evaluate and discuss the process (Bjerknes et al. 2000).

4.1.6 Team coordination

Carmel states that building relationships means meetings in many forms, working together "shoulder to shoulder," arranging a kick-off meeting and social meetings, etc. He also points that building trust takes time (Carmel 1999, pp. 146). If the team members do not from time to time meet face to face, the trust between them begins to fall below the sufficient level required to work together effectively (Carmel 1999, pp. 146). One of the experts said that they believe that people from different sites should meet around every third month.

The experts stated that it is useful to work with partners with whom you have worked before. Carmel discusses this issue, also mentioning that dispersed teams may have difficulties integrating themselves into a coherent team (Carmel 1999, pp. 61).

According to Paasivaara et al. (2003), companies rarely plan any problem-solving practices beforehand and this leads to delays at the project level. When problems (that are usually both difficult and expensive to solve) occur, members of the project spend time and effort looking for somebody to help them. The article provides three practices related to problem solving: solution provider (a link person tries to solve the problems that have occurred), bulletin boards with e-mail list, and problem e-mail box. One expert in this study talked about the significance of hallway conversations. Herbsleb et al. (1999) point out that developers in a single location rely heavily on ad hoc communication. People often have difficulties seeing its critical relevance to team coordination because this kind of ad hoc communication is "invisible" (Herbsleb et al. 1999, pp. 64).

4.1.7 Different views

The findings of our study are in line with results in traditional software development, where misunderstanding the requirements is listed as a key risk (Keil et al., 1998). If the risk of misunderstanding the goals is this high in software development in general, it is easy to understand the concern in multisite or collaborative development.

4.1.8 Availability of human resources

Herbsleb et al. (1999) also mention concerns regarding the availability of human resources, i.e., that people change and this causes problems: the new employees do not know the project as well.

4.1.9 Monitoring the work

Paasivaara et al. (2004) report difficulties in monitoring how the subcontractors' work was progressing. They said that there were many people in the project who wanted to know what the project's status was. Furthermore, the subcontractor needs to know what the current situation is. Customers often forgot to inform the subcontractors if changes were made to the documents. In our study, only customers were interviewed, so we have only the other party's opinion on the subject.

4.1.10 Commitment

Commitment was identified as a key issue, according to our interviewees. While we have not found any prior studies stating the importance of commitment in collaborative settings, Abrahamsson (2002) notes the importance of commitment in traditional software projects.

4.2 Important factors for successful collaboration

4.2.1 Effective communication

Battin et al. (2001) state the importance of communication and suggest solutions to improve communication in geographically dispersed projects: the use of liaison personnel – which in their case were engineers who travelled to the target site for a period of time and helped to build bridges between sites – intranet publication, conference calls and travel. All of these were apparent in our study, except the use of liaison personnel. Intranet publication, teleconferencing and travelling between sites from time to time were familiar points. Carmel (1999) and Herbsleb et al. (2001) stress the importance of communications, such as face to face meetings.

Bjerknes et al. (2000) point out the importance of workshops. Herbsleb et al. (1999) state the significance of bringing people together early enough. The value of workshops also came up in the interviews and the experts pointed that technical people from both parties should participate in these workshops and work with each other. Technical details should also be included in the contract (how the software is tested, how it is delivered, who decides its acceptance, etc.).

4.2.2 Careful preparations

Careful preparations should include several different aspects in order to enable a bright start for the joint project. There are e.g., contractual issues, relationship issues, and issues

related to understanding the requirements, all of which should be taken care of before starting the collaborative project.

One expert said that they may write the requirements two times. First they are written with the customer's own people, and then with the subcontractor. In this way they make sure that the subcontractor understands the requirements. Bjerkes et al. (2000) make several proposals for improvements in the customer-supplier relationship. For contextual issues at the beginning of the collaboration, the customer should create a flexible funding procedure, inform the supplier of the IT strategy, and specify the development strategy, making the goals visible. The supplier should make their process visible, and discuss their own strategy. Both should, for example, become aware of each other's strong and weak sides. In order to create a mutual understanding, the supplier should make themselves familiar with the customer's world. The customer may offer a course on being a customer etc. Workshops are also very good opportunities to get to know each other, and should be held both before and after the signing of the contract (Bjerknes et al. 2000).

The results of Kobitzsch et al.'s (2001) report of a case study of a German company's multisite software development in India highlight the positive effects of careful preparation (Kobitzsch et al. 2001, pp. 84).

Beulen et al. (2002) predict that flexibility will be the key in future IT-outsourcing contracts. One interviewee in our study stated the importance of bringing technical people together and letting them participate in the creation of the contract. Another pointed out the risk of pushing competitive bidding too hard. If the cost is too low, there is a chance that the project will fail. The expert observed that the damage is then bigger than if the customer had paid a little more in the beginning. Khan et al.'s (2003) study supports this finding.

4.2.3 Understanding cultural differences

Krishna et al. (2004) report that problems occur when working with foreign teams: "British managers in an outsourcing relationship with a particular Indian software supplier found that Indian programmers, in deference to authority, would not voice criticism in face-to-face meetings but would sometimes send their opinions in e-mail messages after the meetings had disbanded." (Krishna et al. 2004, pp. 65). The interviewees in our study brought out similar experiences.

4.2.4 Clear specifications

The experts said that the specifications should be understandable for everyone. "Clear specifications" means that all the documents and specifications should be written in such a way that nobody could misunderstand them. Of course, these specifications must be discussed regularly. Regarding clear specifications, Paasivaara et al. (2004) describe a 'solution provider', a person who deals with different problems. When a problem arrives, everybody knows who to contact. Such a provider could also handle requirements and other specifications. If somebody has a question concerning some detail in the

specifications he could directly ask this person, who is likely to know the answer to such a query.

4.2.5 Logical architecture

Consistent with our findings, Herbsleb et al. (1999) also noted the importance of logical architecture.

4.2.6 Efficient information distribution between parties

Paasivaara et al. (2003) point out that information distribution practices should be designed at the beginning of the collaboration. They identify three useful practices for keeping all parties informed: weekly meetings, progress reports and a travelling steering group. Similar practices were also used in Nokia and Philips.

4.2.7 Competence

Carmel (1999) lists specialized talent as the reason that companies practise global software development (Carmel 1999, pp. 4). Kobitzsch et al. (2001) state that in most of today's companies, human resources and competences are bigger reasons for distributing the development than the mere reduction of labour costs. The experts from both companies mentioned both competencies and cost efficiency as reasons for collaboration.

5. Conclusions

While collaborative software development has increased during recent years, little is known about the problems associated with collaborative software development. To fill this gap in research, this study explored the problems and the success factors related to inter-organizational collaboration, through interviews in Nokia and Philips. Ten problems and eleven success factors were found. The generalizability of the problems and success factors found should be evaluated through quantitative survey research.

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