ALIGNING GOALS AND MONITORING SUPPLIERS IN NEW PRODUCT DEVELOPMENT

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ABSTRACT

Involving suppliers in NPD is becoming more important to firms in order to incorporate the latest technology into their products. In such relationships the buying firm is often more powerful than the supplier. However, this paper involves some suppliers that are equally powerful as the buying firm. To study these relationships we apply agency theory on the NPD projects where the buying firm is the principal and the suppliers are the agents. Goal incongruence, control and monitoring of projects are investigated by studying three projects at a high-tech telecommunication firm. To achieve goal alignment, length of the relationship and sharing of technology roadmaps were identified as important mechanisms. In contrast to our expectations, that black-box development would suggest output control, we find that also process and social control are applied in these relationships. Process and social control is present because these suppliers need to be motivated to share technical knowledge. Also, long term commitment from the buying firm was shown to be important. The level of monitoring varied in the projects and depended on the closeness of the relationship as well as the power position of the supplier.

Keywords: NPD, supplier involvement, agency theory, monitoring

1. INTRODUCTION

Firms are increasingly relying on suppliers to provide new technology to their development of new products. Johnsen’s (2009) review of supplier involvement in NPD shows that most research has focused on powerful buyers collaborating with less powerful suppliers. In such collaborations the supplier has limited power to influence the NPD project. In contrast, in projects where the buying firm is dependent on the supplier, the supplier has greater influence on the project which can be perceived as the supplier having more control over the project. For example, the supplier can control the progress of the project and delay it due to lack of prioritization (Primo and Amundson 2002). However, few studies have looked into suppliers’ possibilities to obstruct NPD (Wu and Ragatz 2010). In situations where the supplier has a powerful position, the supplier has larger possibilities to influence the NPD project. However, there is little research on such technological collaborative NPD projects. Instead, studies have focused on how less powerful suppliers can handle the situation of unequal dependence (Johnsen and Ford 2005; Stjernström and Bengtsson 2004). Research on NPD projects where the buyer has less power and thus less influence to control the project and control the supplier relationship is lacking.
The buyer-supplier literature provides insight into issues concerning opportunistic issues in collaborations. For instance, research on supplier involvement in NPD stress the importance of trust (Ragatz et al. 1997; Walter 2003) and partnership (Bonaccorsi and Lipparini 1994; de Faria et al. 2010). However, firms can still have adversarial thoughts and show signs of opportunism in these relationships. Here agency theory can provide more insight into control, monitoring and contractual issues. Agency theory is relevant when one part (principal) depends on another part (agent) for doing something for the principal. An agency perspective can provide insight into interorganisational relationships (Lassar and Kerr 1996; Rossetti and Choi 2008). In particular, it is appropriate to apply agency theory in situations where contracting is difficult. Eisenhardt (1989b) suggests that agency theory is relevant in situations of supplier and buyer relationship and product innovation. Hence, the purpose of this study is to understand the consequences of unequal power distribution in buyer-supplier relationships in NPD projects where external technology suppliers are involved. This is done by using agency theory to analyse our data.

We study a large high-tech buying firm’s NPD projects where technology suppliers are involved by conducting case study research of three NPD projects. This paper will focus on goal incongruence and different forms for the principal to control the agent. We expected to find that output control is related to black-box development since output control “is the degree to which the principal monitors the results or outcomes produced by the agents” (Aulakh and Gencturk 2000 p 524) and thus the principal has no insight into the product’s actual development process but controls the result of the black-box development. In addition, we expect that process control, which “refers to the extent to which the principal monitors the agents’ behaviour or the means used to achieve desired ends” (Aulakh and Gencturk 2000 p 524), is related to gray-box development. In gray-box development the principal participates in the development process and thus can control the agent’s behaviour and development efforts.

However, in collaborative NPD we found that even though the development was black-box, the buyer’s control included output, process and social control. In fact, output control was marginally used. As some suppliers in this study were powerful, it could be difficult to use output control. How can a buying firm control NPD in such situations? If not by output control, then perhaps the other two controls provided by agency theory. Process and social control is perhaps used in order to engage suppliers in providing new technology into the buyer’s product. This study indicates that powerful suppliers need to be motivated to collaborate, not only through the potential business from the project but also through possible long-term collaboration, openness and learning possibilities. While output control controls the end result of the NPD project, process control and social control provides possibilities for extended interaction between the firms and thus opens up for the possibility of a closer collaboration. Through process control the progress of the projects were monitored and in one project a close collaboration with visibility of what the supplier is doing. Social control, on the other hand, was demonstrated through the suppliers’ adaptability, learning from the buying firm and orienting towards the buying firm’s goals. As for goal alignment, this was achieved through using technology roadmaps as a tool to share the firms’ views of the future technologies, markets and products.

2. INVOLVING SUPPLIERS IN NPD

Wagner and Hoegl (2006) argue that even if there are benefits involved with collaborating with suppliers, it is difficult to capitalize on these benefits in individual projects. In contrast to the benefits listed above, there can also be disadvantages or no effect at all from involving suppliers in NPD. For example, a recent study has identified that collaborations with suppliers
did not contribute to innovativeness (Su et al. 2009). Hence, in that study, suppliers do not share their technological knowledge in a way that makes buying firms more innovative. Furthermore, there are negative impacts on technology risk; there is a risk that the buying firm becomes locked into one technology. By being locked into one particular technology, there is a risk that the buying firm loses flexibility and that once the collaboration has started, the supplier lacks incentive to innovate (Handfield et al. 1999). The issue of becoming locked-in also holds true for becoming locked into one supplier if no alternative suppliers are available. Involving suppliers can also be more difficult than what was expected, both in taking longer time than planned and being more difficult to manage (Von Corswant and Tunalv 2002).

Suppliers’ knowledge of the technology requested influences the characteristics of the collaboration. Technical knowledge can be displayed in technology roadmaps, which is a tool to communicate technology, product and market perspectives. It has a long-term vision to help the firm with strategic decision (Phaal et al. 2004). In practice, several types of technological roadmaps are used (Lee and Park 2005). In collaborative NPD technology roadmaps can be shared between participating firms to show their long-term planning. In the case of a powerful buyer, it can influence the supplier’s technology roadmap (McIvor et al. 2006). However, another aspect is that sharing knowledge through technology roadmaps may encourage opportunistic behaviour which could lead to less trust in the collaboration (Petrick and Echols 2004).

Studies show that firms that select suppliers on the basis of their product development capabilities, have higher levels of grey-box and black-box integration (Koufteros et al. 2007). Koufteros et al. (2007 pp. 848) distinguish between grey-box and black-box as follows:

“With a gray-box approach the supplier and the customer work alongside each other. The supplier provides expertise, suggestions and other input towards the product development effort but typically will not assume sole responsibility for developing parts, let alone modules for the final product. On the other hand, a black-box approach implies that each company would concentrate on certain tasks and components. The supplier can be ‘trusted’ to develop parts, components, or subassemblies”

In these cases, the suppliers have a higher level of responsibility for implementing the new technology into the products. Wynstra and Pierick (2000) argue that firms must decide what form of supplier involvement is appropriate if they are to benefit from the collaboration. A powerful buyer can exercise power in ways that may be harmful when involving suppliers in NPD. Such power exercise can be demonstrated when the buying firm is playing suppliers against each other in the design phase and can manifest in suppliers’ reaction of being suspicious when the buying firm requests information (McIvor et al. 2006).

3. AGENCY THEORY

Agency theory handles principal-agent relationships within or between organisations where the principal delegates work to the agent. In this paper, the principal represents the buying firm while the agent is the supplier. In agency theory the contract between the principal and agent is investigated with concerns on two problems, namely the agency problem and the problem of risk sharing. The agency problem involves basically two parts (i) goal conflict and (ii) verification (Eisenhardt 1989b). Risk sharing concerns the difference in attitude towards risk of the principal and agent. Often agency theory takes the principal’s point of view (cf. Aulakh and Gencturk 2000; Rijsdijk and van den Ende 2011) but some more recent studies takes both the principal and agent’s perspective (cf. Dou et al. 2009; van der Valk and van Iwaarden 2011). This paper focuses on goal incongruence and the different forms of controlling the agent.
Goal incongruence comes from the assumption that the agent has interests that are not in accordance with the principal’s interest. By developing goal congruence in buyer-supplier relationships, the firms can achieve compatible objectives even though the buying firm may have preferences that are not aligned with the supplier’s original preferences. Generally, buyers might prefer quality and lower prices while suppliers could prefer profit and requested volumes. Another cause for goal incongruence in buyer-supplier relationships is contractual inflexibility (Rossetti and Choi 2008). Goal congruence can work as an assurance against opportunism in a buyer-supplier relationship (Jap 1999). Furthermore, firms in a relationship with goal congruence see a longer time horizon for their collaboration than other firms (Jap and Anderson 2003).

Three forms of control combinations in NPD are discussed by Rijsdijk and van den Ende (2011): outcome (output) control, process control and clan control. By using output control, desired outputs are monitored and evaluated. In addition, process control involves monitoring the agent’s behaviour and mechanisms for appropriate behaviour while clan control is a socialization process among individuals. Similarly, Aulakh and Gencturk (2000) investigate output control, process control and social control in inter- and intraorganisational relationships. Social control refers to monitoring and orienting agents towards organisational goals. Social control within the firm created shared values and improved adaptability (Aulakh and Gencturk 2000), which also was suggested to have similar effects in intraorganisational relationships. Rijsdijk and van den Ende (2011) show that combining these controls had varied effect on the project’s performance.

Monitoring involves observing the agent’s efforts and outcomes which enables the principal to be up to date on the agent’s progress. Output monitoring refers to measuring such things as delivery time, quality and product accuracy. Behaviour monitoring on the other hand involves evaluating the agent’s processes. By using monitoring, principals can decrease their agent’s level of not fulfilling promises or obligations (Rokkan and Buvik 2003). In this scenario the agent likely perceived monitoring as legitimate and thus negative impacts were avoided. There is a cost to monitor an agent and when this cost is high an outcome-based contract is to be preferred. But where the costs of monitoring are acceptable, a behaviour-based contract could be more efficient (Eisenhardt 1989b). However, more monitoring is not always better (Jacobides and Croson 2001) and does not necessarily increase the agent’s alignment towards the principal’s desires (Tosi et al. 1997). Moreover, close monitoring may have negative effects on the agent as it perceives a loss of self-control and distrust from the principal. One way to avoid the negative effect from monitoring is to have social contracts (van der Valk and van Iwaarden 2011).

Monitoring agents in a buyer-supplier relationship can have different effects depending on if the relationship is output or behaviour based (Heide et al. 2007). Moreover, a powerful buyer has more possibility to force the supplier to accept monitoring. If instead the supplier was powerful it could more easily mitigate the buying firm’s monitoring. Additionally, monitoring effects depend on the relationship between the firms. Closer relationships with informal arrangements which allows for behavioural monitoring can suppress opportunistic behaviour (Heide et al. 2007). Hence, firms have several aspects to consider before they decide upon how to monitor their suppliers. One point would be that by combining contracts and trust in buyer-supplier relationships opportunism can be better mitigated than when contract and trust is used separately (Liu et al. 2009).
4. RESEARCH METHOD

Our studied firm will from here on be called Radcomp, a large system integrator that is accustomed to collaborate with technology suppliers in NPD. It is a high-tech company that incorporates new technologies from suppliers regularly and handles several uncertainties related to technology, suppliers and competition from low-cost firms. Before starting the studies, three meetings with Radcomp’s strategic management were conducted. In these meetings, the study’s objective and possible projects to study were discussed. The case selection was information-oriented (Flyvbjerg 2004) and thus information-rich cases (Patton 2002) were selected. These NPD projects were strategically important to Radcomp, had close collaboration with external technology suppliers and involved several of Radcomp’s competences. To ensure that the case had rich information, Radcomp actively participated in the sampling of the projects.

Sampling of individuals included a variety of respondents in order to gain a clear picture of the projects. Respondents were individuals involved in the projects, hence knowledgeable informants who view the phenomena from diverse competencies were interviewed (Eisenhardt and Graebner 2007). Before starting the interviews, an interview guide that contained the main topics for discussion with the respondents was prepared. The interview guide was developed to be flexible and allow for follow-up questions to be asked.

The interviews were recorded, transcribed and sent to the respondent for reviewing and possible clarification. The interview data was collected through semi-structured interviews. In total, 22 interviews were conducted, corresponding to 25.5 hours of interviewing. In the first and third case the supplier’s view of the collaboration was included. In the second case this was not possible due to sensitive negotiations being conducted between the focal firm and the supplier. However, validity was ensured by including different functions’ views of the projects as well as two of the suppliers’ views.

After collecting the data, the interpretation phase started. When mapping the cases, core situations, such as problematic situations in the project, were identified and interpreted. Furthermore, detailed case descriptions were written in which the respondents’ views of important episodes are presented. In accordance with Eisenhardt (1989a) within-case analysis, detailed case write-ups, were made. The data was systematically structured and analysed. The text was classified into content categories in order to structure the data. More specifically, the data was structured according to different phases and hand-overs of the projects.

5. THE THREE CASES

The research presented is based on three case studies conducted at Radcomp, a large and world-leading high-tech telecom company with about 100 000 employees. Innovation is important at Radcomp, where a fifth of the employees work in R&D. Each study was of an NPD project where external suppliers provided new technology to the products.

The three case studies represent NPD projects where in total five external technology suppliers have been involved in developing a new system or component for Radcomp. The first case involved developing a completely new product, an antenna, on a system level while the other two cases concern development of a new generation of components, a converter and a processor. The supplier in the first project is called Antsup, the two suppliers in the second project are called Consup1 and Consup2, and the suppliers in the final project are called Prosup1 and Prosup2. Different project teams and individuals at Radcomp were involved in the projects, but with similar responsibilities. Key data of the firms involved in this study is
shown in table 1. As can be seen in table 1, the suppliers have a relatively high R&D spending, which support the argument that they are technology suppliers and thus provide new technology into the NPD projects.

<table>
<thead>
<tr>
<th></th>
<th>Radcomp</th>
<th>Antsup</th>
<th>Consup1</th>
<th>Consup2</th>
<th>Prosup1</th>
<th>Prosup2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of employees</td>
<td>104 500</td>
<td>6 700</td>
<td>34 600</td>
<td>9 200</td>
<td>11 000</td>
<td>82 500</td>
</tr>
<tr>
<td>Sales M EUR</td>
<td>25 213</td>
<td>1 323</td>
<td>11 515</td>
<td>2 270</td>
<td>5 700</td>
<td>41 000</td>
</tr>
<tr>
<td>R&amp;D spending as % of revenue</td>
<td>13%</td>
<td>10%</td>
<td>14%</td>
<td>17%</td>
<td>23%</td>
<td>15%</td>
</tr>
<tr>
<td>Previous generations of NPD involving the supplier</td>
<td>-</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Project duration</td>
<td>-</td>
<td>2 years</td>
<td>2 years</td>
<td>2 years</td>
<td>2 years</td>
<td>2 years</td>
</tr>
</tbody>
</table>

Table 1 Key data of Radcomp and its suppliers

5.1 CASE 1: ANTENNA

This collaborative NPD project concerned an innovative product that combined two existing technologies, radio and antenna, and merging them into one product. Hence, it was a new concept based on known technology. The radio-antenna is a product for the mobile operator market and has the benefits of lower power consumption, faster installation time and can easily introduce new technologies and frequency bands. This product was designed to handle the increasing demand on mobile broadband, both on speed and coverage from mobile users. In contrast to other radio solutions this product has been designed to easily blend into the environment and can be put on buildings without being detected.

In the design phase the firms had workshops for two days every two weeks where ten individuals participated, five from each firm. Additional contact was through telephone conferences, e-mails and sharing documents on a shared home page. In the project, technical information was openly shared.

5.2 CASE 2: CONVERTER

The second case was the development of Radcomp’s 5th generation of a radio base platform. On this platform we particularly investigated the analogue-digital converter, which is a critical component. This devise converts analogue input to digital output and sets the band-width of the receiver; therefore it is important to have a converter with good performance. Comparing with previous generation of platforms, the converter has improved the capacity for each generation.

Radcomp makes a tentative specification which is sent to the two suppliers Consup1 and Consup2. The suppliers then reply with time schedules and design comments but it is Radcomp that decides what the suppliers should develop. Hence, it is Radcomp that pushes these two suppliers to integrate new technology into the component. At Radcomp there are internal project meetings where the suppliers are not present. Communication with the supplier consists of monitoring what the suppliers are doing. Meetings take place about once a month and there are weekly telephone calls to see how far the suppliers have progressed. The supplier who has the best overall solution wins the first piece of the business.
5.3 **CASE 3: PROCESSOR**

In the telecommunication industry there is a standard computing architecture that most firms in the business use. However, Radcomp uses a different architecture which its competitors do not use. This means that Radcomp has its own architecture and develops its own computer platform. On this platform a processor is added, which is the component that we are studying in this case. Our study is of the fourth generation of platforms. The platforms are delivered to several of Radcomp’s internal customers, which have different demands on the computers. Requirements from these customers include aspects of capacity, size, encryption and cost.

The dialogue with the supplier consists mainly of telephone calls and emails between one development engineer at Radcomp and one contact person at the supplier. The contact person forwards technical issues to other development engineers within the supplier’s organisation. There are weekly telephone calls between these two individuals. The communication is of a technical nature where problem reports are presented. When there were major technical issues the buying firm’s R&D engineers went to the supplier for a few days of de-bugging. Commercial aspects are handled outside the NPD project team, where the key account manager at the supplier and the purchaser at Radcomp meet to discuss contracts and prices.

6. **ANALYSIS AND DISCUSSION**

In this section, our cases will be analysed by applying agency theory. As previously mentioned, in this paper the principal is the buying firm and its agent is the supplier.

6.1 **GOAL INCONGRUENCE**

Analytical dimension to investigate goal incongruence and the evidence from our cases can be found in table 2.
<table>
<thead>
<tr>
<th>Analytical dimension</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desire to cooperate</td>
<td>This project is highly prioritized at Antsup. It felt like Antsup wanted to collaborate. [...] By collaborating with Radcomp they climb in the value chain. (Strategic product Development)</td>
<td>We’re pushing their technology and our specifications are very tough. But they like this because, obviously Radcomp is the number one guy. (Sourcing Manager)</td>
<td>Look at it this way, we have a rather large business with Radcomp, but Prosup2 will not go under if we lose that deal. But the strategic value of collaborating with Radcomp is many times more important (KAM, Prosup2)</td>
</tr>
<tr>
<td>Length of relationship</td>
<td>We have worked together in 20 years. (Strategic product Development)</td>
<td>There must always be a relatively long-term consideration (Supply Manager F)</td>
<td>I have known some of Prosup2’s people for 20-25 years. We all know who we are. (R&amp;D Manager J)</td>
</tr>
<tr>
<td>Technology roadmaps</td>
<td>We found out that Antsup and Radcomp had a shared view on strategy and on R&amp;D along with our technology roadmaps (R&amp;D Manager E, supplier)</td>
<td>We get technology roadmaps from the suppliers (R&amp;D Manager G) We show them our roadmaps. (Supply Manager)</td>
<td>Prosup2 has a technology roadmap that is competitive. That is important since Radcomp is very technology oriented. (KAM, Prosup2)</td>
</tr>
<tr>
<td>Goal alignment</td>
<td>There will be more products with Antsup as collaboration partner so I think a longer collaboration is planned. (Supply Manager A)</td>
<td>The suppliers want to be updated and we also stay updated about the progress of their technology. They tell us about development in technology and we tell them if there have been any changes on our platforms. (R&amp;D Manager H)</td>
<td>The design process is decoupled from the future process [...] It is a large technology exchange discussion for the future which involved the long term technology roadmap (KAM, Prosup2)</td>
</tr>
<tr>
<td>Problem resolution</td>
<td>We discussed openly what are the challenges and problems or these things to understand time lines and so on. (Project Manager B, Antsup)</td>
<td>Often we have discussions about products and potential problems connected to them. (R&amp;D Manager H)</td>
<td>Much of the help we get is help to help ourselves. (R&amp;D Manager K)</td>
</tr>
<tr>
<td>Conflict of interest</td>
<td>China is a competitor and there we have the problem of copying. We do not want any manufacturing in China, this we have been very clear on from the beginning (R&amp;D Manager, Antsup)</td>
<td>They ask all type of questions, they ask us ‘why do you want a double in and out put?’ that’s our business; you don’t need to know the benefit of that. Those relationship problems we had a while. (Sourcing Manager)</td>
<td>Many firms have a tendency to ’always know best’ and have solutions to solve a problem ’this way’ otherwise the counterpart is not even worth talking to. Sometimes I feel that Prosup2 didn’t always understand what Radcomp really wanted. (KAM, Prosup2)</td>
</tr>
</tbody>
</table>

**Table 2 Findings: Goal incongruence**
Agent’s desire to cooperate (Rossetti and Choi 2008) was identified from both the buying firm and the supplying firms. The desire to cooperate was not necessarily connected to the product itself, but rather to Radcomp’s competence and knowledge of technology and future development. All agents in our cases have a long history with the principal, about 20 years of collaboration in different forms. Although this is the first NPD collaboration between Radcomp and Antsup, several individuals that handle regular business between the firms are also included in the NPD project team. Thus, both firms have included individuals that know each other in the NPD project. A longer relationship would suggest a behaviour based contract while a shorter would suggest an output based contract. Also, three of the agents involved in the projects have collaborated with Radcomp in previous generations of the product development, see table 1.

Technology roadmaps can be used as a strategic tool for firms to understand the future direction of each other’s development. In this paper we define technology roadmaps similarly to Handfield et al. (1999 pp. 73) which is a roadmap that “describe the performance, cost, and technology characteristics of future products each company plans to develop/introduce over some specified time horizon.” This is in accordance with how two of our projects at Radcomp shared future directions with the suppliers involved. However, sharing technology roadmaps may not be enough, in order for firms to capture benefits they need to align their technology roadmaps with their core suppliers (McDermott and Handfield 2000; van Echtelt et al. 2008). Close collaboration was also needed for aligning technology roadmaps, which requires exchange in information, this can be difficult and even if it is particularly important to the firm it may take years to achieve (van Echtelt et al. 2008). In one of our studied projects Radcomp had a strategic technology alignment program that was on top management level from both firms and discusses technology solutions that could be possible within five to ten years. However, this technology alignment was not noted within the NPD project although the project team was aware of it and one team member also occasionally joined these meetings.

The firms were clear on keeping design projects and future discussion apart as to not discuss design detail but keep a larger view in mind at the technology alignment meetings.

As this study focuses on collaborative NPD projects, R&D spending at the firms could be interesting to study. As can be seen in table 1, the R&D spending varies between the firms, from ten to 23% of their revenue. Radcomp had discussions with their suppliers about future technologies and future products, this shows a desire to align goals of future product development. Radcomp and its suppliers continuously update each other on changes in the technological roadmap. Moreover, since more products or future generations already are planned, Radcomp is careful to maintain goal alignment between it and its suppliers.

Goal incongruence or goal conflict, as previously discussed comes from the assumption that the agent has interests that diverge from the principal’s interest. Hence, by investigating conflicts of interest in the relationships we try to identify if there is a goal conflict. We found conflicts of interest in regard to future production sites, learning information about the product’s systems and how to understand each other and solve problems. Firms can have different approaches towards solving problems, it could depend on several variables, and one of them could be the size of the firm. As can be seen in table 1, the size of the firms involved varies from mid-sized company to large company. In all projects, problems are openly discussed between the firms. Also here the firms’ alignment is demonstrated by the approach to understand the other party’s situation and trying to solve problems together.

6.2 CONTROL AND MONITORING

Findings from our cases on control and monitoring can be found in table 3.
<table>
<thead>
<tr>
<th>Analytical dimension</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology newness</td>
<td>The concept is new but it’s based on a known technology (Project Manager A)</td>
<td>We push them pretty hard and they will tell us that ‘this we don’t know’ (Sourcing Manager)</td>
<td>It’s incremental, you keep the old and add something new (R&amp;D Manager K)</td>
</tr>
<tr>
<td>Contract</td>
<td>To be honest, this couldn’t work if we only tried to rely on the contract. (R&amp;D manager J, Antsup)</td>
<td>We don’t have development agreement. What we have is protected in IP and NDA (Sourcing Manager)</td>
<td>We have contracts of secrecy with Prosup2, that we can’t tell anyone what we are doing or what they are doing. (R&amp;D Manager J)</td>
</tr>
<tr>
<td>Design responsibility</td>
<td>I think we buy the antenna black-box (Strategic Product development)</td>
<td>In a way you could say that we direct their technology development (R&amp;D Manager G)</td>
<td>We get Prosup2’s reference design. What we do is to test and control that the interface works as it should (R&amp;D Manager J)</td>
</tr>
<tr>
<td>Output control</td>
<td>From my point of view we don’t let go of the control. We enhance it in contracts and are much tougher than when we simply buy a product. In that way it’s a better control, but can we trust them? (Sourcing Manager)</td>
<td>We speak to the suppliers and give them a specification. Then we follow-up. We monitor them (R&amp;D Manager G)</td>
<td>Prodap2 provides us with a design that we can test early. There is much debugging, more than that isn’t really the collaboration. (Project Manager)</td>
</tr>
<tr>
<td>Process control</td>
<td>We need to have a very close collaboration if it’s to work. We need total transparency in their supply chain without controlling them. We need visibility to make a contract that pushes them to perform at a certain level. It’s a difficult balance. (Supply Manager)</td>
<td>We contact the supplier and then take the role to monitor what’s going on. […] We don’t want to reveal our systems to a supplier. That’s how spies put together a puzzle, so it’s up to us to give them as few pieces as possible. (R&amp;D Manager G)</td>
<td>It’s important to have a process where the customer is close so we can tell them what is happening and what we are doing to solve it. However, Radcomp has little insight into Prosup2. […]but we still decide (KAM, Prosup2)</td>
</tr>
<tr>
<td>Social control</td>
<td>We learned a lot about how Radcomp do things and we try to learn from it, especially in this project and we adapt the ways we do it. (Project Manager B, Antsup)</td>
<td>They often do exactly what we tell them to and then they make that solution even if there might be a better one. They choose the track we have pointed to and don’t look at other options (R&amp;D Manager H)</td>
<td>On a higher level there is collaboration, Technology Alignment Program, it’s a group of top technical managers. (R&amp;D Manager J)</td>
</tr>
<tr>
<td>Clan control</td>
<td>We have permanent meetings with top-management, where we look deep into each other. Also we have everyday communication. (R&amp;D manager J, Antsup)</td>
<td>With the suppliers we have project meetings (Sourcing manager)</td>
<td>I can’t say that we see a lot of Prosup2. (R&amp;D Manager J)</td>
</tr>
</tbody>
</table>

Table 3 Findings: Control and monitoring
The NPD projects were all based on known technology and two of them were incremental projects, where new generations of an existing product were developed. All projects had duration of about two years, see table 1. Moreover, they included intellectual property (IP) rights and non-disclosure agreements (NDA); it was generally believed that these contracts could not protect all knowledge. Hence, the limitations of contracts were confirmed in all cases. Following Koufteros et al.’s (2007) definition of design responsibility, it is clear that the suppliers in our study provided expertise to the projects and were trusted to develop parts. These parts were all critical for the end product and contributed with considerable output characteristic for the end product. Our projects were all black-box developments where the agents had responsibility to implement the new technology into the products and the principal had system knowledge.

Output control can be viewed as black box development where the supplier has design responsibilities and would be preferable in short term relationships where the monitoring ability during the project is low. As described by the sourcing manager in the first case, Radcomp has better control and do not let go of the control. But, by relying on output control, there is less insight into the process, which is also described by the sourcing managers concern, that even though Radcomp has better control there is still the question if Radcomp can trust the supplier. Since the supplier is on his own to succeed towards the goal and principal is not responsible for providing direction during the progress, in such a situation Radcomp would not know about the progress. Therefore, Radcomp also follow-up the suppliers’ progress in order to be informed about possible difficulties in the development. In the projects studied, output control was demonstrated through contracts, follow-up on specifications and testing of the developed product.

Process control would be preferred when there is collaboration between supplier and buyer and the monitoring ability is high. In the projects studied, the monitoring ability varied. In the close collaboration with the less powerful supplier monitoring was more easily accomplished than in the project where the supplier was more powerful. However, a longer relationship would suggest a behaviour based contract. But in these projects, it was the project that did not have any previous generation of NPD projects that showed the most signs of process control. In process control, behaviours and mechanisms are monitored and evaluated. This was demonstrated through transparency, visibility, monitoring what is going on and discussions. Related to process control, Radcomp highlighted the need for possible monitoring and transparency from the supplier’s side in the first project. In the second project, the lack of trust from Radcomp’s side was evident from the fear of revealing too much to the suppliers and thereby providing them with knowledge about Radcomp’s systems. Finally, in the third project, the supplier emphasized the need to keep Radcomp close to update them on the project’s progress. However, the supplier also described how Radcomp was not allowed access to monitor the supplier and that in reality it was the supplier that decided over the project.

In our study, we investigate social control (Aulakh and Gencturk 2000) which involves monitoring and orienting the agent towards organisational goals. Aligning goals has previously been discussed in relation to technology roadmaps. However, in the social control shared values and adaptability are also evaluated. Our study shows that in case one and two the suppliers demonstrate adaptability toward Radcomp and their way of working. Antsup viewed it a possibility to learn from Radcomp and its processes while in the second project the suppliers do what Radcomp tells them to do and do not investigate other options. In our third case, there was an alignment that was more oriented towards Prosup2’s goals than towards Radcomp’s goals. This could be related to that the supplier is more powerful than
Radcomp. Partly, it can also be related to the differences in the firms’ cultures, Radcomp is more consensus oriented than Prosup2.

The concept of clan control (Rijsdijk and van den Ende 2011) refers to shared norms and values and is an informal control which is a process among individuals that involves coordination and communication. Coordination in this paper refers to external coordination, which is coordination between Radcomp and its suppliers involved in the NPD project. There are challenges to coordinating suppliers, some of these concern the difficulties to communicate technical knowledge and challenges of integrating suppliers (Lakemond et al. 2006). Similar challenges could partly be the reason for Radcomp’s variation in our projects where external coordination ranged from joint development to development at the supplier. Within these projects Radcomp had different coordination strategies, from close collaboration to a monitoring role to a less influential role. Von Corswant and Tunalv (2002) discovered that the suppliers in their study preferred the buying firm to not be directly involved in the development but instead have the role as a coordinator of the NPD project. This is in alignment with our second project. However, in our first study the supplier expressed no such preferences; on the contrary Radcomp’s direct involvement was necessary for the project to progress. In our third study the supplier was responsible for both designing and developing the component and thus Radcomp no real influence on the product and thus little coordination were necessary.

7. CONCLUSIONS

This paper has shown that agency theory sheds light on buyer-supplier collaboration in NPD where technology suppliers provide new technology. In this study the buying firm is the principal while the suppliers are the agents. Three high-tech NPD projects have been studied and the aspects of goal incongruence, control and monitoring from agency theory have been applied.

We have shown that related to goal incongruence, the length of the relationship and sharing of technology roadmaps are important. By The studied firms have had collaboration for more than 20 years although the NPD projects themselves lasted two years. Research indicates that firms select suppliers based on experience from previous relations (McDermott and Handfield 2000; Rundquist 2008). Additionally, individuals from both the suppliers’ side and the buying firm that know each other from previous business occasions were on the project team. Longer relationships support goal alignment, especially highlighted is the importance of technology roadmaps. By comparing and discussing the firms’ technology roadmaps, goals for the future and future possible business opportunities can be discussed. Similar to McIvor et al.’s (2006) study, this paper has shown that the buying firm can influence the suppliers and thus adapt and align their roadmaps towards the buying firm’s roadmap. Moreover, technology roadmaps is a tool that makes it possible for firms to learn and understand each other’s view of technology developments, market outlook and future products. The studied firm managed their roadmap differently depending on the NPD project. In one project the roadmap was shared, discussed and a shared view of strategy and technology development. In another project the roadmap was demonstrated and the buying firm influenced the suppliers’ roadmaps. Finally, in the third project future technology was not discussed in the forum of the project, instead a managerial group from the buying firm and the supplier had a strategic alignment forum where future technologies, markets and products are discussed. Thus, as can be seen from these three projects, technology roadmaps is a tool that can be used differently depending on the supplier and the specific project.
In regards to control and monitoring we expected to find output control in the relationships since the developments were black-box. Also supporting this was the fact that monitoring abilities during the projects were limited in two of our cases. In addition, coordination between the principal and its agents show clearly defined responsibilities, which would suggest output control. Moreover, communication varied, in some cases limited and mostly about testing of a designed product or irregular and more related to business agreements, which also would suggest that output control is the most appropriate mode of control. However, there were also factors supporting a behaviour-based control, the firms’ history of long-term collaboration and joined project teams, which was used in the first project.

However, despite this we find that the projects were more oriented towards process and social control. This indicates that in NPD where technology suppliers are involved, it is important that these suppliers are motivated to collaborate. In order to motivate suppliers, openness, learning possibilities and long-term commitment may be necessary. In line with this we find that process control in the form of the principal dictating and providing input needed for agents to reach the principal’s goal was not present. However, process control in the form of monitoring progress and discussing technology roadmap development was present. Close collaboration and transparency from the supplier without Radcomp actually controlling the supplier was emphasized as important in one of the projects. The balance of having close collaboration, visibility and push the supplier to perform without actually controlling the supplier was viewed as a difficult task. On the contrary, in the second project, it was indicated that the collaboration should not become too close to the supplier since Radcomp were concerned of revealing too much knowledge about their system. In the final project Radcomp had little insight and thus had difficulties to monitor the supplier. The supplier’s powerful position of being a large company and as good as alone on the market to provide this component made it difficult for Radcomp to gain access to monitor the project’s progress.

Limitations to this study should be mentioned. First, we have only studied three cases at one firm. Although the projects and products have similarities, they involve different individuals at the buying firm and different suppliers. Secondly, of the three projects, two suppliers were interviewed but one was not possible to include in our study. Finally, generalization is limited due to our choice of method. However, we believe we have managed to gain detailed insight into NPD collaborations by applying agency theory. It would be interesting to further apply agency theory on NPD collaborations in other industries to find similarities or differences.

REFERENCES


